The Institute of Brewing & Distilling

REPORT FROM THE EXAMINERS

2009

General Certificate and Diplomas (in Brewing, Distilling and Beverage Packaging) as well as Master Brewer reports in one handy volume.

Board of Examiners and Examination Centres 2009

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The Fundamentals, General Certificate, Diploma and Master Brewer Examinations were held in the following worldwide centres:

UK & Ireland	Aberlour
	Alton
	Bath
	Bedford
	Burton on Trent
	Bushmills
	Cardiff
	Cork
	Dublin
	Dundalk
	Durham
	Edinburgh
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Australia	Abbotsford
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Canada	Calgary
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Germany	Nuremberg
Ghana	Accra
Hungary	Bocs
India	Chennai
	Mumbai
Japan	Tokyo
Kenya	Nairobi
Lesotho	Maseru
Malaysia	Singapore
Myanmar	Yangon
The Netherlands	Zouterwoude
New Zealand	Auckland
	Christchurch
Nigeria	Ibadan
	Lagos
Norway	Oslo
Romania	Brasov
Russia	Moscow
	St Petersburg
Serbia	Apatin
Seychelles	Mahe
South Africa	Cape Town
	Durban
	Johannesburg
	Pretoria
Sri Lanka	Colombo
Suriname	Paramaribo
Tanzania	Dar Es Salaam
Turkey	Ankara
Uganda	Kampala
USA	Arlington
	Davis
	Eden
	Elkton
	Fort Worth
	Golden
	Irwindale
	Ithaca
	Milwaukee
	Philadephia
	Trenton
	Wisconsin
Vietnam	Ho Chi Min City
West Indies	Basseterre, St Kitts
	Champs Fleurs, Trinidad
	Roseau, Dominica
	Kingston, Jamaica
	St Georges, Grenada
	St Michael, Barbados
Zambia	Lusaka

The statistics

Diploma in Brewing, Beverage Packaging and Distilling and Master Brewer Examinations

469 candidates sat all or part of the Institute's Diploma and Master Brewer Examinations (508 in 2008) at 66 centres around the world.

62 candidates sat all or part of the Master Brewer. 13 accumulated passes in all modules.

344 candidates sat all or part of the Diploma in Brewing. 61 accumulated passes in all modules.

45 candidates sat all or part of the Diploma in Distilling. 13 accumulated passes in all modules.

18 candidates sat all or part of the Diploma in Packaging.

The number of candidates who sat each module of the Diploma and Master Brewer Examinations and the split between candidates in the UK & Ireland and the rest of the world, are shown in the tables on the right.

Number of candidates who sat each module

Exam	Module	2009	2008
Diploma in Brewing	Module One	206	212
	Module Two	161	166
	Module Three	134	170
Diploma in Distilling	Module One	22	9
	Module Two	15	14
	Module Three	18	14
Diploma in Packaging	Module One	9	14
	Module Two	9	0
	Module Three	0	5
Master Brewer	Module One	23	34
	Module Two	25	24
	Module Three	18	26
	Module Four	19	14
	Module Five	20	20

Split between the British Isles and the rest of world

	UK & Ireland	Rest of World
Total Dipl.Brew Candidates	108	236
Total Dipl.Distil Candidates	41	4
Total Dipl.Pack Candidates	11	7
Total M.Brew Candidates	26	36

Report from the Chairman of the Board of Examiners

2009 Results

Continuing the trend of recent years, candidate numbers registered for the 2009 examinations showed an increase over the previous year, with the average performance across all of the IBD exams essentially maintained compared with 2008.

In total this year, there were 13 new Master Brewers qualifying, with 62 candidates achieving the Diploma in Brewing and 13 the Diploma in Distilling. Also 69 candidates obtained the GCB and 56 the GCP in November 2008, with 89 and 27 passing GCB and GCP respectively in May 2009. In addition, a record 96 candidates obtained the General Certificate in Distilling in May 2009. Finally, a total of 11 candidates passed the new Certificate in the Fundamentals of the Brewing and Packaging of Beer set in November 2008 and April 2009.

2009 Award Winners

I should like to congratulate all candidates who have attained qualification, especially those achieving distinctions and awards.

In particular, many congratulations to Vanitha Engelbrecht (SAB) for achieving the IBD's highest accolade – the JS Hough Award, given for outstanding qualification at Master Brewer level.

In addition, I should like to congratulate Kevin Wright (who attended the UC Davis extension programme) for being awarded the 2009 JS Ford prize (Dipl. Brew.) and Aaron Charles Frederick Flaherty (Diageo) for attaining the 2009 Diploma in Distilling Award (awarded by the Worshipful Company of Distillers).

Tyler Laverty (UC Davis) received the Crisp Malting award (for the best paper in 2009 Dipl. Brew. Module 1); Louis Richard De Jager (SAB) was awarded the Brewery Engineers Association award (for the highest result in the Process Technology section of 2009 Dipl. Brew. Module 3); Frances Ruth Jack (Scottish Whisky Research Institute) achieved the Simpsons Malt award (for the best paper in 2009 Diploma in Distilling Module 1); Jeremy Matthew Stephens, (Morrison Bowmore Distillers Ltd) attained the Gin and Vodka Association prize (for best paper in 2009 Dipl. Distill. Module 2); Bryan Daniel Egan (Molson Coors, Canada) attained the Quinn Glass prize (for the best result in 2009 Diploma in Packaging Module 1) and Lachlan Kenneth Paul (South Australian Brewing Co) was awarded the Hyster prize (for best result in 2009 Diploma in Packaging Module 2)

Finally, congratulations are extended to Jana Stavikova (InBev, Czech Republic) and Andras Toth (InBev, Hungary) who both obtained the Worshipful Company of Brewers award for 2008 GCB (both achieved identical, outstanding marks in May 2008 exam), to Iuliana Tetel (Inbev, Romania) for obtaining the Worshipful Company of Brewers award for 2008 GCP, and to William Patterson (Diageo) who received the 2008 GCD Scotch Whisky Association award.

The 2009 General Certificate awards await the results of the November round of examinations.

Examiners' Reports

As previously, all the Examiners' reports are published here as this special supplement in the Brewer and Distiller International. However they are also available via the IBD web site, in the Journal (JIB) or by application to the IBD Examinations Administration team at Clarges Street.

Future candidates are strongly encouraged to regard these reports as essential reading in that they contain descriptions of the ideal content of answers, sound advice on examination technique and detailed analysis of the year's papers.

In addition, for the first time this year, M. Brew and Diploma candidates who were unsuccessful in any of the examination modules, will be receiving, by post, individual feedback forms indicating performance on the questions answered. These candidates should use this feedback in conjunction with the relevant examiner's report, to understand which syllabus sections they need to concentrate on for future exams.

General Certificate candidates have been receiving information on their individual performance now for some time, and this will continue.

I trust that all unsuccessful candidates will find this feedback information of value for their future studies.

The following section summarises overall examination performance:

For Master Brewer examinations, the number of entrants continues to increase year on year; in 2009, pass rates were 65% pass for module 1, 60% for module 2, 72% pass for module 3, 79% for module 4 and 65% pass for module 5.

The results for the Diploma in Brewing in 2009 were rather mixed compared with the results for 2008. Of the individual Brewing modules, the pass rate for module 1 increased to 74%, compared to 2008, but dropped alarmingly for module 2 (42%). The pass rate for module 3 was maintained (67%), but the examiner and moderator noted that the quality of knowledge displayed for Process Technology was rather poor, such that most unsuccessful candidates scored very badly in this section B and many candidates that passed had relied disproportionately on their Packaging results.

The pass rates for candidates sitting the Diploma in Distilling examinations (which were set to the new syllabus) were very high but did not quite replicate the phenomenal 100% pass for all three modules of last year. This year the pass rates were: 95% for module 1, 73% for module 2 and, again, 100% for module 3.

This year all three modules of the new Diploma in Beverage Packaging were available, although no candidates elected to study module 3; the pass rates for modules 1 and 2 were identical (89%). No candidate has yet completed all 3 modules, to attain the overall Diploma qualification, but hopefully the first Dipl. Pack. will be awarded next year.

General comments from all examiners for the written papers for M. Brew and Diplomas to unsuccessful candidates include the necessity to concentrate on answering the precise questions asked, by paying particular attention to preparation, organisation and time management. As ever, it does appear that some students are very poorly prepared and do not seem to have appreciated the full syllabus content of the modules involved.

The results for the GCB, GCP and GCD exams in November 2008 and May 2009 are very much in line with previous years, with some improvement in some areas, but no consistent trends. The results for some elements of GCP (especially the Returnable Bottle option) remain surprisingly low.

New developments

Regarding developments for IBD qualifications, there has been quite a high level of activity.

As stated above, all three modules of the new Diploma in Beverage Packaging (Dipl. Pack.) are now established.

Also, in May this year, we successfully trialled a new on-line

(web-based) system for GCB examinations at six centres worldwide, in addition to paper-based exams, but in a more modern format. This new format allows more scope in the way multiple choice questions are set; sample questions are available on the IBD web site. Because of the success and ease of use of this new on-line examination system, the plan is to extend this facility to all GCB and GCP candidates from November 2009 onwards; paper-based exams are still available, but companies are being encouraged to adopt the on-line system as the main option.

This will be extended to other IBD MCQ (Multiple Choice Questions) exams (GCD, FBPB) in due course and the development of a Fundamentals of Distilling qualification (comparable to FBPB) is nearly complete.

However, the major feature of development activity is the completion of the M. Brew syllabus review by the Master Brewer project team; the results of the review have already been published in summary in the *Brewer & Distiller International* in June 2009 and the new syllabus is now available. Attached to this report (as below) is the full report from the project team. The essential features of the review were to increase the emphasis on key management principles, by replacing Module 5 Case Study paper with a practical project, changing the theme of Module 4 from "Operations Management" to "Resource Management and Regulatory Compliance" and modernising the syllabus contents of modules 1–3. The time scale for the new syllabus is with immediate effect for new M. Brew candidates; candidates already started on the M. Brew programme can elect to follow the new syllabus or the existing syllabus for this coming year, since next June (2010) only, we will offer examinations set to both the old and the new syllabus. From 2011, only the new syllabus will be available. The last Module 5 Case Study paper will be set in June 2010.

Acknowledgements
This report again indicates a busy, but productive, year for the IBD Board of Examiners and the Examinations Department. As ever, I must express my gratitude to all the examiners and moderators for their continuing hard work and contributions to this most important function of the IBD.
I am particularly indebted to the Clarges Street based team for all their efforts and support. Thanks go to Jessica Baldwin, Andrea Williams, Sarah Bartlett, Natalie Michel and Carolin Harvey (covering for Jessica, currently on maternity leave) for their sterling work in organising and operating the IBD examination system.

Finally, good luck to all prospective candidates in the pursuit of IBD qualifications.

David G Taylor
August 2009

Master Brewer Examinations

Revision of the IBD Master Brewer Qualificaton

Background
Over the past year, a major revision of the syllabus and examination format of the IBD Master Brewer qualification has been carried out by a project team led by Dr Harry White (a past president of the IBD) and consisting of members of the M. Brew. exam group of the IBD Board of Examiners, plus representatives of IBD-approved training organisations.

The IBD Master Brewer is a professional qualification that is much respected world-wide and is unique in that it is designed to test technical and managerial competence at a senior level (albeit, by written examination) and truly requires several years practical brewing experience.

However, it is now some 15 years since the current syllabus was established and, although still appropriate to many aspects of brewing operations, it has been indicated by many senior members of the industry to the IBD that there was a need to revitalise this qualification, in order to ensure its complete relevance to the requirements of modern brewery management.

This revitalisation was the main brief for the project team, but with the understanding that any new format would, in no way, compromise the essential Master Brewer feature of its value as an assessment of technical competence, and that any re-design would maintain or, indeed enhance, its academic status and strive for true equivalence to a university Masters degree. At the same time, it was felt that there was a need to increase the emphasis on assessment of key management principles, equivalent with the requirements of a Diploma in Management Studies.

The revision process is now complete and the proposals for the re-structured Master Brewer qualification are summarized in this report. The new syllabus is in the final stages of development and will be published in full by end of July 2009. It should be noted here that all features of the revised syllabus and examination format have been approved by the full Board of Examiners and have been endorsed by the IBD Council.

The essential features of the revised M. Brew include:
- Replacement of Module 5 (Case Study) by a Practical Project.
- Total review of the syllabus content of Module 4, to provide greater emphasise on general management principles.
- Re-formatting of syllabus contents of all Modules 1 to 4, including removal of the "Competence Log".
- Re-structuring of the Examination format.
- Increased emphasis on the need for mentoring, with the introduction of an IBD approved Mentors scheme.

New Module 5
It was decided early on in the revision process that the modular nature of the examination process should be maintained, but that a complete re-thinking of the value of module 5 (case study) was required. The original concept when the modular structure was first introduced 15 years ago, was that the case study paper would represent the opportunity for candidates to "pull together" all the features learnt in studying for modules 1 to 4, in so far as, no candidate would be allowed to sit module 5 until all other modules had been passed. This policy was changed a few years later, so that module 5 became just another paper, albeit requiring a wide knowledge and experience base in order to achieve success. However, in more recent years, the true value of this module has become more and more questioned, with the developing concern that maybe this examination format had "run its course" and required re-assessment.
A key feature of the new M. Brew structure is that Module 5 will no longer be examined as a case study paper, but will be a Practical Project that candidates can carry out at their place of work or at an academic institution if they so wish. The concept of including a practical project to be assessed by the IBD BoE is especially useful in enhancing the premise that the M. Brew. does indeed represent a practical assessment of application of technical knowledge, as well as providing the candidates and their companies with the opportunity of carrying out a potentially valuable investigation or achieving a practical process or product development.

It is anticipated that most (if not all, as is the current situation) M. Brew candidates will not register for all modules in one year, so that a requirement will be that candidates can only submit a Module 5 Project after having registered for at least one other M. Brew module.

Module 5 Project
The details of the proposed Module 5 Project are as follows:

1. General features of the Project
The Project must be an original piece of work and will be assessed by the BoE against the following criteria:
relevance to brief, quality of discussion, appropriate use of references,

extent of analysis and evaluation, comment and originality.

The Project should demonstrate the candidates' own experiences, ideas, judgment, and investigations to the production of a comprehensive and useful document which is relevant to their organization and to their own personal development.

Every opportunity should be taken to demonstrate the candidate's information gathering and presentation skills, as well as abilities to interpret and evaluate information critically and creatively.

The title and subject matter for the Project will be decided by the Candidate and must comply with the criteria set by the IBD Board of Examiners.

The Project must be approved by the IBD Board of Examiners before work starts.

The Project dissertation should have a word count of 8,000–10,000 words, using Microsoft Word in English.

2. Project scope and subject

The project may encompass any areas within the scope of the Master Brewer Syllabus, as long as it demonstrates the candidate's overall competence as a well-rounded potential senior manager in the brewing industry

The subject matter can be of any technical topic relevant to their brewery or organisation.

It should be well structured and cover both technical and managerial aspects.

Some subject ideas:

- Process/plant optimisation
- Capacity increase proposals including detailed investment justification.
- Quality/Troubleshooting investigation.
- New product or process introduction.
- New plant proposal or commissioning.
- Efficiency investigation such as beer losses or line operation.
- An environmental compliance task

3. Project Sponsor

The candidate must obtain a Sponsor for the Project from within his/her organisation.

The role of the Sponsor is to:

- Support the candidate with resources and opportunities to carry out the project within their organisation.
- To agree the topic of the Project with the candidate, bearing in mind the scope set by the IBD, with his/her Mentor
- Confirm that the Project is the candidate's own original work

4. Project Mentor

The candidate must have an appointed Mentor whose responsibility will be to:

- Endorse the candidate's original Project proposal to the IBD.
- Be a source of advice and guidance should the candidate seek and require it throughout the Project.
- Endorse the candidate's Project submission prior to assessment by the Board of Examiners.

Note: ideally, the Sponsor and Mentor should not be the same person, but this will not be a requirement

5. Project pass criteria

The Project will be assessed by the examiners and supported by the Moderator where appropriate.

There will be three categories of assessment:

1) Fail = <50 marks/100;
2) Pass = 50 – 69 marks/100,
3) Distinction = >69 marks/100.

6. Confidentiality

The content of the Project and name of the candidate will remain confidential (as for all other modules).

The candidate must be aware of their company's policy on confidentiality and check this with their sponsor.

7. Declaration – candidate's own work

Candidates will have to declare formally that the Project is their own work, but it is recognised that it may be part of an overall project, in which case the support and assistance of others should be included in a list of 'Acknowledgements'.

If verification or validity of the project being the candidate's own work is required, the BoE reserve the right to communicate with all involved (sponsor, mentor, candidate) and may require a '*viva'* follow-up.

8. Late Submissions

Projects submitted after the stated deadline for that year, will not be accepted for assessment.

9. Proposed Timetable

YEAR 1.

End August: Candidates to obtain a Sponsor and Mentor for their project. If an internal Mentor is not available then the candidate should apply to the IBD for an appointed IBD Mentor.

End September: Candidates register for Module 5 (Project must be Sponsor and Mentor supported) and submit a Project Proposal for approval by IBD Board of Examiners.

End October: Project 'approved' by Board of Examiners and work can commence.

YEAR 2

End May: Project completed and submitted to Mentor and Sponsor for approval.

Mid June: Project to be submitted to the BoE at Clarges Street for assessment. The submission is to be formally supported by the candidates Mentor and/or Sponsor.

August: Results of Project assessment published with rest of exam results.

10. General Notes

The last Module 5 Case Study examination will take place in June 2010.

The first Assignment cycle will start in August 2009 for assessment in June 2010.

Candidates obtaining a 'Fail' assessment will not be allowed to 'resubmit' their Project, but will need to carry out another Project at a later date.

Module 4

In order to achieve the desired increased emphasis on assessment of key management principles, it has been agreed to alter the theme of the content of Module 4 from "Central Functions" to "Operations Management" and the new title is "Resource Management and Regulatory Compliance"

The new syllabus elements are designed to be equivalent with the requirements of a Diploma in Management Studies and the content for this module is now re-structured in six units, as follows:

- Unit 4.1 – Environment (includes: sustainability and climate change, energy and water conservation, waste minimisation).
- Unit 4.2 – Health and Safety (includes: regulatory requirements, management, hazard identification and risk assessment, accident investigation).
- Unit 4.3 – Quality Assurance (includes: food safety, quality systems)
- Unit 4.4 – Financial Management (includes: revenue budgeting, management accounting, project management).
- Unit 4.5 – Supply Chain (includes: capacity planning, manufacturing scheduling, inventory control, procurement, logistics).
- Unit 4.6 – Resource Planning (includes: maintenance, human resources, world class manufacturing, information technology).

Modules 1–3

Modules 1, 2 and 3 have been re-formatted. There has been little change to individual syllabus content for each of these modules, but with increased emphasis on management principles and re-structuring to produce a common format (like module 4 using a "3 tier" approach).

Module 1 – continues to be called "Materials and Wort Production"

Content to include six units:

1.1 – Raw Material – Malted Barley
1.2 – Raw Material – Adjuncts
1.3 – Raw Material – Hops
1.4 – Raw Material – Water
1.5 – Brewhouse Operations (includes: materials and composition of wort, selection, design and layout of plant, wort production, control of hygiene, quality assurance procedures)
1.6 – Management (includes general management, utilities usage, control of costs).

Module 2 – continues to be called "Beer Processing".
Content to include five units:
2.1 – Yeast Husbandry (includes: yeast management, propagation)
2.2 – Fermentation Operations (includes: design of product and process specifications, selection, design and layout of plant, technical management of fermentation, control of hygiene, quality assurance procedures).
2.3 – Maturation and Conditioning Operations (includes: design of product and process specifications, selection, design and layout of plant, technical management of maturation, control of hygiene, quality assurance procedures).
2.4 – Filtration, Clarification and Bright Beer Storage (includes: design of product and process specifications, selection, design and layout of plant, technical management of filtration, control of hygiene, quality assurance procedures).
2.5 – Management (includes general management, utilities usage, control of costs).

Module 3 – to be re-titled: Packaging of Beer
Content to include five units:
3.1 – Bottling Line Operations (includes: design of product and process specifications, selection, design and layout of plant, technical management of bottling, control of hygiene, quality assurance procedures).
3.2 – Canning Line Operations (includes: design of product and process specifications, selection, design and layout of plant, technical management of canning, control of hygiene, quality assurance procedures).
3.3 – Large Pack Filling Operations (Keg or Cask) (includes: design of product and process specifications, selection, design and layout of plant, technical management of kegging/ cask racking, control of hygiene, quality assurance procedures, dispense systems and procedures).
3.4 – Supply Chain Procedures (includes: supplier management, traceability, internal control
3.5 – Management (includes general management, utilities usage, control of costs).

Revised Examination Format
For modules 1-4, the examination will consist of two written exams:
Short Answer Paper: "short answers" and "multiple choice", in order to ensure as complete a coverage of the syllabus as possible; to be two hours and worth 100 marks.
Long Answer (Essay) Paper: choice of four from six for two hours; to be worth 25 marks each.

Each module to be sat on separate days; short answer paper in the morning, "essay" paper in the afternoon.

Also the pass mark for each of modules 1–4 will be increased to 50% (from current 45%).

Finally, the IBD Board of Examiners will still recommend that a minimum of three years (and ideally five years) practical experience of brewery management, in as many different operational functions as possible, is a basic requirement for all potential M. Brew candidates.

Mentors
The IBD BoE strongly advises all M. Brew candidates to secure the services of a mentor to guide their progress through the syllabus and the examination system; this becomes especially important with the planned introduction of the revised Module 5 as a practical project.

A Mentor can either be someone in the candidate's organisation, (and must be a Senior Manager and member of the IBD) or someone appointed by the IBD.

The BoE have proposed that the IBD should appoint Accredited Mentors (like the IBD Trainer Accreditation system), who will likely be derived from a group of experienced qualified members from the different sections of the IBD.

Communication between candidates and Mentors will depend on location and circumstances, but could include visits, telephone conversations and e-mails.

Summary
The objective of the revision project for the Master Brewer was to ensure that the IBD's most prestigious qualification continues to represent one of the highest accolades recognised by the global brewing community.

The inclusion of a practical project (as Module 5) can only serve to enhance the position of the M. Brew as the premier assessment of technical brewing competence, with the very real status of compatibility with a university Masters qualification, but still requiring several years' practical brewing experience.

Also, with the increased emphasis on key managerial principles designed to be totally relevant to brewery management, the modified M. Brew can be regarded as equivalent to many comparable Diplomas in Management Studies.

The net outcome of this revision is to place the IBD Master Brewer qualification, in reality, as a Master of Brewing Operations, to which all potential senior brewery managers would undoubtedly wish to aspire.

Timetable
The new detailed syllabus will be published in July 2009, with the plan to start the first Assignment cycle (for Module 5 Projects) in August 2009 for assessment in June 2010. However, current candidates can still opt to take the existing Module 5 – Case Study paper for one more year; the last Module 5 Case Study examination will take place in June 2010.

The new syllabus for Modules 1 to 4 will apply from this year, for examination in June 2010, but the IBD BoE will also run the existing syllabus in parallel for examination in June 2010 for those candidates who choose to continue with the current syllabus.

There will be a complete change to the new syllabus with effect for examinations in June 2011.

Further details are available from the IBD Examinations Department or on the IBD website.

David G. Taylor, Chairman IBD Board of Examiners
21st May, 2009

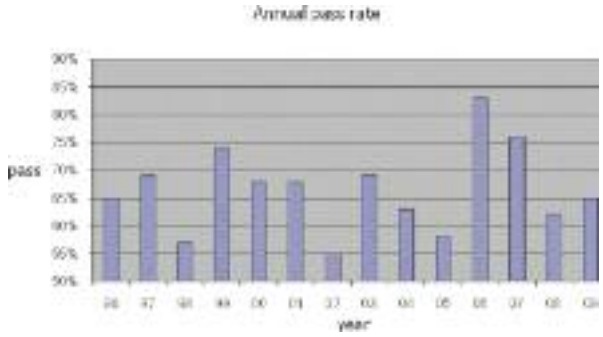
The Institute of Brewing & Distilling
Examinations 2009

Question Papers and Examiners' Reports

MASTER BREWER EXAMINATION 2009

Module 1 – Raw Materials and Wort Production

There were 23 papers returned; this is two thirds last year's number. 15 (65 %) of candidates achieved a pass mark. This success rate should be compared with previous years' results, as shown in the chart below.



This year the general standard of papers was only a little better than last year though there were a couple of outstanding papers. The pass rate at 65 % compares unfavourably with most other years.

This year all candidates attempted five questions; this is a record as it has not happened in the last ten years. This implies that this year's candidates are better time keepers than their predecessors; the fifth question answered was often the weakest, but this probably represents a lack of knowledge rather than a shortage of time to do the question justice.

I make no apologies for reminding candidates and mentors again to take note of the following points:

- Too many candidates fail to read the questions carefully enough and either miss out some parts or misinterpret the question.
- Some candidates fail to read the 'Instructions to Candidates' which are written on the inside cover of the examination scripts; one candidate illuminated his/her answer with beautifully drawn diagrams, but sadly these were displayed on the unlined sheets, which are not marked.
- Mentors should be encouraging their pupils to get as wide a range of practical brewing experience as is feasible in their individual situations and to read as widely as possible from textbooks, journals as well as electronic media. Mentors also have a responsibility to ensure that candidates under their tutelage are properly prepared for the examinations.

Question 1 – Weather and Malt Quality
Discuss how variations in annual weather conditions can affect the quality of harvested barley. Explain how the maltster can adjust conditions at appropriate stages of the malting process to ensure that the degree of modification, as requested by the brewer, remains consistent despite any variations in barley quality caused by the weather.

This question was attempted by 12 (52%) of candidates with nine (75%) achieving a pass. Though not a particularly popular question, but it was answered very well by those who attempted it. The question was about how weather may affect the barley crop and what process variables the maltster has available to ensure delivered malt meets the brewer's requirements. Some candidates used this as an opportunity to discuss climate and climate change but must be careful to distinguish climate change, the tendency of weather patterns to change from one season to the next and weather, the particular conditions which prevail during a particular growing season. A few candidates reminded me of politicians during television and radio interviews: answering the question they would like to have been asked, but not covering the topics raised by the actual question. Consequently they described how malt is made, referring to steeping, germination etc without explaining how the process variables could be adjusted to ensure barley of varying quality, eg dormancy, nitrogen content etc could be made into malt which meets the brewer's specifications.

Question 2 – Malt analysis
Debate the merit of parameters which are used to describe the attributes of malt. Which are the eight most important for lager malt and which eight are most important for ale malt? Explain why these parameters are at the top of the list for the malt purchased in a brewery.

This question was attempted by only 16 (70%) of candidates with 10 (63%) achieving a pass mark. There was one good answer to this question and too many mediocre and unsatisfactory ones. As the relationship between maltster and brewer gets more distant in an increasingly competitive world, it is vital that brewers understand how malt is made and how its quality is measured and therefore be able to predict the way a particular batch may perform in the brewery. Too many answers suggested that candidates don't really understand what each parameter of malt analysis is telling them; several referred to percentage modification without defining which measure of modification they were referring to. As always, it is important to read the question carefully: several candidates failed to specify the correct number of parameters, some listed too many, some not enough.

Question 3 – Hop Products and Sun Strike
Describe the manufacturing processes for making hop products that protect beer, packaged in clear or green bottles, from the adverse effects of exposure to sunlight. Describe how those products are used in brewing, that is from brewhouse to final package and outline the precautions that must be observed to make them effective at preventing 'light-struck' flavours from developing during the shelf-life period.

This question was attempted by 7 (30%) of candidates with four (57%) achieving a pass mark. This somewhat focussed question elicited only a few answers, which for those that gained a pass mark did so by quite a wide margin; those who failed, did so dismally. A couple of candidates showed a very great understanding of the mechanism of the production of the light struck flavour and the biochemistry of producing the reduced hop compounds. They however failed to appreciate the precautions that must be taken to ensure that beer brewed with these products must not come into contact with beer bittered using normal hop and must be kept separate from yeast which has fermented normally hopped beers. Other candidates were somewhat vague about reduced hop products and their manufacture, but were very well aware of the precautions required when using them. All candidates referred to the propensity of these products to confer enhanced foam stability to beer.

Question 4 – Water Use in the Brewhouse
Describe various ways of using water in a brewhouse. Include an appropriate specification for each application mentioned and outline how raw water, high in bicarbonate and nitrate, might be treated to achieve the specifications described.

This question was attempted by 16 (70%) of candidates with only eight (50%) achieving a pass mark. The general standard of answers to this question was very poor with a surprising number of candidates unable to describe correctly specifications for product (brewing) water (for the production of beer itself), process water (for cleaning brewery plant, washing beer packages before filling, cooling and heating) and service water (for boilers, utility cooling towers and general cleaning). Several candidates were woolly about how to remove nitrate from water, one thought it could be done by aeration and a few proposed activated carbon filters to do the job. As with last year's exam the descriptions of de-ionisation plant using ion exchange resins and of reverse osmosis

equipment were often sketchy and incomplete. Water is ubiquitous on the planet but getting the right grade for the duty is key to producing beer of the desired quality as well as keeping costs to a minimum.

Question 5 – Dry Goods Handling Plant
Outline a dry goods handling plant from silo to grist case for use in a brewhouse producing pale lager beer. Highlight key differences in this equipment in a brewhouse utilising lauter tuns from one utilising mash filters. Describe how performance of this equipment can be monitored and how its efficiency can be optimised.

This question was the most popular of this year's paper, it was attempted by 19 (83%) of candidates with 13 (68%) achieving a pass mark. The general standard of answers was reasonable. All candidates identified the use of six roll mills (with or without prior conditioning) for use with lauter tuns and hammer mills for use with mash filters. Many answers though were short on descriptions of how the two types of mill operate and the differences between them. Only one candidate mentioned the possibility of flooding the hammer mill and grist case with carbon dioxide to limit the deoxygenation of fatty acids in the grist by lipoxygenases, which can be a problem with very finely divided grist material. Performance management and efficiency improvement were described well by some candidates, clearly demonstrating the benefits of practical experience in a brewhouse. Correct interpretation of the questions could have gained some candidates extra points if they hadn't described dry goods handling from delivery vehicle to malt storage silo, and hadn't described in detail the operation of a lauter tun and a mash filter.

Question 6 – Liquid Brewing Adjunct
Describe how one liquid brewing adjunct is manufactured from a cereal source. Produce an outline specification for the chosen finished product. Discuss the technological and economic factors that need to be considered with its use in the brewhouse.

This question was attempted by 13 (57%) of candidates with eight (62%) gaining a pass mark. A rather mixed bunch of answers was elicited by this question, some good but mostly mediocre. Most candidates showed a reasonable understanding of the production process of making syrup from refined starches, though several were confused about the operation of acid conversion, acid/enzyme conversion and enzyme/enzyme conversion. In general, there was a good grasp of the economic aspects: wort extending/high gravity brewing considerations etc; and technological factors: storage and dispensing equipment/dilution equipment, etc. Answers which included how refined starch is made from a selected, usually grain, source garnered many more marks than those which started the production process with refined starch.

Question 7 – Trub Separation
Describe, including the benefits and drawbacks, the various devices available for separating spent hop material and trub from wort at the end of the kettle boil. Why is this process important and how would you monitor cold wort quality to ensure that it has been carried out successfully?

This question was attempted by 18 (78%) of candidates with 10 (56%) obtaining a pass mark. This was a popular question though the standard of answers was not particularly high. This was a question crying out for answers which included suitably labelled diagrams; these were surprising thin on the ground. The question did not imply how many devices should be described, yet several answers only included descriptions of a hop back and a whirlpool.

Question 8 – Quality Assurance and Sampling in the Brewhouse
Prepare a plan outlining the quality assurance procedures and sampling requirements needed to control the production of wort in the brewhouse from raw materials intake to the transfer of cooled wort to the fermenter. Highlight aspects of the plan that will ensure food safety throughout these process stages.

This question was attempted by 14 (61%) of candidates with only seven (50%) gaining a pass mark. Similar questions have been posed in previous years' examinations and I have advised candidates, in previous exam reports, to outline a structured procedure for checking all the activities that ensure product quality and food safety. These can typically include supplier audit, supplier certificates of analysis, product analysis, evaluating risk and hazard, standard operating procedures, training initiatives and much else, all backed up by suitable records. Where appropriate, pertinent examples help illuminate a good answer.

Bob Illingworth
June 2009

MASTER BREWER EXAMINATION 2009

Module 2 – Fermentation and Beer Processing

Twenty five candidates submitted scripts for the paper and 15 gained pass grades, a pass rate of 60%, which is slightly lower than last year. There were two excellent papers at Grade A, one at grade B, four at grade C and eight at grade D. There were eight papers at grade E and two papers at grade F. The better candidates demonstrated both widespread knowledge of the whole of the syllabus areas and depth of knowledge and experience in them.

There were some areas of examination technique that let candidates down. Candidates need only write the question number at the start of their answers. There is no benefit or score attracted by copying out the question from the examination paper. Time management was clearly a problem for some candidates with four fairly complete answers presented, and then the fifth was barely started. There were some questions that candidates had either not read properly or had misunderstood the direction required, resulting in irrelevant information being presented.

Several questions were ideally answered by including a well presented labelled diagram or graph, or a table of information and comments. This is a simple way of presenting large amounts of information without taking too much time. Diagrams ranged from very good to very poor. The best used at least half a side of paper, were drawn with a ruler and were neatly annotated with appropriate labels. The worst were very small, untidy and without adequate labelling. It is worth noting for future candidates that they are recommended to practice drawing diagrams of all of the main plant items (vessels, filters etc.) as part of their preparation. Candidates should also note that information supplied in one answer can be referred to in another answer without repeating the information in full.

Question 1 – Cylindroconical fermenters
With the aid of clearly labelled diagrams, describe in detail the design and operation of a cylindro-conical fermenting vessel for the fermentation of 2000 hl of wort. Include in the answer details of utilities/services requirements and of control instrumentation and systems to automate the operation to minimise manual input. What preventative maintenance tasks should be carried out on the whole installation?

This was the most popular question. 23 candidates attempted it with 19 passing (83%). There were two good answers.

The first part of the question worth 45% of the marks required a diagram of a cylindro-conical fermenting vessel. This should have included approximate dimensions, height: diameter ratio and capacity, including headspace, for 2000 hl of wort. The diagram labels and text should have gone on to describe typical design features such as material of construction and type of insulation, position of cooling jackets, services such as carbon dioxide exhaust and CIP (cleaning in place) delivery, and fittings and equipment such as temperature probes, anti-vacuum valve, pressure relief valve, spray ball, sampling device, inlet valve etc.

Operation was a separate part of the question worth 35% of the marks, and should have included a brief description of wort main sterilisation, filling, yeast pitching, fermentation control, yeast cropping, and vessel emptying and CIP. A description of the vessel cleaning process required a simple list of the typical components of a CIP cycle, to include rinses, detergent washing and sterilisation. For each step typical times and

temperatures needed to be stated along with detergent and sterilant concentrations.

The final part of the answer required presentation of a preventative maintenance regime, covering calibration of the various instruments fitted, functionality checks on spray balls or jets and safety devices and inspection and replacement of wear and tear parts such as gaskets and seals.

Question 2 – Fermentation parameters
Describe a typical fermentation and conditioning profile for EITHER a lager OR an ale. Include all of the key parameters that will influence process consistency and final beer quality.
How might the final beer flavour be affected by other factors in the fermentation, conditioning and filtration processes?

22 candidates attempted this question with 9 passing (41%). There was one very good answer.

The first part of the question worth 60% of the marks was most effectively answered by the use of an annotated process chart illustrating a typical lager or ale fermentation and conditioning profile. Parameters to be shown included wort original gravity, wort dissolved oxygen, attenuation vs. time, fermentation temperature, yeast cell count, pH and diacetyl, time of crops, cooling profiles as well as overall process time. In each case appropriate values and units should have been stated. Common causes of lost marks included forgetting to include the conditioning phase, and missing one or more of the key parameters.

The second part of the question asked for what other factors in fermentation, conditioning and filtration might affect flavour. Several candidates failed to see the word "other", and so did not cover the aspects of microbiological infection, chemical contamination from CIP, filter aids, etc., oxygen ingress, deliberate and accidental process additions, etc., that scored good marks for some.

Question 3 – Yeast handling
Describe, in detail, the essential points to be contained in a document to specify operational best practices for the processes of yeast cropping, yeast storage and yeast pitching.

22 candidates attempted this question with 16 passing (73%), with four good answers and one exceptional answer.

This was a three part question with each attracting approximately one third of the marks. The ideal answer would have started with a general introduction describing the objectives and importance of yeast handling in terms of process consistency and product quality.

The section on yeast cropping should have included a description of the actual cropping process and equipment, and the key factors to preserve yeast quality. These should include cleaning, pumping speeds and low shear forces, timing of cropping, discarding trub, temperature, the importance of keeping strains and generations separate, expected size of yeast crop etc.

Yeast storage should have included a description of yeast storage equipment, together with a discussion of the conditions of storage such as time, temperature, agitation, significance of oxygen, and tests such as yeast viability, yeast vitality and microbiology.

Yeast pitching should have included a description of the actual pitching process and equipment, including cleaning procedures. This section should also have included a discussion on how yeast for pitching is selected, typical pitching rates and the effects of under and over pitching. The process of acid washing could be covered in either storage or pitching sections.

The best answers included all the important facts and figures including actual temperatures, times, consistencies, viabilities etc together with detailed descriptions of how the processes are carried out and the equipment used. Poorer answers lacked the level of detail that is required to define a best practice, or included alternatives that, while used, are not optimal.

Question 4 – beer clarification
Describe briefly the range of equipment available for the clarification of green beer. Discuss the advantages and disadvantages of each.

13 candidates attempted this question with 8 passing (62%). There were two good answers. This was a single part question worth 100% of the marks.

This should have been a very straight-forward question. The question used the word "clarification", so centrifuges should have featured along with all forms of final filtration. Not all candidates included them, and some who did failed to mention they would not produce on their own beer ready for packaging. Answers should have included a brief description, and outline diagrams only, of centrifuges, plate and frame, candle, leaf and crossflow filters. The relative advantages and disadvantages of each could have been covered in table form or by the use of bullet points. Parameters to consider were those such as flow rate, turnaround time, ease of automation, maintenance requirements, cleaning, flexibility, capital and running costs, use or avoidance of kieselguhr, etc.

The main reason for scoring poorly was a lack of detailed knowledge of all the types of equipment. In particular candidates tended to make only vague statements regarding the advantages and disadvantages.

Question 5 – CIP design
Describe the design and operation of a CIP (cleaning in place) plant suitable for use in a conditioning tank farm of 10 x 500 hl tanks and 20 x 2000hl tanks where up to three simultaneous tank and mains cleans are required.
What equipment, systems and procedures should be in place to ensure all plant is cleaned effectively?

12 candidates attempted this question with ten passing (83%). There was only one good answer.

This was a variation on a standard question on CIP, specifically looking for a system to conduct multiple, simultaneous cleans. Most candidates picked up on this, but failed to include detail of sizing and pump and mains layout to achieve the aims. Some candidates decided two or three independent systems should be installed, which was not appropriate.

The first part of the question, worth 70% of the marks, was best addressed by means of a diagram illustrating the typical features of a recovery CIP system. Dependent on the type of system selected, design features to show included concentrated and dilute detergent and sterilant tanks, water and rinse water tanks, mains, valves, pumps, heat exchangers, along with flow, pressure, temperature and conductivity probes. The operation part of the question was looking for a brief description of typical cleaning cycles including rinses, detergent and sterilant washes with details of appropriate times, temperatures and chemical selection and concentrations

The second part of the answer should have included details of the automatic controls of conductivity, temperature, etc. if not mentioned earlier. Calibration and verification of these systems, visual inspection of the plant, microbiological tests of rinse water, plant and subsequent product should all have been discussed. The use of traditional and rapid micro methods could have been discussed. Other checks should include periodic inspection of spray balls and jets, manual detergent and sterilant analyses, and audit of cleaning cycles.

Question 6 – Control of filtration
Discuss the range of monitoring and control procedures that should be in place for the process of filtration of beer from conditioning tank to bright beer tank to achieve consistent final product quality and assured product safety.

15 candidates attempted this question with only six passing (40%). There was only one good answer. This was a single part question worth 100% of the marks.

The answer to this question required an outline of Management, Quality Assurance/Control and Food Safety systems, and how they are applied throughout the process. The stronger answers employed useful flow diagrams to illustrate the process flow from cold wort to bright beer tank and to demonstrate the critical control points for both product quality and safety.

The key product parameters to measure at each stage should have included at least ABV, OG/OE, dissolved oxygen and CO_2, colour, haze and taste. Consideration of in-line, at-line and laboratory based tests should have been made. Microbiological results should be monitored on a screening basis and stepped up for troubleshooting. Process parameters such as pressures, temperatures, additive dosing rates, etc. should also have been featured. Trending and review of results, calibration of sensors and use of SOPs would feature in better answers.

Product safety risks are controlled initially through the HACCP assessment process, which should have been outlined. Descriptions of

the materials or processes at risk and the preventative measures that can be taken in each case should be included. Materials to be mentioned could have included priming sugars, hop preparations, oxygen, carbon dioxide antifoam, enzymes, kieselguhr, etc. Appropriate preventative measures might have included the use of product specifications, supplier quality assurance, clear labelling and storage etc. Processes such as wort aeration, cooling and CIP should have been discussed along with the importance of sterile filters, product and coolant pressures in heat exchangers and CIP interlocks. Other basic measures such as housekeeping routines, equipment maintenance and product traceability could also have been described.

Question 7 – Reducing processing costs
Due to a downturn in volume requirements, a cost reduction programme has to be implemented in the fermentation and beer processing areas. What savings could be made, in addition to labour costs, in these areas? How could the impact on product quality of all savings, including labour, be minimised?

This was the least popular question with five attempts, only two of which passed (40%) but there was one good answer.

The ideal answer would have listed the major elements contributing to the cost of the product in the process, then measures to control each element, then the means of minimising quality impact. A table format would have been ideal.

The elements to feature should have included beer losses (with controls through interface management, yeast growth, overfoam prevention, optimising filter runs, etc.), energy management (with consideration of reducing hot cleaning, increasing cold storage temperatures, planning to minimise compressor starts), CIP chemicals (with consideration of reducing cleaning frequencies, chemical strengths, optimise recovery with conductivity control, acid cleans to reduce loss of caustic in CO_2 atmospheres), gas management (optimise CO_2 recovery, use nitrogen instead of CO_2), process aids and additions (reduction, optimising kieselguhr usage), etc. Quality impacts can be reduced through careful monitoring of analytical or microbiological parameters affected by the proposed changes and taking corrective actions at minimal cost, and by training/multi-skilling the remaining labour force.

Some candidates proposed capital intensive solutions (e.g. beer recovery systems) without considering the potential for payback. In cash-strapped times only projects with a quick return will be considered.

Question 8 – Brewery hygiene
Describe in detail the housekeeping, cleaning and sterilisation procedures that should be used to ensure product quality and personal safety of operators in the fermentation and beer processing areas of a brewery.
Discuss how the effectiveness of these procedures can be evaluated.

13 candidates attempted this question with eight passing (62%). There were no good answers. This was a two part question. The first part was worth 75% of the marks.

The purpose of this question was to allow candidates to display their practical knowledge of the hygiene procedures used in fermentation and beer processing. Discussion of housekeeping should have described the tasks that are routinely carried out and the equipment required for activities such as environmental cleaning of fermentation halls and powder handling areas, storage of chemicals and additives etc. On cleaning and sterilizing, the vessels, mains and ancillary equipment to be cleaned or sterilized in each area should have been discussed (e.g. beer transfer mains, yeast pitching mains and bright beer tanks), together with appropriate cleaning or sterilising conditions such as type of chemical, concentration, time, temperature, frequency. In terms of management control the use of formal systems such as ISO9001, HACCP and COSHH was also relevant.

The second part of the question was worth 25% of the marks. The effectiveness of these procedures can be assessed through various techniques such as periodic visual inspection of vessels after CIP, microbiological tests of plant and product at various stages, quality trending and reviews, housekeeping and environmental audits, hazard and accident reporting.

Some candidates failed to read the question thoroughly and discussed general safety of operators (not related to hygiene and housekeeping) and so gained no marks for these aspects.

Jeremy Stead

MASTER BREWER EXAMINATION 2009

Module 3 – Packaging and Beer Dispense

In 2009, 18 papers were received of which 13 (72%) achieved the pass standard. This represents an increase on last year's percentage and is the best rate for several years. Pass marks were seen at grades A, B, C and D.

The increase in pass rate above to the level of 2008 was very encouraging and the overall standard was again improved on last year. As was the case last year, there were three particularly good scripts and several candidates produced excellent answers to some of the questions.

The spread of popularity of the eight questions was more even this year and in line with the overall pass rate the individual question pass rates were good ranging from 50 – 100 %. This indicates that the general level of preparation across the syllabus was good and that candidates are not focussing too tightly on restricted parts of the syllabus.

As with last year the best candidates were able to clearly demonstrate their knowledge and direct experience of a topic area. To score a good pass this standard is needed across a range of answers.

Examination technique was good with most candidates addressing five questions with a full response to each. The advice remains the same that it is almost always the case that five evenly spread answers will achieve a better overall result than all the effort being focussed in two or three answers.

Lack of technical detail in scripts, typified by answers dealing only with broad general management principles lead to poor scores. Similarly, poor scores were associated with answers which included unfeasible solutions which were not recognised as such.

Question 1 – Plant Design
Design a bottling line to produce the following volumes of returnable bottled beer:
200,000 hectolitres of 330 ml bottles
300,000 hectolitres of 500 ml bottles.
Five brands will be bottled in each size, but a common bottle for each size will be used for all brands.
State any assumptions made. Include the expected staffing levels, and justify the choice of equipment and machine throughputs.

This was the equal second most popular question with 14 (78%) of candidates answering. It was relatively poorly answered overall with only eight (57%) reaching the pass standard, though there were some very good (and one near perfect) answers.

This question saw the largest range in the quality of the answers. In general the assumptions made were sensible though not always complete. A common error in the calculation for sizing was to only take one bottle – based on expected speed for the two bottles and then only size the line to be able to produce the volume requirement of that one bottle. Numerical errors were not heavily penalised but marks were lost when obviously wrongly sized lines were not recognised by candidates.

Question 2 – Draught Dispense System
Describe in detail a complete dispense system suitable for a draught lager beer.
List suitable materials of construction for all components.
Give details of operating specifications and describe procedures to ensure the system continues to operate optimally.

This was the fourth most popular question with 11 (61%) candidates answering. It was answered relatively well and 8 (73%) achieved the pass mark and there were two very good answers.

Good marks were achieved by candidates who addressed the question, included all the key elements of the dispense system and could give details of practical procedures to maintain and operate a dispense system. Unfortunately some candidates restricted their answers to text book descriptions of cellar design with little or no referencing of this

information to the question asked. It is likely that direct experience of seeing a dispense system being installed would be of benefit to those who have not seen this.

Question 3 – New Bottle Introduction
Describe the tests and trials which would be undertaken prior to the introduction of a new shape of glass bottle on to an existing glass bottle packaging line.
Assume new wet glue paper labels and secondary packaging will be needed.

This was the least popular question with 8 (50%) of candidates answering. It was also the most poorly answered with 4 (50%) achieving the pass standard, however this did include one excellent answer.

A good answer to this question included testing (in-house or by the supplier) to meet specifications (with examples) and subsequent trials to prove compatibility with the packaging plant and further fit-for-purpose trials of the filled containers and secondary packaging. Poorer answers detailed only one of the above with, for example, only laboratory tests or data from the filler being considered and little or no consideration given to secondary packaging.

Question 4 – Utilities and Services
List the utilities and services required to operate EITHER a keg racking line OR a cask racking line.
For each utility or service, indicate a suitable target setting for the plant and describe how variation in the quality or quantity of supply could impact on product quality or line performance.

This was the equal second most popular question with 14 (78%) of candidates answering, of these nine (64%) achieved the pass mark with a couple of very good responses.

The poorest answers to this question did not progress much further than a list of services with a limited range of usage. Slightly better answers included a good range of uses. Good answers were able to demonstrate working levels of usage and the impact on the operation of poor supply conditions. These could range from beer taint or coder issues to complete plant shutdown. Good candidates were also able to describe systems and procedures to ensure maintenance of good supply.

Question 5 – Management Information System
What management information should be collected on a small pack line to allow effective control of conformance to performance and quality targets?
Describe suitable reports and illustrate how these reports effectively present the data in a form which is of use to the line manager.

This was the second equal least popular question with nine (50%) of candidates answering. It was reasonably well answered with six (67%) reaching the pass standard including three very good answers.

To answer this question well both quality and performance data needed to be considered and poorer answers tended not to deal with the full breadth of information available either manually or electronically. Once the scope of the answer was restricted in this way it was then also harder to score well on the use of reports though marks were available for a good range of valuable reports.

Question 6 – Revenue Budget
Describe the components which make up a revenue budget for EITHER a canning operation OR a non-returnable bottling operation.
Give examples of situations which can lead to adverse performance against budget and actions which could be taken to deal with these situations.

This was a moderately popular question with ten (56%) of candidates answering. It was easily the best answered with all ten (100%) reaching the pass standard including many very good answers.

All candidates reached the pass standard for this question. Whilst the components of the budget were generally well documented by all, it was the second part of the question where better candidates were able to demonstrate a wider knowledge and experience. Particularly good answers picked four or five examples of differing types of situation related to materials or efficiency, plant or planning/demand and explained causes and corrective actions.

Question 7 – HACCP Assessment
Describe the process of conducting an initial HACCP (Hazard Analysis Critical Control Point) assessment of EITHER a keg racking OR a cask racking line.
For the chosen line, give examples of risks which would be identified and how they are controlled.

This was the most popular question with 15 (83%) candidates answering. It was also the second best answered with 12 (80%) achieving the standard needed for a pass including a good proportion of comfortable passes.

To score well on this question it was necessary to both describe the HACCP assessment process in general and in detail for a bulk pack line. Most candidates were able to give the general description but again the detail was the discriminating factor between candidates. Good answers mentioned a range of relevant risks and detail on how these risks could be controlled through design and process/procedures. Poorer answers incorrectly identified critical control points or just listed every risk of all kinds which could be thought of.

Question 8 – Small Pack Filler Technical Detail
For EITHER a modern can filler and seamer OR a modern bottle filler and crowner, describe the features appropriate for assuring product quality and operating efficiency.
Include ancillary inspection equipment which could be located nearby on the line.

This was the second equal least popular question with nine (50%) of candidates answering. It was reasonably well answered with six (67%) reaching the pass standard though only one answer significantly exceeded the pass standard.

This question was designed to allow candidates to demonstrate how these key plant items can impact on performance and how the design of the plant can have an influence. Additionally the ancillary inspection equipment can be used for process control and monitoring as well as a quality control use. In this case it was the breadth of knowledge which discriminated candidates. Poorer answers focussed on only one or two features such as bottle burst detection and rinsing. Good answers on the other hand included a good range of features, the operating principle for each and the benefit to efficiency, quality or both.

Jonathan Brown

MASTER BREWER EXAMINATION 2009

Module 4 - Central Functions

Of the 19 candidates this year 15 passed (78.95%), a lower proportion than last year but with more attempts made at the finance and capacity questions. Three candidates achieved a B grade, six a C grade and six a D grade. The four failed candidates achieved an E grade. Knowledge and experience of Quality Systems and Food Safety was good and was excellent for Project Management. The finance question was attempted was by over half the candidates with an improvement in knowledge and answers given.

Question 1 – Quality Systems and Food Safety
Describe systems and procedures which would demonstrate to Regulatory Authorities and customers the brewery's competence in food safety and product quality.
To ensure traceability for investigating complaints, specify the type and location of appropriate production records.

Attempted by 17, passed by 15 (88%)
Most candidates answered the question well but relied mostly on HACCP to prove competence in food safety. Cleaning records, pest control and materials management were rarely covered. Few candidates adequately covered the type and location of appropriate production records.

Question 2 – Steam Plant
Describe an appropriate steam raising plant for a 1 million hectolitre brewery showing the principle components on a diagram. Give examples of temperatures, pressures and flow rates.
What factors should be considered in the design to ensure sufficient capacity for reliable, economic steam supply?
Describe potential problems with the volume and quality of condensate which may be returned to the steam boiler system. What routine tests should be conducted to prevent problems occurring?

Attempted by 12, Passed by eight – (67%)
Some good diagrams were presented, often with appropriate flows and temperatures. Others lacked detail. Design for sufficient economic supply was less well answered but the better candidates provided good answers for condense problems which included testing and trap inspection.

Question 3 – Electrical Voltages
Identify the different voltages of electricity used in a brewery, giving an example of plant or equipment for each.
What type of protection for plant and personnel would be appropriate in each case?
Show on a chart with typical values, the proportion of electricity consumed in different parts of the brewery.

Attempted by nine, Passed by seven – (78%)
Voltages were generally well described and some good examples given of relevant plant in the candidate's brewery. The significance of personnel protection was well understood and the better candidates were able to describe in more detail aspects of plant protection including circuit breakers, fuses, insulation and permits. Most candidates assessed refrigeration would consume the most electricity on site with sketchy detail on other areas.

Question 4 – Project Management
Describe the various stages of a capital plant project from identification of need to successful completion. Use a recent large or small project as an example.
Identify the key personnel involved and describe their roles and responsibilities.
What measures and procedures need to be in place to ensure the project is successful in terms of cost control and fitness for purpose?

Attempted by 14, passed by 13 – (93%)
As in previous years, candidates showed a good understanding of project management and had clearly had some experience. The stages, roles and responsibilities were well understood and the better candidates linked the importance of early user involvement with successful implementation. Other candidates concentrated on financial criteria and performance trials to measure success.

Question 5 – Maintenance Strategies
Describe appropriate maintenance strategies for brewing, process and packaging plant. Include strategies for spare parts availability.
Specify relevant performance measures to assess the effectiveness of the maintenance strategy in each area, giving examples of typical values.

Attempted by 11, Passed by six (55%)
Relative to other years this subject was attempted by few and poorly answered. There was little differentiation between strategies for high speed packaging plant and the brewing process and little detail given, particularly on spares holdings. RCM and TPM were often described as generic procedures but without any detail on application to the candidate's brewery.

Question 6 – Effluent
Describe the main sources of brewery effluent, their typical strengths and quantities in relation to brewery outputs.
What procedures should be put in place to ensure compliance with the local discharge consents or regulations?
Describe in priority order, options to minimize each effluent stream and the impact on costs.

Attempted by 13, Passed by 10 – (77%)
This question was generally well understood and answered by several candidates and showed a good knowledge of local compliance requirements. Descriptions of effluent sources were good and the better candidates provided options to minimize costs including separation, loss minimisation and CIP optimisation.

Question 7 – Production Capacity
If a Brewery needed to meet demand by expanding its packaging capacity by 20% with an additional bottling line, what other functions would need to be assessed to ensure they are sufficient to meet the increased output?
Assuming brewing, services and beer processing had been working close to capacity, discuss the options available to address any shortfall, identifying the risks and cost implications of each suggestion.

Attempted by ten, Passed by five – (50%)
This was the least well answered question although a higher proportion of candidates attempted it. Some good answers were received describing utilities, fermentation and filtration that would need to be reconsidered but little analysis on risks and costs of each suggestion. Some papers were lists of options without analysis or discussion.

Question 8 – Finance
For a brewery producing 500,000 hl per year in keg, bottle and can, describe a structure of departmental budgets that would provide adequate cost control, stating what items should be included in each.
For each cost item, specify which costs could be considered fixed and which could be variable, giving reasons.
What type and frequency of reporting or enquiry would be essential to give departmental managers enough information to evaluate variances that might occur?

Attempted by nine, Passed by five – (56%)
More candidates than normal attempted this finance question and a level of understanding budgets was shown although in general the question was not comprehensively answered. The better candidates proposed the possibility of semi variable costs for labour and utilities which showed some experience but most provided a variety of standard versions. Detail was short and finance remains a weak area.

Ian Bearpark

MASTER BREWER EXAMINATION 2009

Module 5 – Case study

This year 20 candidates sat the paper and 13 passed (65%),which is a exactly the same as last year. 15 candidates chose Question 1 and eight of those achieved a pass, five candidates chose Question 2 and all of them achieved a pass.

This years marks were generally higher than previous years despite no change in the overall pass rate and it was particularly pleasing to see several improvements including some very good A grade answers, clear evidence of study and examination technique optimising marks and no candidate appearing ill prepared.

Question 1
Global rationalization of production facilities has meant that extra volume has to be produced in a brewery without the time for significant capital investment. Considering each key stage from raw materials to finished goods warehouse outline potential opportunities to increase output by approximately 30%. Include the impact expected on both quality and cost highlighting any compromises that would have to be made.

This question was looking for the candidate to illustrate, hopefully from experience, the range of options through operations, planning and innovation to maximise the output from an existing brewery.
Good answers had clear and planned structures which identified potential opportunities to improve out put in key areas including; recipes,

processes, manning patterns, packaging efficiency and logistics.

Assumptions at the start of the answer could be used to gain marks and focus the rest of the script by proposing such actions as SKU (Stock Keeping Unit) rationalisation across a group of breweries supplying the market or if only one brewery was available how it could benefit from a reduction in complexity.

Another simple point was for the candidate to cover the whole scope identified in the question to make all marks available rather than spending too much time on one aspect such as recipe development and nothing on forecasting and logistics.

It was noticeable that where candidates had used the planning time to map out the above in a clear flow chart then made sure they analysed each step identified they tended to get marks in more of the available batches. Charts also appeared to help candidates identify gaps in their answers and lead to more innovative proposals.

The question specifically stated that significant capital investment was not available so marks were lost if this was proposed also contracting out was not considered as a valid answer unless carefully integrated with more reasoned analysis such as SKU rationalisation between sites.

Central to the good answers were clear discussion of recipe optimisation, high gravity brewing, yeast management, vessel utilisation, blending, stabilisation and filtration, packaging output and efficiency, reliability centered maintenance, provision of services, warehousing and transport logistics. Over arching this was a discussion about forecasting and planning output through the site to get the highest level of output whilst not compromising on quality.

Having covered the technical detail time then needed to be given to the human dimension, shift structures, training and multi-skilling.

At each stage comment was also needed on the potential consequence to quality, such as the link between high gravity brewing and flavour and the link to cost such as the increased cost of losses when high gravity brewing. Good candidates illustrated an understanding of costing where some increases in batch or processing cost could be clearly beneficial by reducing the unit cost due to increased output.

Question 2
Recent legislation and developments in quality assurance have lead to a globalisation of brewery based systems. Detail the standard template required for all breweries in a major global group.

This question was very well answered by those who attempted it with all candidates achieving good passes. There was pleasing evidence that these successful candidates had read previous examiners reports and picked up some key technique advice, such as, time management, answer structure, use of tables and explanation of acronyms. It was particularly pleasing to see all the answers to this question taking the text book principles of quality management such as HACCP and showing a clear understanding of how critical control points related to the brewing and packaging process and how they were defined.

The answer required an introduction stating assumptions about the site or sites that the template would apply to, its range and scope so that it was robust and relevant to the application.

Whilst reference to computer systems such as SAP gained a few marks the question was looking more for management, control and monitoring principles than the system platforms for delivering it. Marks were gained for clear understanding and description of a quality management system such as ISO, hazard analysis and control such as HACCP, control of substances hazardous to health such as COSHH and general HR (Human Resources) policies including a framework to apply the specific systems supported by training and audit.

Links to the customer and consumer are also important with a clear contact policy and complaints procedure including full product recall and environmental impact sections.

Details were required for the product and materials analysis, specification and control, including detail such as vendor appraisal, flavour profiling, product safety and parameters for analysis in brewing, process, packaging, storage and delivery.

Lastly, for completeness, such areas as maintenance procedures and performance, legislation compliance and administration requirements such as insurance and operational licensing should have been covered.

Jim Robertson

DIPLOMA IN BREWING EXAMINATION 2009

Module 1 – Materials and Wort

The examination was sat by 206 candidates, compared with 212 candidates in 2008 and 184 in candidates in 2007. The pass rate for the examination this year was 74%. This compares with a pass rate in 2008 of 63% and 2007 of 70%.

The grade distribution was as follows (2008 in parentheses):

A:	4%	(1%)
B:	12%	(5%)
C:	30%	(18%)
D:	30%	(38%)
E:	13%	(21%)
F:	8%	(12%)
G:	3%	(4%)

Time management is a very important part of doing well on the exam and once again it is pleasing to note that almost all of the candidates answered six questions. The skill of thinking quickly and concisely is not just important for examinations, it is a skill required for all aspects of life. Furthermore, the ability to communicate knowledge to others is essential. If you have a passion for producing high quality beer, it is essential that you continue to learn and communicate your knowledge. The very best candidates showed an ability to write quickly, legibly and clearly, using diagrams that were accurately labelled to enhance their answers.

There continue to be candidates that have difficulty in writing legibly or coherently which does make it much more difficult for the examiner to correctly assess their paper. In the case of those candidates that were close to pass/fail this inability may have been an impediment to receiving a passing grade. Once again the examiners request that you number each question that you have answered clearly in the examination booklet as well as marking on the front of the examination booklet which questions were attempted, for example, Q1, Q2 etc, in this way sections or parts of answers will not get mixed up. It is of utmost importance for the candidate to clearly mark on the first page of the examination booklet the questions, in order, that they have answered.

Question 1
Outline the operational stages involved in processing barley into malt. Explain the main aims of each stage and how these aims are achieved. [20]

This question was attempted by 196 candidates (94%) with 81% achieving the pass mark. The majority of students did very well at this question, with good use of diagrams to illustrate the design and operation of the different processes. Many candidates started their description of the malting process at steeping and neglected to mention storage and grading/ cleaning of barley thereby forfeiting marks. Some candidates went into too much detail about the biochemistry of germination at the expense of answering the part of the question about 'how these aims are achieved' which required consideration of process technology and key operational criteria.

The aim of storage is to keep the barley in condition until malting is to begin. Through the use of proper temperature of storage and aeration the barley is maintained in condition. Before malting the barley must be mechanically cleaned and sized. A top paper would give a brief description of the process involved and the aim of these processes in achieving uniformity in the process. In steeping the aim is to hydrate the grain to 40–45% moisture through a series of wet and dry cycles. A brief description of the process and the signals to moving the process to the next stage, germination was required for top marks.

The aim of germination is to control the growth of the grain through humidification to allow for modification of the grain. Top marks were given to those papers that briefly detailed how modification is controlled through humidification, air flow, CO_2 removal and turning. The aim of the final stage of kilning is to terminate grain growth (modification), fix the extract and enzyme potential, develop flavour and colour and make

the malt storable. Again a brief description of how the actual process of drying the grain was required to achieve top marks.

Question 2
What are the most important qualities of a malt destined for use as the main grist constituent in brewing? [8]
Give typical specifications for each of these quality parameters and explain their relevance to brewing. [12]

This question was attempted by 183 candidates (88%), with 74% achieving the pass mark. This question was generally well answered with good awareness shown of the important malt specification parameters and their typical values, although weaker answers tended to concentrate on trivial details at the expense of the bigger picture. Where answers fell short it was generally in relation to a lack of detail about the brewing relevance of the parameters. Surprisingly few people actually bothered to mention the obvious economic significance of parameters like extract and fermentability.
The examiner was looking for the following malt parameters :
- Varietal Purity
- Moisture
- Extract
- Colour
- Modification (as defined by Kolbach Index, Fine Coarse difference, Friability, cold water extract)
- Enzyme activity
- Beta-glucan content
- FAN Content
- Fermentability

For part 2 the examiner expected a typical range listing for all qualities listed in Part 1. Varietal purity is important to brewing in that the proper variety along with its' quality specification is received by the brewer. If a high enzyme malt is received when moderate or lower enzyme malt is expected the final beer produced will be out of specification. The level of extract is important in that this is the source for the final beer strength. Malt colour translates to final beer colour. Proper modification of the malt is necessary to ensure that the malt will possess the extract levels, ability to be milled and low levels of those compounds that would limit separation, physical stability and final beer strength. Beta-glucan content is of course related to wort and beer separation and filtration problems. FAN content is important in terms of yeast fermentation and is related to wort fermentability.

Question 3
Outline the chemical changes that take place during wort boiling. [10]
Summarise the basic principles of design and operation of wort kettles (coppers). [10]

This question, attempted by 179 candidates (86%) with 77% achieving the pass mark, was generally answered well. Candidates should take care to answer the question which was asked. For example some candidates wanted to list the objectives of wort boiling in the first part of the question, rather than listing chemical changes which occur. Part 1 seemed to be better answered than Part 2 of this question. Many of the summaries of design principles and operation of wort kettles were brief and/or incomplete. The subject of vigour was poorly addressed and features like the spreader cone or vapour stack were often absent from diagrams. A limited number of kettle designs were referred to and the key subject of energy efficiency in the wort boiling process was not given sufficient attention by many.

The candidate was expected to discuss the following changes that take place during wort boiling:
- pH drop – due to addition of hop bitter acids, formation of acidic Maillard products, precipitation of alkaline phosphates, oxidation of polyphenols, reaction of polypeptides with calcium liberating H+ ions
- Protein removal – coagulation of high molecular weight protein material
- Colour development (non-enzymatic browning) – Maillard reaction
- Amadori compound – flavour
- Strecker reaction – formation of aldehydes and pyrazines
- Hop alpha isomerisation
- S-methylmethionine converted to DMS
- Sterilisation
- Enzyme inactivation

Answers to part two were significantly enhanced by the use of a diagram highlighting the design considerations such as heating surface, vent, condensate ring etc. Those that used diagrams generally received top marks. Types of heating systems for kettles was also discussed for top marks by several of the candidates (direct fired, internal calandria, external calandria, Merlin, overpressure, continuous wort boiling, microwaving). A well constructed answer detailed the modes of wort boiling heat transfer (forced convection, nucleate boiling, film boiling), the material of construction (i.e. wetability of the material of design, compatibility with cleaning agents), fouling, safety and energy conservation.

Question 4
Give an account of the range of brewhouse adjuncts. [12]
Discuss the advantages and disadvantages of using each type of adjunct and highlight their potential impacts on the brewing process. [8]

This question was attempted by only 173 candidates (83%), with just 58% achieving the pass mark. There were very few answers worthy of high marks. Several candidates provided only scant information and many answers did not address the advantages and disadvantages of using each type. All in all; a very poor and disappointing performance for an easier question. Answers detailing the variety and merits of the various brewhouse adjuncts varied substantially in their content and level of detail. Some candidates merely listed cereals which could be used as solid adjuncts, rather than also considering the various processed forms which find application (grits, torrefied, micronized cereals etc.). Several candidates focused almost entirely on either solid or liquid adjuncts but not both.

Some provided a good account of the range of available adjuncts but were less informative on the advantages and disadvantages of the various types and their impacts on the brewing process. There is a wide range of solid adjuncts (principally cereals) available for use in brewing as a source of fermentable extract. For full marks the candidates needed to detail the overall advantages of using adjunct in place of malt. Several candidates set about answering the first part of the question in table format, which worked to some extent, but some candidates did not provide sufficient discussion, merely presenting a list of potential materials. The examiner was looking for information on the production of the adjunct.

The second section was not covered anything like as well as the first section; indeed some candidates elected to ignore this section completely! The examiner was looking for details such as the use of roasted barley could increase beta-glucan therefore processing problems and also increased wear on roller mills and transfer systems. Torrified adjuncts could increase wort lipid content although provide energy cost savings (pre-gelatinised) and deliver lower wort protein therefore better stability. Flaked adjuncts, because they are pre-gelatinised result in energy cost savings. Grits may result in higher beta-glucans and resultant processing problems. Flour adjuncts may exhibit storage problems in terms of bridging, explosion hazards and transfer problems as well as set mash phenomenon and runoff problems (size).

Finally syrups may have storage and handling problems due to viscosity and are prone to microbiological problems.

Question 5
Outline the theory and practical features of different wort separation techniques. [10]
Discuss their respective merits in relation to run-off rates, extract recovery and wort quality. [10]

This question was attempted by 166 candidates (80%) with 72% achieving the pass mark. This question was poorly answered with good answers accompanied with diagrams illustrating the three systems. Some candidates neglected to mention the Mash Tun at all and just described the Mash Filter and Lauter Tun.

There were a large number of mistakes in quoting Darcy's law – in particular there seemed to be several papers where the permeability factor (K) was omitted from the equation. Many candidates were happy to write down Darcy's law, but then gave relatively little attention to explaining its' significance and only good candidates tended to explain clearly how the different designs of mash separation equipment optimised various parameters in the equation.

The overall goal of all wort separation systems is to maximize extract

recovery in a timely fashion (economics) and to minimize leaching of undesirable compounds (tannins, polyphenols, steely ends etc). There are three different systems for wort separation, the infusion system (single vessel mash tun and lauter tun), Lauter tun, and mash filter. The candidates were expected to describe the important features of and workings of each system. Once again diagrams were used to advantage by those candidates achieving top marks.

Part two of the question was best answered in table form comparing the run-off rates, extract recovery percent and extract quality. Top marks went to those that included information about capital and operation cost comparisons and detailed elements of wort quality such as polyphenols.

Question 6

Discuss the relevance of brewhouse pipework, vessels and ancillary plant design to hygiene management. Your answer should include evaluation of the risks involved. [8]
Outline the range and main constituents of commercially available cleaning agents and explain how their action can be evaluated. [6]
Describe typical cleaning regimes which are operated in a brewhouse to ensure hygiene control. [6]

This question was the least popular question attempted by only 58 candidates (28%) with 63% achieving the pass mark. Where candidates attempted the question they tended to score 'average marks' with few outstanding answers. It was perhaps surprising that some candidates scored least well on the practical part of the question, where typical brewhouse cleaning regimes were described.

The system should be constructed of stainless steel to withstand cleaning temperatures and pressures, should have sanitary welds, sanitary connections, and vessels should have CIP systems in place with proper drainage. Pipework should have no dead ends, minimised bends, sanitary welds, little variation in line diameter and proper slope. Equipment CIP systems should have complete vessel coverage and the system should be designed to allow for a CIP cycle within a timeframe of the brew centre timing.

The detailed requirements of a cleaning agent are high solubility in water, good cleaning power with regard to dirt, high wetting power, little redeposition of dirt, no foam, easily rinsed, no reaction with salts in water, not corrosive to equipment, easy and safe to use, low cost and little pollution of the waste water. The major cleaning agent in the brewhouse is caustic soda (wetting agents added) and to validate it effectiveness operators can visually check, utilise pH measurement, or turbidity measurement of the return solution.

Acid cleaners for scale removal can be used and the validation methods are similar for those used to validate caustic cleaning. In terms of sanitisers, chlorine based are best used in the brewhouse and validation methods include micro testing (swab, plating) and the use of a bioluminescence detection method.

A typical cleaning regime is a balance of efficiency versus cost. The first step should be a pre-rinse step to eliminate loose soil and to wet the equipment. The next step would be a caustic step for removal of organic material followed by a rinse to eliminate any residual caustic or soil. The next step could be an acid rinse to eliminate beer stone (scale) or a sanitation step to sterilise the lines with a chlorine-based sanitiser followed by another rinse step.

For the Mash tun, cereal cooker, whirlpool, lines, wort cooler, and the kettle a rinse should be done after each use followed by a 2–5% caustic wash (at 70–90C).

Sanitiser steps should be done on kettle out lines through the wort cooler and to the fermenter.

Question 7

Give a description of hop constituents that are relevant to brewing and explain their significance. [20]

This question was attempted by 135 candidates (65%) with 60% achieving the pass mark. This question was often answered with insufficient detail. It was often one of the last answers attempted, which perhaps explains the lack of detail in most answers. Many candidates omitted to consider the tannins fraction and therefore scored no marks in relation to their brewing significance. The hop aroma fraction was poorly described by many, with only the most basic facts regarding late hop addition and dry hopping; very little comment on the chemical nature of the essential oils. Most candidates were more comfortable describing the hop bittering components, although not all could differentiate between hard resins and soft resins, α-acids and β-acids etc.

Many answers focused totally on chemical fractions, with no attention whatsoever to their origins in the hop cone (lupulin glands etc.)

Only the cones of un-fertilised female plant are used as the source for hops for brewing. There are three main components of brewing value, total resins, essential oils and the tannins. The smallest component, tannins are detrimental to beer as they are precursors for haze formation, promote precipitation of polyphenol-protein complex during wort boiling, and aid in formation of trub.

The essential oils, broken into two main groups, the hydrocarbons and oxygenated terpenes represent 0.3 to 3% of total weight of hop. They are responsible for hop aroma (e.g. myrcene, farnescene, humulene, geraniol, linalool).

Total resins can be divided into hard resins characterised by solubility in cold methanol and diethyl ether and soft resins(alpha and beta acids) soluble in hexane. The alpha components (humulones , ad, co) represent 35–70, 10–15, and 20–55 % of the alphas. Under wort boiling they are transformed to iso-alpha acids which are the main bittering components of beer (dependant on boil time, pH, presence of co-factors (Mg)). The beta acids (lupulones) add little bitterness to beer.

Question 8

Outline the key inorganic components of brewing liquor (production water) and discuss their relevance to brewing process and beer quality. [20]

This question was attempted by 133 candidates (64%) with 77% achieving the pass mark. In general this question was well-answered and scored good marks for many candidates; not-surprisingly, the brewing significance of many inorganic ion-species was widely well-appreciated. Poorer answers frequently gave a list of ions, without going on to detail their brewing significance. Some answers were way too brief. Where candidates use bulleted lists and abbreviated forms of answers they must be careful not to assume knowledge on behalf of the examiners.

For example:
Cu^{2+} - flavour instability
Does not actually describe that copper can act as a pro-oxidant which can give rise to oxidation of beer during prolonged storage.

The key component is calcium which plays a role in water hardness, reduces pH in mashing, boiling, and fermentation thereby increasing fermentability through increased FAN and soluble protein. Calcium is also instrumental in increased extract recovery, increased rate of run-off, reduced extraction of tannins and silicates, reduced isomerization of alpha acids, improved protein precipitation and reduced colour during boil, improved yeast flocculation, and improved beer stability by removing oxalic acids as calcium oxalate.

- Magnesium exerts similar reactions to calcium, and is more soluble in water. Is serves as an enzyme co-factor for yeast fermentation and can impart a bitter taste to beer.
- Sodium exhibits a salty, sour taste to beer at 150ppm of higher. At lower concentrations it can impart sweetness and fullness.
- Chloride ion improves clarification and beer colloidal stability, and can negatively impact yeast flocculation. It imparts a mellow flavour and palate fullness to final beer.
- Sulphates serve as precursors for SO_2 and H_2S formation by yeast and will impart a drier more bitter flavour in beer.
- Nitrate can form carcinogenic ATNC when in beer.
- Manganese is a yeast co-factor at low levels yeast but can be inhibitory at higher concentrations.
- Iron can prevent proper saccarification of the mash and serves as a catalyst for auto-oxidation of polyphenol off flavours. It can act as a foam stabiliser and also generate beer haze.
- The presence of ammonium in beer is a sign of contamination, an indication of pollution.
- Zinc is an important co-factor for yeast growth but at high levels inhibits amylase activity and is a haze promoter.
- Copper is a co-factor for yeast metabolism at low levels and is inhibitory to yeast at high levels and may play a role in beer oxidation.

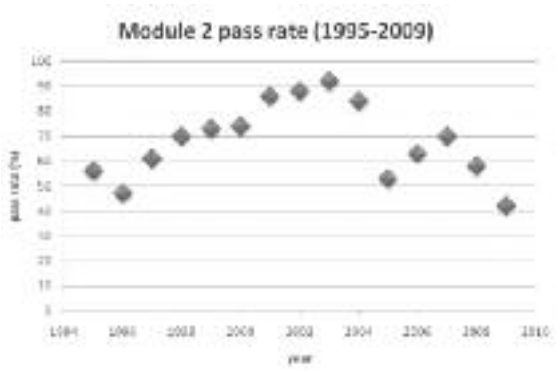
Rob McCaig – July 2009

DIPLOMA IN BREWING EXAMINATION 2009

Module 2 – Yeast and Beer

Overview

In all there were 161 submitted scripts with 68 candidates achieving a pass grade to give a pass rate of 42.2%. This is a disappointing result and is markedly lower than last year's 'low' of 58%. Indeed in recent years – with the exception of 70% in 2007 – the pass rate has been broadly disappointing with 63% (2006) and 53% (2005). Although clearly other factors have changed, further analysis (below) reveals that the last time the pass rate for Module 2 dipped below 50% was in 1996 with 47%. It is reasonable to speculate that the major changes and challenges our industry has experienced in recent years may – in the broadest sense – have contributed to the decline in pass rate.



Certainly against a backdrop of consolidation, mergers and closures, candidates can perhaps be forgiven for having their minds on other things and finding preparation, revision and reading around the syllabus something of a stretch. However, whilst sympathetic, the vast majority of candidates now opt to take a single module at a time and should focus their efforts and spread the load over the months rather than cramming exclusively on revision notes.

Turning to this year's results, although there were no A grade passes, good papers achieving the B grade held up at 5.6% compared to 5.4% in 2008, 6.3% in 2007 and 4% in 2006. As with 2008, 50% of the candidates straddled the grades between a pass and fail although the proportion of D grades fell from last years 34.3% to 27.3% whereas 'fails' increased from 15.7 to 22.4%. Once again both the examiner and moderator felt this major cohort set out to do the bare minimum to pass this Module.

Table 1: Overall pass/fail rates and grades

Passed	**68**	**42.2%**
Grade		
A	0	0%
B	9	5.6%
C	15	9.3%
D	44	27.3%
Failed	**93**	**57.8%**
Grade		
E	36	22.4%
F	41	25.5%
G	16	9.9%

Analysis of questions that were answered and the corresponding pass rate was illuminating. Question 8 was the least popular being answered by 50% of the candidates with only 35% passing. Although Question 2 was the most popular (attempted by 88% of candidates) only 22% achieved a pass.

In all, 32 manuscripts were moderated by Tobin Eppard, who independently remarked them using the same marking scheme as the examiner. The majority (26) were up to five marks shy of the pass mark with the remainder at the D/C interface between D/C (2) and C/B (4). The moderation process moved 13 candidates from an E to a pass.

Table 2: Performance by question

Question	Answered by	Passed by	Passed %
1	134	29	22
2	141	31	22
3	110	64	58
4	106	46	43
5	133	67	50
6	127	66	52
7	129	78	61
8	81	28	35

Examination technique

In reviewing past examiners reports it is apparent that the same issues and concerns crop up year after year which beg the question whether new routes to communicate to candidates are necessary. Anyway, back in 1996, the examiner asked 'do candidates ever take heed of the examiners reports?' and that 'they should answer the question that has been set and not the one they would have liked to be set'. Similarly in 1999, 'there was a strong tendency from a number of candidates to answer the question without heeding the precise wording, and to stray away from the point of the answers'. Further in 1998 some good advice to 'cut out the waffle and set out the salient points in an uncluttered way; make use of tables to set out facts in a logical manner'.

Building on this, in 2009:
(i) far too many candidates ran their answers continuously without so much as a gap let alone a new page to start a question,
(ii) legibility plumbed new depths with a handful of papers veering on the unreadable (its hard to reward good stuff if you can't read it!) and (iii) new for 2009 – were drawings based on the primitive art school which either filled a page or resembled a postage stamp stuck in the corner. Drawings are great if they add value to text and develop a point but become redundant (and a waste of examination time) if either simply repeat the other. Also, as someone who has no drawing skills, the use of colour and text boxes to highlight points on or within a drawing makes a (positive) difference.

Similarly, lists were great as long as there was sufficient 'meat' to confirm understanding and positioning. Again time management and allocation was a concern with many candidates. There is no need to write down the question and the answer should be proportional to the marks that are allocated. Finally a couple of simple ones; insert the number of questions attempted in order on the front cover of the answer book and respond to six questions however briefly (no passes were achieved this year with five or less questions answered).

Questions and answers

The questions and answers were firmly based on the syllabus. Whilst the revision notes provide a firm grounding it is not sufficient to learn them parrot-fashion and then regurgitate them irrespective of context. Understanding helps as does making appropriate connections across the syllabus and, where appropriate, commenting from experience. Further a little reading around the subject can make a huge difference and garner additional marks as well as the enthusiastic support of the examiner and moderator. Scanning and dipping into the popular brewing press is highly recommended particularly as both frequently contain readable overviews that link well with the Diploma content. Similarly downloads of useful articles can be sourced from the IBD website via 'learning materials'.

Question 1.

Explain how the nutritional requirements of yeast that support growth and fermentation are met by wort. [20]

Broadly the marking scheme focussed on five segments (oxygen, inorganic ions, vitamins, nitrogen and sugars) each with four marks. Allocation of marks was around key points e.g. for oxygen – typical levels, sterols, UFA and role. In addition an additional mark was allocated for insights above and beyond the norm such as the contribution of wort UFA or involvement of glycogen. So for inorganic ions, a mark for examples of anions, cations, and divalent ions and an additional mark for example of role or function. Marks for vitamins included roles, levels, examples and any additional insight. In the case of nitrogen, a mark for role, uptake, transamination and, where appropriate a bonus e.g. recognition of peptides. Sugars was fairly as in 'what', uptake, metabolism and importantly linkage to energy/ATP for cell

growth. As with last year many candidates answered the question they hoped for with lots on about HMP shunt, Krebs cycle which regrettably was just a waste of ink and time!

Question 2.
Describe in detail the contribution of maturation/cold storage to beer quality. [20]

Marking was formulaic focussing on process (two for warm, cold and times and temperature), flavour (six for diacetyl pathway, timeline management, process factors, innovations and gas washing of H_2S), two marks (impact on oxygen and microbiology), seven marks on solids separation/haze removal (mechanism, process aids, other hazes and finings) and three for additions (foam, colour, hop products and syrups). A lot of candidates limited their answers to what they used in their breweries rather than the coverage of the syllabus.

Question 3.
Outline the basic principles of fermenter design, operation and control. [10]
Describe the advantages and disadvantages of the various options. [10]

The examiner took a view here as some candidates ignored the 'various options' and homed in exclusively on cylindro conical vessels. As the split remained at ten marks split across design (size, shape, mixing), operation (pitching, cropping, top pressure, CO_2 collection) and control (temperature, automation, monitoring) this was then diluted in terms of detail if a candidate described two or three systems. Pros and cons (10 marks) pretty much fell out of this with CCVs being the benchmark with insights such as scale, filling time, footprint, CIP, cropping, cooling, losses, pitching, unitank/DPV etc.

Question 4.
Select TWO of the following to answer.
Differentiation in the laboratory of ale and lager yeast [10]
(a) Describe the applications, strengths and weaknesses of bioluminescence in hygiene management [10]
(b) Outline the detection and significance of anaerobic and aerobic microorganisms in the brewery [10]

For 4(a) marks were awarded for flocculation, fermentation performance, temperature (not fermentation but growth limits), giant colony, X-α-gal, melibiose and genetic fingerprinting techniques (two marks only irrespective of the frequent inordinate detail devoted to the methods). An additional mark was awarded for any taxonomic gems particularly for the rare occasions when a candidate described lager strains as *S. pastorianus*! One mark floated for an additional insight or know-how. Bioluminescence (4b) was also straightforward with a mark apiece for the reaction, background (history, firefly), hygiene testing, real time, comparatively poor sensitivity, lack of selectivity, ease of use, use in CIP/reclean and product testing (or not).

One mark floating. In the case of 4(c) again a logical split between detection and significance with five marks each. Detection encompassed sampling (plates, filtration, drips) and testing (media for this and that, ± oxygen + analysis, e.g. Gram, catalase, microscopic exam). Significance was essentially a romp through examples (not exhaustive) of anaerobes, aerobes (including yeasts) what they are, what they do.

Question 5.
Describe the relative merits of descriptive and difference testing of beer flavour AND write brief notes on the origin and significance of the following sensory notes.
(a) phenolic/medicinal [2]
(b) diacetyl [2]
(c) metallic [2]
(d) cardboard/papery [2]
(e) hydrogen sulphide [2]

Marking of 'testing' was divided into examples (two marks), explanation (6) and merits/disadvantages (2). For the sensory notes and two marks, the candidate should offer a bit more than the basics with details of source(s), impact on flavour etc.

Question 6.
(a) Discuss how process factors can impact on beer colour. [10]
(b) Describe the available methods for the measurement of colour in wort and beer. [10]

The process factors piece (ten marks) was broken down into kilning, raw materials, mashing/last running, wort boiling, additions and ageing with physical parameters – time, temperature and pH - overlaid on top. Measurement was split with five marks for a decent explanation of Tristimulus and five for Lovibond, OD_{430} and their limitations.

Question 7.
Outline the design, operation and application of the following filtration systems.
(a) Powder [10]
(b) Cross-flow [5]
(c) Sterile [5]

'Powder' was split three ways – design (depth, basics/background of powders, charges), operation (precoat etc) and application (plate and frame, candle and leaf/screen). Darcy's law was rewarded where pertinent/explained in context. There was also a mark for the role/purpose of filtration. For crossflow and sterile filtration (five each) reasonable detail, understanding, roles and benefits were required.

Question 8.
Describe the systems and procedures to assure product hygiene/food safety across the brewery [20]

This was poorly answered and possibly misread by many. The clues were in the question as in 'systems', 'procedures' and 'product hygiene/food safety'. So this wasn't a question exclusively about CIP – anything but. Good answers recognised the importance of 'systems' in the form of QA/QC, ISO, HACCP, RFT, GMP, and TQM. 10 marks on offer – pretty much a mark each with HACCP up to 3 if the steps and examples were detailed. Two marks were given for comments on food safety (biological, physical and chemical). Eight marks were on offer for the 'what' of assurance e.g. CIP, pasteurisation, sterile filtration, EBI, hygienic design, environment/air hygiene, surfaces, housekeeping, pest control, raw material, supplier QA, testing, training, top-down commitment etc.

David Quain

DIPLOMA IN BREWING EXAMINATION 2009

Module 3 – Packaging & Process Technology

General Comments:
The overall pass rate is very similar to 2008, but it was encouraging that there were far fewer Grade G candidates and a greater percentage of Grade A and B passes than the previous year.
However, there are unfortunately still a number of candidates who are sitting the exam clearly with little or no preparation and this cannot be helpful to a candidate's morale.
There has also been an indication in 2009 that candidates are not studying the Section B syllabus to the same extent, expecting to 'wing-it' on their performance on the packaging questions. I do not believe that the paper in 2009 was any more difficult than previous years, but pass rates on the process technology questions were particularly low. It is perhaps time to assess whether the present policy of "compensation" continues in future years. This allows for the high marks in Section A (marks over and above the pass mark) to be offset (compensate) for failure to make the pass mark in Section B, allowing candidates to pass the module with little or no understanding of process technology. In future years a pass mark on both Sections A and B may be required.

A candidate should try to please the Examiner, but failure to fill out the question numbers on the front of the first book, as instructed, is lazy and sets the marking off on the wrong foot.

I fail to understand why candidates waste valuable time in writing out

the question in full at the top of their answer. It gets no marks and it's time better spent on the answer. Similarly, any information not relevant to the question should not be included, however much the candidate wishes to demonstrate their breath of knowledge. If it is not relevant, it gets no marks and wastes time. Similarly answering a different question to the one asked is also senseless!

And finally those treasury tags – the little metal and string ties intended for holding together two books if more than one is needed. If not needed, please don't thread them round and round through the holes until they are so tight that the book won't open properly. The Examiner has to unravel them. Leave it on the desk!

The overall pass rates, and details of candidates' performance on individual questions are shown in the tables below.

Table 1: Overall Pass/Fail Rates and Grades

Diploma in Brewing Module 3 - June 2009

Number of Candidates		134	
Passed		90	67%
Grade	A	11	8%
	B	20	15%
	C	24	18%
	D	35	26%
Failed		44	33%
Grade	E	24	18%
	F	15	11%
	G	5	4%

Table 2: Performance by Question

Diploma in Brewing Module 3 - June 2009

Question	Answered by:	Passed by:	Passed %
1	83	52	63%
2	52	32	62%
3	88	70	80%
4	64	48	78%
5	108	93	86%
6	103	79	77%
7	54	18	30%
8	112	44	39%
9	94	65	69%
10	21	10	48%

Question 1.

Describe one method to increase the carbon dioxide content of beer in, or after, the bright beer tank. [4]

Define the condition of supersaturation of carbon dioxide in beer. Explain how it can occur and what are its implications for beer quality in the brewery and in the retail outlet. [6]

Calculate the maximum carbon dioxide content in g l^{-1} that could be reached at the bottom of a bright beer tank if the depth of beer is 20 metres, its temperature is 2°C, its density is 1.006 x 10^3kg m^{-3} and a top pressure of 1 bar gauge (100 kPa gauge) is applied to the tank.[8]

Comment on the implications of this result in the normal operation of a bright beer tank? [2]

Data:-
Henry's constant for CO_2 at 2°C = 84.1 x 10^3kPa mole fraction^{-1}
Relative molecular weight of CO_2 = 44
Relative molecular weight of beer assumed = 18
Gravitational constant = 9.81 m s^{-2}
Atmospheric Pressure = 101.35 kPa

Of the methods for increasing the CO_2 content of beer, top pressure on the BBT is the most ineffective, yet it was the choice of many candidates. It is very slow and could create concentration gradients within the tank and a non-homogeneous batch.

The use of a carbonating "stone" or sinter in the tank base is better but requires a top pressure on the tank to prevent overfoaming and gas loss. Many candidates selected the venturi but there was poor understanding in a number of answers about how it worked and why it was effective in dissolving CO_2 readily.

For in-line carbonation, the venturi, sinter or semi-permeable membrane systems can be used.

Supersaturation was poorly understood, with much confusion with the equilibrium state of saturation or beer being 'over specification'. Supersaturation is a level of carbonation over and above equilibrium level (saturation) caused either by a drop in pressure in the system or a rise in temperature. It is an unstable condition and CO_2 will be lost from the beer until equilibrium is re-established. It is convenient for the beer industry that this return to equilibrium is not immediate and can be beneficial for product presentation. In retail, CO_2 supersaturation gives good presentation with foam renewal, gas rise and tingle on the palate. The evolution is helped by nucleation sites, either natural or by roughening the glass surface deliberately by etching. Uncontrolled release of the supersaturation can cause fobbing at the dispense tap or overfoaming from the bottle or can on opening.
In the brewery, loss of head potential and haze formation from collapsed foam, and cavitation at pump suction are problems associated with supersaturation but controlled foaming at the bottle jetter is helpful in controlling TIPO.

The calculation was well attempted and most candidates remembered to use absolute pressure in Henry's equation. The pressure at the BBT base works out as 398.7 kPa abs., which, if equilibrium was established, could give a CO_2 content of 5.8 v/v (11.6 g/l).

However, very few candidates gave any thought to the implications of this result in the context of BBT operation. Residence time in BBT is usually short, often a few hours or a few days maximum and the beer supplied into BBT should be in specification, say for example at 2.5v/v (5.0 g/l). The top pressure of 1 bar g. is applied to keep this level of CO_2 in solution at the beer surface – equilibrium CO_2 content at 1 bar g. and 2°C is 2.94 v/v (5.88 g/l). The beer at the base of the BBT will also be at 2.5v/v at the time of filling. Given time, the beer at the top surface might rise to 2.94v/v but it is inconceivable that levels as high as 5.8 v/v would ever be reached at the BBT base during normal BBT operation. So we have a workable situation provided residence times are kept low. It should also be noted that the height of this BBT was made large for this question and it is much more usual to have shallower BBTs with an aspect ratio height: diameter of say 2:1.

Question 2

Write brief notes, in the context of packaging, on FOUR of the following analytical methods [5 marks each}

- **Alcohol content**
- **Carbon dioxide content**
- **Package contents**
- **Beer bitterness**
- **Predicted shelf life**
- **Total in-package oxygen**

This was one of the least popular questions. Of those who answered this question, there were three categories:

- Those who read the question, knew about the methods and answered the question well.
- Those who read the question but knew little about the analytical methods, scoring just a few marks.
- Those who didn't read the question and wrote a lot about the topics, but nothing on the analytical methods. This group were awarded zero marks.

So it is most important that candidates read the question carefully and understand what is being asked.

The analytical methods are well documented in EBC, IOB and ASBC methods and elsewhere, so will not be repeated here, but better answers made reference to calibration, accuracy of the methods such as r(95) and ease of use, in addition to a good description of the methods.

All too often, trade names were used such as Alcolyser. It is not acceptable just to say that a sample is injected into a "black box" and the result read off the screen. Candidates should know the principles on which the machines work to provide an analysis and the limitations.

The question asked for four out of six, so candidates answering all six wasted time for no additional marks – the first four answers only being awarded.

Question 3

List the main raw materials, and the typical percentage of each material, for the manufacture of glass bottles for beer. [4]

Describe in detail, and with diagrams, the manufacturing process for

glass beer bottles from batched raw materials to the formed bottle. [12]

Outline the type and purpose of treatments applied to the bottles after the forming process. [4]

The standard of answer for this question on glass bottle manufacture was very high with 80% of the 88 attempts getting a pass mark. Sketches were mostly well drawn of the furnace, gob former and moulding machines. These are not easy sketches, particularly the mould sequence, so it was encouraging to see that candidates must have practised producing these sketches before the exam.

Most candidates could also quote the constituents of glass with approximate percentages.

The first mould of the bottle forming sequence was often drawn upside down and candidates should note that the parison is flipped from upside-down to right-way-up in moving from first to second mould.

The correct word for the cut-off piece of molten glass is a "gob", but a number of answers used the word "glob", so it must be wrong in someone's notes or lectures?

And finally, I question the benefit of drawing a fully annotated diagram of a bottle for this question as attempted by quite a few students. It is time consuming and added little to the answer.

Question 4

If the repeatability, r(95), and reproducibility, R(95), for the measurement of the alcohol content of beer are 0.08 and 0.18 %ABV respectively, which of the following is the most appropriate specification for a nominal 4.5%ABV beer being brewed at one brewery and packaged at a second brewery? Explain the reasons for choosing the specification selected. [8]

- **4.5 ± 0.05%ABV**
- **4.5 ± 0.1 % ABV**
- **4.5 ± 0.2 % ABV**
- **4.5 ± 0.5 % ABV**

Explain the difference between the accuracy and the precision of a set of results of measurements made on packaged beer. [4]

The following data was collected for a random sample of 30 filled packages, of 500 ml nominal contents. What is the mean of these results? [4]

Frequency	Contents ml
1	465
1	470
2	475
4	485
5	495
6	500
5	505
3	515
2	525
1	530

If the tolerable negative error for this package size is 15 ml, comment on whether the batch conforms to average contents legislation. [4]

Whilst some marks were given for stating the definitions of r(95) and R(95), the 8 marks for the first part of this question should have indicated that more than a guess at the best specification was needed.

Virtually no one made reference to process capability in answering this question. The process capability index Cp is (USL – LSL)/6s where USL and LSL are the upper and lower specification limits respectively and s is the standard deviation, which is r(95)/2.83. Cp needs to be greater than 1.0, which means that the specification range should be greater than 6s.

If r(95) for the ABV method is 0.08 % ABV, then 6s is 0.17% ABV so a specification of ± 0.1% would be acceptable but tight, with the process capability very close to the specification limits. A spec of ± 0.2% would be more acceptable.

However, the beer is being moved between breweries, so R(95) needs to be considered. By the same calculation, the spec range needs to be greater than 6s, which in these circumstances is 0.38% ABV. The previous spec of ± 0.2 %ABV is just workable but tight. Of concern is the large variance between r(95) and R(95) which suggests that there are inter-laboratory differences of equipment or method that need to be investigated before a spec of ± 0.2 % ABV can be adopted with confidence.

In the EU, a single specification for ABV on a package, for example 4.5% ABV, has an implicit range legally defined as ± 0.5% ABV. It is not uncommon for breweries to run with two specifications – an inner tight specification as target and an outer, "slacker" specification for absolute beer release. In this case, a target spec of ± 0.2 % ABV with an outer limit of ± 0.5% ABV would fulfil the requirement.

"Accuracy" and "Precision" of measurements was well answered, usually by the use of archery target diagrams. This was a major improvement from a few years previous when this same part-question was answered abysmally.

The mean for the data worked out as 498.3 ml, which meant that the batch was non-conforming to average contents rules for the following reasons::

- The mean was less than nominal. The mean must be greater or equal to nominal contents, i.e. 500 ml, on a representative sample.
- 4 out of 30 samples were more than 1 x TNE below nominal, i.e 485 ml. No more than 2.5% of packages can be less than I x TNE below nominal.
- No package can be less than 2 x TNE below nominal. i.e 470ml. There was one package in this sample at 465 ml.

Question 5

For EITHER a small pack (bottle or can) line OR for a large pack (cask or keg) line, describe in detail the precautions to be taken from bright beer tank to final package to minimise:-

- **Oxygen pick-up [5]**
- **Beer dilution [5]**
- **Loss of foam potential [5]**
- **Microbiological contamination [5]**

This question was asking for the "precautions to be taken", so it did not require scene-setting in describing the background; for example we don't need to know why oxygen is bad for beer, just the precautions to minimise its pick-up.

Also the question specifically stated "from BBT to final package". So any details about steps taken in the brewhouse, fermentation or conditioning are not relevant to this question except to state that the beer needs to be received into BBT with low DO, good foam, in spec for ABV and microbiologically sound.

Section B – Process Technology

Question 6

Sketch a Pressure-Enthalpy phase diagram for the water/steam system. [2]

On the same diagram, use a constant pressure line to explain the following terms :-

- **dry saturated steam**
- **superheated steam**
- **enthalpy difference**
- **sensible heat**
- **latent heat of vaporisation**
- **dryness fraction [6]**

List the advantages of steam for heating and sterilisation duties in a brewery. [4]

Outline the desirable physical properties of insulation material used for the lagging of steam pipes. [2]

A pipe of 300mm outside diameter (o.d.) carries steam at 140°C and is lagged with 25mm of insulation. The thermal conductivity of the insulation is 0.04 W $m^{-1}K^{-1}$. Neglecting the temperature drop across the pipe wall, calculate the heat loss per linear metre of pipe if the external surface temperature of the insulation is 30°C. [6]

The pressure-enthalpy diagram was a straightforward text book answer and was well tackled by most candidates.

For the advantages of steam for heating and sterilisation, the following points were expected:

- high latent heat
- latent heat released at convenient pressures and temperatures eg for wort boiling
- the raw material is cheap! – water bur treated.
- non-toxic, non-tainting (provided boiler feed chemicals are OK)
- high lethal rate on microorganisms
- easily distributed and at various pressures

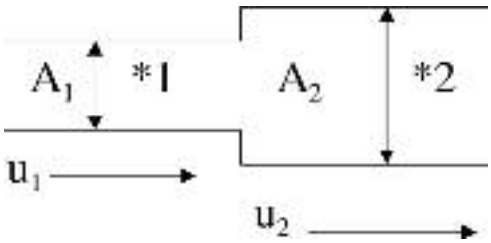
- recovery and reuse of raw material as condensate – heat saving
- motive power eg steam turbine as well as heating.

Insulation of steam pipes (and for other above-ambient applications) needs to be open pore structure to facilitate moisture escape e.g. glass or mineral wool. Some candidates failed to mention that low conductivity (U–value) was important! It also needs to be fire resistant, capable of withstanding steam temperatures, available often as pre-formed sections and protected from mechanical damage by metal or plastic cladding. For this question, some candidates just listed the uses for steam, which was clearly not the question asked.

In this calculation, and as in previous years, many candidates failed to differentiate between cross-sectional area (πr^2 or $\pi d^2/4$) and surface area, which is circumference x length ($2\pi rL$ or πdL). If a pipe is losing heat, it is losing it from its surface area, not its cross-sectional area. But which surface do we take – the surface inside the insulation or the outside area? They are not the same. The log mean area (or log mean diameter) should be used and this works out as $1.02m^2$ per linear metre of pipe.
Putting this log mean area A_{LM} into the equation $Q = k/x \times A_{LM} \times (T_1 - T_2)$ gave an answer for heat loss of 179.5 Watts per linear metre.

Question 7
Explain with the aid of a diagram how the laws of conservation of mass and conservation of energy can be used to predict the flow conditions at one point in a pipe system from knowledge of the conditions at a second point in the same system. [6]
In calculating the pressure drop due to friction in pipes, explain with the use of a diagram, the relationship between friction factor and Reynolds number for both laminar and turbulent flow regimes. [8]
Explain how the loss due to friction of bends, T-pieces, fittings and valves can be dealt with in calculating the total pressure loss in piping systems. [6]

Not only was this question one of the least popular to answer, but, of those attempting this question, only 30% - 18 candidates – passed. For a question dealing with the basic underlying principles of fluid flow, this is a most unsatisfactory result – not least because moving liquids is a key unit operation in breweries.
Some candidates even attempted to answer this question by talking about heat energy, when the question clearly states "flow conditions"!



Conservation of mass states that at points 1 and 2 in the system, the mass flowrates are equal, $G_1 = G_2$ and $u_1\rho_1A_1 = u_2\rho_2A_2$.
For an incompressible fluid, $\rho 1 = \rho 2$ so $u_1A_1 = u_2A_2$

Conservation of energy (Bernoulli equation) states that the sum of pressure energy, kinetic energy and potential energy in a fluid system is constant.

$$P + 0.5\,\rho\,u^2 + \rho\,g\,h = \text{constant}.$$

So if we take two different points, 1 and 2 in the same fluid system:

$$P_1 + 0.5\,\rho_1\,u_1^2 + \rho_1\,g\,h_1 = P_2 + 0.5\,\rho_2\,u_2^2 + \rho_2\,g\,h_2$$

This ignores pressure losses due to friction, ΔP_f, and pressure gains due to pumping input, ΔP_w

The second part of this question required a diagram of a Moody chart (log scale) showing the friction factor, C_f, plotted against Reynolds Number, Re, and the relative roughness e, which is the absolute roughness divided by the pipe diameter = e/d.
The pressure loss due to friction can be calculated from the equation:

$$\Delta P_f = 2 \times C_f \times L/d \times \rho \times u^2 \qquad \text{Equation 1}$$

For laminar flow with Re < 2000, $C_f = 16/Re$

For turbulent flow with Re > 4000, C_f is read from the Moody chart at the known Re and on the line corresponding to the pipes relative roughness.
Pressure loss due to fittings etc. can be accounted for in two ways:-
- equivalent pie diameters
- velocity heads

For the first method, the friction caused by fittings, valves etc. can be expressed as an equivalent straight length of pipe. For example a tee-piece might be equivalent to 60 pipe diameters. Therefore in a 100mm pipe, the tee piece is equivalent to $60 \times 0.1 = 6$ metres of straight pipe. This length of pipe is added to the total pipe length in equation 1 above. For the second method, the friction can be expressed as so many velocity heads, for example a tee-piece might be 1.8 velocity heads, where a velocity head is $u^2/2g$. This head loss due to friction can then added into the Bernoulli equation when used in units of head.

Question 8
Explain the principles of the three mechanisms by which heat can be transferred from one solid or fluid to another. [6]

By considering the relationship between the overall heat transfer coefficient and film heat transfer coefficients, explain how the fouling of a heat exchange surface is incorporated into the design calculations of a heat exchanger. [6]

An ice bank cooler is used to chill a beer to 5°C from a storage temperature of 20°C. The beer is dispensed at a flow rate of 0.04 kg $^{s-1}$ and cooled through a stainless steel coil within the stirred ice/water bath, at a constant temperature of 0°C. Calculate the length of cooling coil required. [8]

Data:
Assume that the stainless steel coil is thin walled of 8mm o.d. and 1mm wall thickness.
Specific heat of the beer = 4.2 kJ kg^{-1} K^{-1}
Coolant side film heat transfer coefficient = 1000 W $m^{-2}K^{-1}$
Beer side film heat transfer coefficient = 3000 W $m^{-2}K^{-1}$
Thermal conductivity of stainless steel = 25 W $m^{-1}K^{-1}$

This was the most popular question and I would have expected good answers explaining the three mechanisms of heat transfer – conduction, convection and radiation – but that was not the case, being poorly and inadequately answered by many candidates.

In calculating the overall heat transfer coefficient U, the materials and the films are combined as resistances, that is as reciprocals.

$$1/U = x_1/k_1 + x_2/k_2 + \ldots\ldots + 1/h_1 + 1/h_2.$$

Fouling adds further resistances to heat transfer and if R_1 and R_2 are the inside and outside fouling resistances then:-

$$1/U = x_1/k_1 + x_2/k_2 + \ldots\ldots + 1/h_1 + 1/h_2 + \mathbf{R_1 + R_2}$$

In practice, R_1 and R_2 cannot be predicted with any accuracy, although previous experience with similar heat exchangers on similar duties may give a guide.

Fouling can be minimised in HE design by ensuring highly turbulent flow, keeping the temperature difference as low as possible, say by increasing the heat transfer area, and by using a material with a wettable surface that will minimise film boiling.

In the calculation, first calculate the heat lost by the beer using $Q = m \times c_p \times \Delta T$ giving 2520 W.

Then use $Q = U \times A \times \Delta T_{LMTD}$, where $\Delta T_{LMTD} = 10.82°C$ and $A = \pi dL$, to find L.

Since the question states "a thin-walled pipe", the effect of wall thickness can be ignored and:
$1/U = x/k\ 1/h_1 + 1/h_2 = 0/001/25 + 1/1000 + 1/3000$
$U = 728.3$ W m^{-2} K^{-1} giving length of 12.7m.

If wall thickness was included and a log mean diameter calculated as 6.95 mm, U would work out as 675.7 W m^{-2} K^{-1} and length of 13.7m.

Question 9

Explain, with the use of one diagram for each, the differences in design of centrifugal pumps and positive displacement pumps. Outline their respective advantages and disadvantages for pumping duties in the brewery. [6]

Explain, using a head-flowrate characteristic curve diagram, where the points of maximum pressure, maximum flowrate, and maximum efficiency will occur for a centrifugal pump. Show on the same diagram the effect of reducing the impellor diameter on head and flowrate. [4]

List the type of pump which would be the ideal choice for each of the following duties and explain briefly the reasons for these choices:-

1. Pumping mash from mash mixer to lauter tun. [2]

2. Pumping yeast slurry from FV to storage. [2]

3. Scavenging CIP fluids from a tank being cleaned. [2]

4. Dosing additives/processing aids into beer. [2]

5. Pumping feed water into a steam boiler at 600 kPa g [2]

A textbook question, but it was surprising how few candidates were able to draw a recognisable centrifugal or PD pump, let alone explain their principle of operation.

Few of the sketches of centrifugal pumps showed the volute, some had impellors touching the casing and only a very few candidates attempted a plan and elevation to explain fully the differences in design.

The advantages and disadvantages however were quite well covered and so too was the sketch of the characteristic curve, with the requested points shown.

For the ideal choice of pump for the given duties, often the reason for choice was omitted (probably not known?) but also it was not sufficient just to say 'centrifugal pump' or 'positive displacement pump', since there are quite different capabilities of pumps within the same category.

1. Mash transfer – an open impellor centrifugal pump to handle a large volume flow and fast flow rate but with low shear to avoid degradation of the mash particles, which could lead to separation problems.
2. Pumping yeast – hygiene is a key consideration as well as low shear, so there are several possibilities. An open impellor centrifugal pump with a hygienic shaft seal, possibly a steam seal, peristaltic pump, diaphragm pump or single screw (mono) pump.
3. CIP Scavenge – self priming is the issue since the tank will not always provide a flooded suction to the pump. A self priming centrifugal pump with closed impeller, or a liquid ring pump. There was quite a lot of confusion with a number of candidates specifying a CIP supply pump instead of a scavenge pump. These are quite different duties and would be serviced by quite different pumps.
4. Additive dosing – a positive displacement pump would meet this duty for a metered flow, possibly against a high back pressure and cleanable. Diaphragm or peristaltic pump will do the duty.
5. Boiler Feed water - this requires a high pressure pump delivering 6 bar g. Whilst positive displacement pumps could do this duty, the multistage closed impellor centrifugal pump is ideal in terms of space, constant flow and working OK against a closed valve. Without risk of damage.

Question 10

Describe the factors to be considered when selecting and siting remote sensors in a brewery. [6]

Explain the concept of a Distributed Control System (DCS) and explain the advantages of such a system. [6]

Describe the purpose and operation of each of the following levels in computer control system architecture: -

Input/Output (I/O) interface. [2]

Programmable Logic Controller - PLC, [2]

Supervisory Control and Date Acquisition – SCADA [2]

Management Information System - MIS or MRPII level. [2]

This was by far the least popular question attempted by only 21 candidates and with only ten passing. Considering that most of our breweries are run by automated systems, it was surprising that more candidates did not feel confident to attempt this question.

In the selection and siting of sensors, the following should be considered:-

- The sensor needs to be appropriate for the intended use, for example for control or just for a rough indication
- Attention should be given to the accuracy, repeatability and reliability of the sensor, and of the whole system to which the sensor is connected.
- The range and span of the sensor should be suitable for the expected process variations
- The sensor needs to retain its accuracy after CIP or high temperature sterilisation – it must be capable of being over-ranged without damage.
- The fitting of the sensor into the pipe or plant needs careful design to avoid crevices and creating shadowing during CIP.
- The sensor location must be accessible for calibration and maintenance, but protected from the risk of accidental damage.
- It must be positioned so that it is able to "sense" the required parameter. For example it would be pointless to site a sensor in a dead leg where it did not 'see' the process fluids.
- In wet and dusty areas, the sensors, and their fitment, needs to be designed to the appropriate standard for safety (dust explosions) or water ingress such as IP 65 standard.

A Distributed Control System comprises a number of networked PCs, PLCs and control devices and is an alternative approach to having one large single computer controlling all the plant. It has the advantage of being less vulnerable to catastrophic failure, since the network can run with "hot standbys" – PC/PLCs that are running in parallel with the main PC/PLCs and can take over control seamlessly in the event of failure of one component. There is also less hard wiring required since the network handles the data transmission. At plant level, networks such as Hart, Profibus, Foundation Fieldbus or Devicenet can operate with Ethernet at the PC/SCADA level. International standards for networks allow connection of devices from different manufacturers onto the same system

I/O Interface - all signals from the plant, INPUTS, (photocells, proximity switches etc) and signals going out to the Plant, OUTPUTS (to operate valves, motors etc.) are routed through a gateway. This is usually panel mounted and provides the interface between the hard wiring to/from the plant and the PC/PLC wiring.

PLC – a device for controlling a batch or continuous process using software based on ladder logic; a symbol language understood by electricians. They are sometimes called step controllers since they were originally designed to take over the control from very basic step sequence machines such as card readers. They are rugged machines and can operate as stand-alone controllers, but will now most often be interfaced with higher-level systems, such as SCADA, MIS or MRPII.

SCADA – a PC based interface allowing easy information flow from PLCs and instructions to the PLCs. It usually provides the live plant mimics that are used by the operators to initiate and control the process stages, as well as providing real time information on the plant status. It provides the data gathering from which information systems can work to produce trends, reports etc.

MIS – takes data from the SCADA level and analyses the data for trends, plant performance etc and provides historical records. It will often interface also with logistic, financial and planning systems to provide information visibility across the company.

Brian Eaton

DIPLOMA IN DISTILLING EXAMINATION 2009

The 2009 Diploma examinations were based on a revised syllabus, but for cereal spirits the changes were minor. However, a more comprehensive examination based on all three of cereal, grape and molasses spirits was also introduced at the same time. The 2009 examinations were expected to be the first to include candidates from brandy and rum distilling. Specific papers for these subjects were required only for Module 1, but since no-one registered from these industries these papers were not used, and so are not discussed here. However, some candidates chose to answer the brandy and rum versions of questions of module 2.

Many of the 45 candidates sat only one module examination, but two passed in all 3 modules this year. I congratulate all 13 candidates who gained the Diploma in Distilling in 2009, 11 of them by passes over successive years. There were only five failures out of the 45, and that statistic is better than first appears since two of these candidates also sat other modules, which they passed. Commencing this year, the Examinations Office of the IBD will provide failed candidates with an indication of how well or badly they scored in each of their answers. However, the explanations in this report of what constituted good or bad answers must also be carefully considered in preparation for successful re-examination in the future. Fail marks were usually the result of insufficient knowledge, but you will see many times in the report that some were for answering a different question from that on the paper. It is essential to read the question carefully to understand what is required.

Module 1

This module attracted 22 candidates, and 21 passed: 10 at grade B, nine at grade C and two at grade D, with 61.0% as the average of the 22 marks. In accordance with its new specification, the Module 1 examination included a multiple-choice section covering raw materials and production of wort or grape must for cereal spirits, brandy and rum. As expected, since all candidates were from whisky distilling they scored well in the 10 questions based on cereal wort. However, there was considerable variation in the accuracy of answers on grapes and molasses. Some questions in each of these blocks of 10 questions certainly required the relevant knowledge, but the correct answers for others should have been deduced from a reasonable knowledge of any version of distilling. No one achieved a 100% score, but several came close and almost everyone scored comfortably above the pass mark in the new multiple-choice section of the examination. The questionnaire replaced two of the essay questions of previous years, so candidates had to write on only four of the six titles offered.

Question 1.
Discuss the value of the essential tests or measurements for assessment of a sample of barley intended for malting, and give a brief outline of each method mentioned. [20]

By specifying the essential assessments of a malting barley, I had intended to indicate that candidates could limit their answer to only a selected few important and rapid methods. However, some candidates with a different concept of "essential" gave very full lists of methods and their laboratory procedures, this was reluctantly accepted as a valid interpretation. The most important of the quality specifications are variety and physical appearance. The assessor has to determine visually the distinct physical attributes of an approved malting variety, that the sample is free of detritus, disease, and mechanical damage, and if the sample is accepted, that the bulk delivery matches the sample. Few papers specifically covered these practical details, but all discussed to some extent at least, visual inspection, moisture content and some test of germination or viability. Total nitrogen was usually included as well, although since I had not specified a grain or malt distillery as the eventual user, a wide range of N content would have been acceptable to my hypothetical maltster. Most of the 20 answers scored sufficiently high marks to give an average of 13.1/20, and all but one person passed.

Question 2.
Sketch the microscopic structure of barley endosperm. [5]
Give an account of the changes which occur in the cell wall, protein and starch of the endosperm during germination. [15]

With only one abstention, question 2 was even more popular, and produced an average mark of only 12.1/20, brought down by several marginal passes and one fail mark for a serious lack of understanding of barley structure. The accuracy and neatness of most of the sketches was much appreciated. The main part of the answer concerned both the enzymic activities and the resulting structural changes in the endosperm cell walls, protein matrix and starch granules, and the best answers gave very detailed accounts of the many different enzymes involved, and their effects. Some candidates who had already answered question 4 craftily referred back to that account of starch degradation, but in comparison with mashing, starch degradation should be only a minor part of the activity during germination and therefore not a major part of this answer. However, few thought to mention pitting of starch granules during malting. Even pitting across the endosperm indicates even malting, active amylase activity, and rapid hydrolysis during mashing.

Question 3.
Discuss the operational requirements of malt mills in both grain and malt whisky distilleries, and the advantages and disadvantages of roller and hammer mills for these purposes. [20]

All answers benefit from good organisation of the material, and question 3 provided an excellent example of that strategy: follow the instructions given in the question and a good mark is assured. "Operational requirements" effectively concerned the different malt grist analyses (which seldom included numerical values for grist fractions, unfortunately) for mash tun, lauter tun, mash filter, grain distilleries with or without grains in the fermentation, and of course how to handle the different texture of green malt. Although that information did not have to come first, it did comprise half of a good answer, and some candidates lost a few marks by concentrating too much on mill design. Comparison of roller and hammer mills was competently provided in most answers, and the best also included sketches. These were not essential in this instance, but neat and informative sketches are always appreciated in support of a good answer. However, I was surprised how seldom the removal of foreign material from the feed to the mill was mentioned. The 21 answers gave (marginally) the highest average mark of the module 1 examination, 13.2/20, although two candidates failed (again, marginally).

Question 4.
With the aid of a sketch showing the basic structure of amylopectin, give an account of the activities of malt alpha and beta amylases and discuss their importance to the mashing process in a malt whisky distillery. [20]

Answering question 4 with a straightforward account of the activities of the two specified enzymes, the various simple saccharide end-products, and the significance of the branch points would have scored a reasonable mark. Better scores required, for example, mention of temperature optima, viscosity and relating the answer specifically to malt distillery procedures; but only three of the answers were of that quality. I have commented in previous years on the poor understanding of biochemistry shown by some candidates; here we go again. For such a basic question on two important malt enzymes, the 19 candidates scored a disappointing average mark of only 11.2/20, brought down by four fail marks, three exactly on the pass mark, and another five whose scores were not much better. Absence of the requested sketch of amylopectin structure contributed to many of the poor marks,

Question 5.
Discuss the differences between mashing with malt or with microbial enzymes in distilleries using unmalted cereal, both in the mashing process itself and the composition of the final wort and wash. [20]

Answers to this question also had to show an acceptable knowledge of biochemistry, and how it relates to distillery practice. Only five candidates answered question 5: were they the only ones with experience of neutral spirit production? Perhaps not: although the different properties of bacterial and fungal enzymes in comparison with barley malt were discussed, unfamiliarity with the practical use of microbial enzymes was obvious in some answers. So the results varied from one excellent mark to two marginal failures. The amylolytic activity of barley malt is very temperature-sensitive, and the high-maltose product of malt enzymolysis is, essentially, fixed by the genetics of barley. Mixtures of microbial enzymes can be prepared for any desired product (glucose, maltose, etc) and operation at any desired temperature, within reasonable limits. Often the product is a 100% glucose wort,

which gives a very efficient fermentation but a different flavour profile in fermented wash compared with the 40–50% maltose wort from hydrolysis by malt. Although that is more relevant to module 2 of these examinations, module 1 candidates should be aware of these flavour implications.

Question 6.
Give a brief account of the likely origin, the effect on product quality and the procedure for removal, of each of the following possible contaminants of a water supply. (Candidate's choice of one specified harmful example of each): a bacterial contaminant. an inorganic anion, an inorganic cation, an organic compound. 4 × [5]

This question was even less popular: only two candidates took up my offer to choose their own subjects for discussion in the context of water quality, but both passed. It would be invidious to comment on the actual answers of only two papers; instead, here is my own suggested answer.

Since the first part concerns bacterial contamination of the water supply, that would eliminate *Legionella* (only a problem in recirculating water) as a choice. *Escherichia coli* would be the simplest to discuss: seldom dangerous itself, but indicating pollution by farm animals or domestic sewage, rendering the water unsuitable for use. Or if there was no alternative, used only after sterilisation, most conveniently done by UV radiation. For inorganic ions, I would have chosen either HCO_3, associated with hardness of water, or SO_4, creating sulphur problems, and either Ca or Fe, both associated with haze, and also discoloration in the case of Fe. All of these ions are most conveniently removed by appropriate ion-exchange resins. There are numerous industrial organo-halogen compounds, which should not be discharged in the first place, which persist through sewage treatment to contaminate downstream water supplies. That is an unlikely scenario for most Scotch whisky distilleries, so agricultural pesticides in farm run-off would probably be a better example for Scottish candidates to discuss as organic pollutants. Activated carbon should be effective in removing both types.

Module 2

The 73% pass-rate for the 15 candidates in this module was disappointing, but five passed at grade B, three at grade C and three in the upper half of grade D. In the 4 failures a common factor was the poor answers to questions 1, 3 and 4, which were all concerned with basic microbiology. Yeast and fermentation are important parts of the module 2 syllabus. Also, most of the candidates who failed answered only five questions. Perhaps they had not properly organised their 30 minutes per answer, but it is also possible that they preferred to concentrate on five that they hoped to answer well. I strongly advise candidates to attempt all six questions of modules 2 and 3. However little you think you know about the topic of your last desperate choice of a sixth question to answer, it is almost certain that you will gain more marks there, rather than by spending a little longer on the other answers. In fact, question 8, which scored by far the highest average mark over all three modules, was the last question attempted by many of the candidates (and they had not been answering in numerical order!)

In the paragraph dealing with question 5, I make the comment that several candidates seemed to be confused by cut points at alcohol strengths which were very different from their own distillery's practice. I regard that type of "what if . . . ?" question as legitimate for an examination on the theory of distillation, to show an understanding of the process. However, I must emphasise that knowledge gained from practical experience is often an important part of a top-quality answer. To include relevant personal opinion creates the good impression that the candidate is thinking about the implications of the question. Just to repeat the information in a text book will not score a high mark, although of course you are unlikely to fail. The examination should allow you to prove your knowledge of the science and technology of distilling, but please remember to keep it relevant. Again I refer enthusiastically to question 8, on sensory assessment, which gave a perfect example of this strategy with many excellent explanations of routine procedures.

Although this module examination was prepared for candidates from all three of cereal, molasses and molasses spirits, only one version of the examination paper was required. Some questions were equally applicable to all potable spirits. For the others, candidates could answer according to their choice of grape, molasses or cereal fermentations for spirit production. Because of the significant differences between the three types of fermentation and therefore what would constitute a correct answer, it was important to specify which had been chosen; this was explained in the instructions at the top of the paper. Although almost all answers related to cereal worts, it is a pleasure to record that Module 2 of 2009 was the first Diploma in Distilling examination also to provide answers on brandy and rum.

Question 1.
Give an account of the tests used to distinguish the genus *Saccharomyces* from other fungi. [10]
How is *S. cerevisiae* distinguished from other *Saccharomyces* species? [6]
Describe briefly one test by which a specific distillery strain of *S. cerevisiae* can be recognised. [4]

Only five candidates attempted question 1: the word attempted is very appropriate since most of the answers were disappointing and only one scored a pass mark. The poor answers concentrated on DNA profiling, which does have some limited relevance, but the most effective tests for the three types of identification are traditional biochemical and microbiological techniques. Certainly there are no alternatives to microscopic appearance and fermentative activity to distinguish *Saccharomyces* from other fungi (i.e. both moulds and other yeasts), and some discussion of the definitive properties was expected. Within the genus *Saccharomyces*, DNA can be used to distinguish species, but testing for specific fermentative patterns is easier (and cheaper?) However, with only one test to be discussed in the final section, the unique DNA fingerprint of a specific strain was an acceptable answer if properly explained, but various cultural methods were equally suitable, and probably more practicable for the majority of distillery laboratories.

Question 2.
Outline the mechanisms used by distillery yeast and lactic acid bacteria for recycling Nicotinamide Adenine Dinucleotide (NAD), and explain the relevance of these mechanisms to the flavour compounds (congeners) in the final beer, wash or wine. [20]

Since different flavour requirements affect "relevance", candidates were requested to specify which product, although of course biochemistry is identical in cereal, grape and molasses fermentations. This question also generated disappointing answers: although eight of the 10 attempts achieved pass mark or above, the average of the marks was only 10.3/ 20. The principal mechanisms of NAD recovery are production of ethanol and lactic acid by *Saccharomyces spp*. and homofermentative lactic bacteria respectively, and these pathways required explanation. However, question 2 also required an account of the effect of NAD recycling on flavour production. There are numerous other pathways which are less relevant to energy-yielding metabolism but very important in the context of production of flavour congeners. Higher alcohols and the precursors of diacetyl were two of the expected examples, and which appeared in the better answers.

Question 3.
Draw a diagram illustrating the progress of a fermentation for brandy, rum or cereal spirit, showing the changes in pH and concentration of alcohol, amino-nitrogen, yeast and fermentable sugar. Sugar can be expressed either as actual amount or indirectly as °Brix, °Plato or specific gravity. [8]
Explain briefly how these parameters are affected by (a) higher and (b) lower fermentation temperature [12]

The widely variable standard of answers continued with question 3, and repeated the 10.3/ 20 average. Although the majority of scripts showed graphs of, or at least acceptably close to, the correct shape, the common fault of lack of calibration of the axes lost marks. This was a more extreme example of different correct answers for brandy, rum and whisky fermentations, and it was essential to specify which was described. This time, answers were assumed to refer to cereal wort unless stated otherwise, and correctly mentioned the effect of lower temperature in slowing yeast growth, and up to about 33°, higher temperature increasing growth. However, only the best answers continued from there to discuss the effect of temperature on production of flavour congeners. In both parts, these faults were so common that many marks were either below or just on the pass mark, and of the 13 candidates attempting this question, three failed.

Question 4.
What are "wild yeasts"? [5]
Discuss the importance of these organisms to (a) the progress of fermentation for brandy, rum or whisky production and (b) the quality of the final distilled spirit. [15]

The significance of wild yeasts is also an important example of differences between the three types of fermentation: desirable for brandy, acceptable for dark rum, but definitely undesirable for whisky. The layout of the question was intended to show candidates that an expanded definition of wild yeasts (5 marks) and discussion of their importance (15 marks) should be provided separately, but many confused the marking system by running both parts together. Biochemically, there are two main types of wild yeasts and it was important to distinguish between their effects.

Aerobes are restricted to growth early in the fermentation but some are nevertheless capable of producing significant amounts of esters in that time. Facultative anaerobes grow throughout the fermentation, affecting both flavour and spirit yield. Not only are their metabolic products important, being different from distillery yeast, but the chemical structure of wild yeast cells could also affect the flavour of the distillate. Few candidates mentioned those occasional wild yeasts which produce zymocin "killer factor" against culture yeast: a possible hazard to "natural" mixed culture grape and molasses fermentations.

However, such contaminants are highly unlikely with pure culture distilling yeast, so their omission from a whisky answer was understandable. The 13 answers produced an unusual mixture of seven excellent and six fail marks with a wide gap between, probably making the average of 10.2/ 20.meaningless.

Question 5.
With the aid of a diagram, explain the development of flavour compounds (congeners) of different volatility over the course of batch (pot) distillation. [10]
Explain, and label the diagram accordingly, the effects of stopping the collection of spirit for maturation at 70%, 60% and 50% alcohol by volume. [10]

All but one of the candidates answered question 5: all passed, some with excellent marks and giving an average of 12.5/ 20. Although most graphs of distillation of congeners of different volatility clearly showed the sequence of their appearance in the distillate, the phrase "with the aid of a diagram" meant that it was to illustrate, not replace, a description in words. So several candidates lost marks in the first half by omitting the description.

For part 2, "label the diagram accordingly" required showing on the graph the different concentrations in the distillate at the time of the 70%, 60% or 50% cut.point. The question was prepared on the (unstated) assumption of a foreshots/ heads to spirit cut in the high 70s, or perhaps 80% abv, so some candidates, whose answers indicated they were accustomed to starting spirit collection in the low 70s, were perplexed by the ridiculously early 70% cut point used as one example. That was not a suggestion for actual production, I just wanted a prediction of what should happen with regard to flavour congeners. If you understand how stills operate you can predict the effect of different conditions from your own distillery's parameters.

Also, the 50% cut point was an extreme example of increasing the content of low-volatile congeners, e.g. peat phenolics. In general, answers showed a good understanding of the principle that the later the cut point, the richer is the distillate in low-volatile congeners. Additional comment on the implications of altered cut point on recycling of feints/tails was also welcome.

Incidentally, a 50% cut point does not necessarily make the spirit too weak for maturation, as some claimed. The alcohol concentration in the distillate is falling so quickly between 60% and 50% ABV that only a relatively small volume of weak spirit is collected over that time. So the % ABV of the bulk spirit must be significantly higher than the average of the ABV values at start and end of collection.

Question 6.
Describe one procedure for each of (a) starting up and (b) closing down a continuous still, in such a way as to minimise the production of below-specification spirit. 2 x [10]

Only four candidates answered question 6, clearly from practical experience of Coffey still operation although of course any type of continuous still for potable spirit would have been acceptable. All chose to answer in the form of an instruction manual, with added information on the significance of successive stages of the procedure, not only to maintain spirit quality, but to prevent loss of alcohol in water, wash/beer and hot and cold feints, also damage by pressure or vacuum. That approach was ideal, and all scored good to excellent marks according to the amount of explanation provided. However, it was certainly not my intention that the question could only be answered from practical experience alone. I had expected that a theoretical knowledge of still operation would be sufficient to work out where and when water, steam, beer/wash and spirit in its various forms should be turned on or off in the process.

Question 7.
Describe the maturation changes which result from contact between the spirit and the inner surface of the cask. [12]
State one method for enhancing these reactions, and explain briefly why it is so effective. [8]

All candidates answered question 7, some giving very good accounts of maturation in general which lost marks because they did not concentrate on, or in one case mention at all, reactions at the spirit/wood interface. So although there were some excellent marks, three candidates failed, and the average mark was 11.3/20. Since the inner surface of the cask must already have been heat-treated, high molecular weight structural components of the oak would be degraded to smaller compounds which could be extracted.

The principal components are cellulose and hemicellulose which provide sugars, and lignin, providing the various degradation products of the guaiacyl and syringyl series. Next in significance are tannins, and various other minor components which could be mentioned for a more complete answer, also extraction of colour. So discussion of the effects of these components on the spirit formed an important part of the answer to the first part.

Also, if the original heat treatment had progressed to charring, absorption of various unwanted congeners by the resulting carbon layer would have a significant beneficial effect. For the second part, scraping and re-charring, with a brief account of the chemical effects of charring, was the method I had in mind to enhance these reactions.

However, explaining the value of occasionally rolling the casks or transferring them to the different micro-climate of another part of warehouse were also accepted as valid answers.

Question 8.
Describe the procedures for one type of Difference Test and one type of Descriptive Test for sensory assessment and quality control of potable spirits. [12]
Discuss briefly the relevance of these two types of test to each of the following products: (a) gin, (b) vodka, (c) new-make pot-distilled spirit, (d) mature pot-distilled spiirit. 4 x [2]

Sensory assessment generated another variation on not answering the actual question, but with less drastic effect on marks. Only one example each of difference test and descriptive test was required for the 12 marks. To describe more was a waste of time, effort and ink. Question 8 was answered and comfortably passed by 11 candidates, generating the highest marks of the examination (average 15.7/20). Presumably this reflected frequent practical experience of the methods involved and assessment of the results, as I suggested in the introduction to this module report.

Module 3

In comparison with the minor changes to Module 2, at least for cereal-based spirits, the changes to the Module 3 syllabus were substantial enough that the final two questions of this paper covered topics which had not been specifically examined before. Of the 18 candidates, all passed: five at grade B, six at grade C and seven at grade D.

Question 1.
With the aid of a sketch of the column, explain the principle of hydro-selective distillation to purify the spirit for gin and vodka production. Show on the sketch the points of entry and removal of

all process streams. Label each stream with its approximate temperature and alcohol content, and its source or destination in other parts of the multi-column system. [20]

Operation of the hydro-selective purifier depends on the relative volatility of the unwanted congeners at different ethanol/water concentrations. The one failure was the inevitable result of completely omitting this aspect from a brief and rather uninformative answer. Otherwise, the eight answers to question 1 adequately explained the principle with the aid of a sketch illustrating the dilution of the alcohol stream by hot water and steam, and the removal of pure spirit, heads and feints.

Despite a specific request, one candidate omitted to sketch the column and associated pipework, but the written explanation was of such a high standard that, for once, a good mark was still justified. Future candidates please note, however, that the loss of marks from failing to provide a requested sketch could mean a fail mark for that answer.

Question 2.
Describe briefly, with a simple sketch of each system, the operation of a Steam Thermo-compressor and Mechanical Vapour Recompression. Give one example for each, describing their importance in energy management. [20]

Since the question specified a sketch of each system I expected some indication of its relationship to associated equipment, as well as the sketch of the "compressor" itself. For the type of thermocompressor described in all seven answers, associated with steam generation for a continuous still, simply to indicate the input of hot spent wash and the origin and destination of steam through the venturi was sufficient. Also, some very commendable drawings were provided of MVR in drying plant for pot ale or spent wash. Since for many of the candidates it was their final answer of the paper, I could not know whether describing only one energy recovery system reflected lack of knowledge, or lack of time. But for whatever reason, there were only four answers complete enough to pass.

Question 3.
On the assumption that three of the factors for charging for effluent treatment are within the control of the distillery, describe briefly one possible way to reduce the contribution of each factor to the total cost. [10]
Give a brief account of two methods for removal of copper from still efflent. [10]

In Britain, effluent charges are calculated by the Mogden formula and I understand that most countries have a similar system. Therefore I expected the three factors to be discussed for the first half of question 3 would be daily volume, BOD and suspended solids content. I had intended the question to encourage discussion of recycling to reduce these amounts, but how to reduce BOD and SS by on-site treatment prior to discharge was the usual interpretation, and there were many good answers to that version.

The second half required a description of two methods for removal of copper. It is highly unlikely that a distillery would use both together, but brief descriptions, for 5 marks each, were required of two possibilities. A simple reed bed was acceptable for one, although methods which allow for copper recovery were preferred, and electrolysis, ion exchange or chemical precipitation appeared in the better answers. Another possibility, although not mentioned by anyone, was extraction by micro-organisms.

Unfortunately two of the answers included little or nothing on copper, so despite good answers to part 1, inevitably could not reach the pass mark for the complete question. Future candidates please note! Twelve answers are sufficient to justify quoting an average mark, which was 11.5/ 20.

Question 4.
Define convection and radiation in the context of heat transfer and describe briefly their relevance to pot stills. [7]
Ignoring the temperature gradient across the structural copper, calculate from the data at the end of the question the heat lost by convection and radiation from 1m^2 of still neck surface when the temperature of the spirit vapour is 90°C. [5]
Given that condensation of the spirit vapour as reflux contributes 90% of that lost energy, calculate the amounts of ethanol and water at 90°C which are condensed per minute on 1m^2 of still neck surface. [8]

Data:

Ambient temperature of still house	*20°C*
Convection heat transfer coefficient from still surface	*10 W $m^{-2}K^{-1}$*
Stefan-Boltzmann constant	*5.67 x 10^{-8} W $m^{-2}K^{-4}$*
Emissivity of still surface	*0.5*
Latent heat of condensation of ethanol at 90°C	*840 kJ kg^{-1}*
Latent heat of condensation of water at 90°C	*2235 kJ kg^{-1}*

Vapour temperature 90°C corresponds to alcohol concentration 60% by weight.

The calculations should have provided inspiration to include heat loss from the still surface in the discussion of convection and radiation: according to the first calculation, convection accounted for 71% of the heat loss at 90°C. Of course, convection within the still is also involved in heating the charge.

However, since the question referred to a distillery context, not specifically distillation, other examples were also welcome and appeared in the best answers. In the second calculation, several were wrong by factors of 60 or 1000 (which should give a clue about the nature of the mistake!) from the correct answers 23 kg min^{-1} of alcohol and 15 kg min^{-1} of water.

However, marks are awarded for correct stages of a clearly explained calculation even if the final answer is wrong. Question 4 was answered by 16 candidates, of whom 13 passed, some with excellent marks; the average mark was 11.9/20. Incidentally, I have no experimental data that 90% of the heat lost from the still comes from condensation of reflux; that was just a guess for the purposes of the calculation,

Question 5.
With the aid of any necessary sketches and graphs, describe the basic design features and pumping characteristics of (a) a centrifugal pump, and (b) a diaphragm positive displacement pump. 2 x [7]
State one typical distillery application for each type of pump, and explain briefly why it was chosen for that duty. [6]

With hindsight, the phrase "any necessary sketches or graphs" was an unfortunate idea to allow candidates to decide how many visual aids were required to answer question 5. For most of the 16 answers it had obviously been decided that the graphs of pump performance which I expected were not necessary, and one of the two given a fail mark provided no sketches of pumps either. Competent explanations usually compensated for the absence of graphs, but not always. Drawings of pumps varied from excellent to adequate, and the question was well enough answered to give an average of 12.8/ 20.

Question 6.
Discuss the possible uses of stainless steel as material of construction of the principal items of process equipment and their components, for production of potable spirits. [14]
Discuss the advantages and disadvantages of stainless steel for these purposes. [6]

Although a brief introductory account of the composition of the range of stainless steels was useful in the context of their specific properties and therefore value for particular purposes, the detailed analyses in some answers were unnecessary. The answer to the first part of question 6 should have concentrated on discussion of the process plant which could usefully be constructed of stainless steel. Essentially, that was "almost everything" expanded to justify 14 marks, with the advantages (e.g. durability, hygiene) and disadvantages (mainly specific types of corrosion, poor heat transfer and sulphur notes in distillation) discussed for the final 6 marks.

In 13 of the 17 answers, quality ranged from adequate to excellent, but the average over all the marks was a disappointing 10.5/20, brought down by four candidates who concentrated so much on irrelevant analytical data that they could not achieve a pass mark. Practising on previous examination papers is commendable, but repeating these practice answers for different questions is not.

Question 7.
Outline the manufacturing processes for glass or PET bottles for potable spirits. [12]
Discuss briefly the advantages and disadvantages of both materials on the packaging line and in subsequent handling. [8]

Fifteen candidates answered question 7, almost all describing glass manufacture, many in impressive detail with accompanying sketches. Assessment of glass vs PET was also competently presented in all but one of the answers; most used tabular presentation, and very effectively. In the exception awarded a fail mark, the candidate had obviously left too little time to complete that part of her/his last question. However, this question generated the best average mark of module 3, 13.5/20.

Question 8.
Summarise the fire and explosion hazards associated with distilling, maturing, packaging and the storage of potable spirits, and describe the necessary safety precautions. [20]

For British candidates, the perfect answer was a summary of the Health & Safety Executive booklets which presumably all had read on numerous occasions. No doubt other countries provide similar information. The question concerned four specific activities of distillation and subsequent processes, so the dust hazards of grain handling were irrelevant, and one candidate's detailed explanation to the exclusion of all else, inevitably failed. Alcohol was not specified in the question because it should have been obvious that it was the principal hazard in distilling, maturation, packaging and bulk storage. There were some excellent assessments of hazards and safety precautions, but others were remarkably uninformative considering the candidates' personal involvement in the topic. To give just one example, I was surprised how seldom numerical values were quoted for flash point, or the concentration of alcohol creating an explosion risk. So the average of the 14 marks was only 11.6/20.

Iain Campbell

DIPLOMA IN BEVERAGE PACKAGING EXAMINATION 2009

2009 has been the second year for this examination, and for the first time had all three modules available for candidates. However, this year no candidates applied for Module Three, therefore the following report covers only the first two modules.

Nine candidates sat both Module One and Module Two – with the results from both modules having a pass rate of 89%, thereby giving an overall pass rate of 89% across both papers.

Each Unit of the Diploma in Beverage Packaging was assessed in three components, viz. assignment (35%), short answer questions (30%) and one long answer question (35%). The unit scores were then combined to give an overall mark and grade for the Module. As with the Diploma in Brewing, an overall pass in the Diploma is only awarded when all three modules have been successfully completed. As this is only the second year, we still have not had any candidate complete the overall Diploma qualification – although this will hopefully happen next year.

Whilst detailed commentary for each unit section is given in the report below there were some common themes which need to be brought to the attention of candidates.

The overall standard of the assignments showed an improvement this year compared to last, possibly helped by the revised guidelines – although some areas continue to be regular issues. The key areas looked for were relevance to brief, quality of discussion, range of references accessed and appropriate use of them, extent of analysis and evaluation, comment and originality. The length and depth of the assignment was a challenge for some candidates – with some assignments being overly brief and other producing a reference tome for the examiner. The use of references and acknowledgements at the end of the assignment is an area which generally most candidates could still do to improve upon.

The short answer questions were a mix of ten multiple-choice and five short answer questions which were designed to test the candidate's breadth of knowledge of the overall syllabus. It was pleasing to see that this was generally well attempted in most units, although calculation questions which required a candidate to apply their knowledge into a practical workplace situation left most candidates lacking.

The long answer question section required the candidate to choose to answer one question from two. These questions were set at a similar level to those used in the Diploma in Brewing and are designed to test a candidate's in depth knowledge of a particular area of the syllabus. These questions tended to show which candidates had only a superficial knowledge of their chosen subject, whilst good candidates were able to provide excellent answers – although the majority of candidates were weak on their knowledge of the brewing and hygiene topics.

Ruth Bromley

Module 1:
Unit 1 – Packaging Theory and Materials

a) Assignment
For a high volume primary packaging material of your choice, outline the manufacturing process and its route through the supply chain to its point of use.
Demonstrate your understanding of the full specification of your chosen primary packaging material by assessing critically its suitability and match to the process.
With today's emphasis on cost reduction investigate ways in which the cost of this material can be reduced through changes to specification and procedures. Explain the implications that may arise as a result of the changes which you propose. Estimate any potential savings that can be made within your site.

This assignment was designed to motivate thinking in terms of material suitability for the task, and ways in which costs can be reduced for a chosen material. These are key elements with regard to packaging and they need to be well understood by all that are involved in packaging management.

With a couple of exceptions, submissions were disappointing in their lack of detail and understanding with regard to the savings that can be made on the chosen material. For example, the bottle was a popular choice (75%) and one obvious way to reduce costs is light-weighting. That is clearly a good option but there will be implications which could arise such as number required, design, shape, vacuity, fill level and breakage. These were, in most cases, not mentioned.

It is important that the question is read carefully. In two instances a complete detailed description of the manufacturing process was given when only an outline was requested. For one of them this oversight extended the assignment to 6500 words, when only 2500 words are asked for.

The candidates need to remember that they are marked under the headings of:
1. Relevance to brief (20)
2. Quality of discussion (20)
3. Range of references accessed and appropriate use of references (10)
4. Conclusions and outputs form the report (10)
5. Extent of analysis and evaluation (20)
6. Comment and originality (20)

Jeremy Browne

(b) Short Answer Questions

The strongest candidate achieved 18 correct answers out of 20 with the weakest achieving just 12.

The questions on which that candidates performed the poorest involved glass bottle treatments and colouring agents, metal can seams, modes for improving PET barrier properties and paper label manufacturing.

The multiple choice questions spanned the entire syllabus including in some instances requiring short computations. Candidates had most difficulty with gas quality specifications and mixed results with the computational questions. All candidates displayed good knowledge of CO_2 liquification processes. All candidates could clearly articulate differences between primary and secondary packaging materials.

(c) Long Answer Questions

Question 1 – Can/bottle manufacturing
Selecting EITHER glass bottles OR metal cans, describe the processes required for manufacturing and delivery of these containers to the brewery. [15]
Write brief notes on the quality assurance steps which should be observed throughout the manufacturing process. [5]

Six candidates chose this question and five passed. Three candidates chose to discuss can manufacturing while the other three discussed bottle manufacturing. The examiner wanted to see a logical flow path for either operation with key steps and their function described in moderate detail. This task required candidates simply to follow the path of production from raw materials to delivered, finished containers at the brewery. Better answers included discussion of both online and offline quality checks.

Question 2 – PET packaging
Present a SWOT (strength, weakness, opportunities, threats) analysis of plastics as a material to replace glass or metal for beer packaging. [14]
Discuss current factors that limit the expansion of plastics for small pack beer packaging. [6]

Two candidates chose this question and both passed. An example of a SWOT analysis for PET packaging was presented in the learning materials. While the examiner was not looking for a memorised regurgitation of this analysis, an understanding of the strengths and weaknesses of PET packaging, in general, would allow a candidate to complete this type of analysis. The second part offered candidates the opportunity to discuss why PET packaging has not expanded appreciably. Surprisingly, the main factor (cost) was not discussed by either candidate as being the main factor limiting expansion.

Tom Shellhammer

Module 1: Unit 2 – Beer Appreciation

(a) Assignment
From a flow diagram of the brewing process, identify the points where oxygen can influence the quality of the final product. Explain why and how.
For a single product gather enough information from each of the key stages to identify the degree of variation and any trend in dissolved oxygen levels in relation to the dissolved oxygen specification at that stage.
Recommend and justify any changes which could be made to dissolved oxygen control and specification to improve the final product.

Six assignments were submitted with two attracting good marks. It is important to read the assignment questions carefully and make sure that the submission fully answers these questions. There was a tendency to only gather data from parts of the process rather than all key stages through to in package. Enough sets of data needed to be collected to identify both the degree of variation and trend at each stage. References need to be referenced both in the reference list plus in the text using the Harvard convention. If possible not only should all the assignment tasks be tackled but also the spirit which is to identify possible areas in your process for performance improvement.

Eric Candy

(b) Short Answer Questions

This section was based on 10 multiple-choice questions (10 marks) set at General Certificate in Brewing (GCB) standard and short answer questions also worth 10 marks. For this section, candidates' results ranged from 13 to 18 marks (out of a total of 20).

A few multiple-choice questions, somewhat surprisingly, caused several candidates some problems to answer. For example, it would be expected that most candidates would know that the best conditions for encouraging carbonation are low temperature and high pressure and that silica hydro-gel absorbs proteins. Finally, it was somewhat disappointing that so few candidates knew that the most likely result of a slow fermentation, from the options given, was a high pH value in the final beer.

Apart from Q14, on factors influencing minimum and maximum storage times in a bright beer tank prior to packaging, the short answer questions were quite well handled. Most candidates described prolonged cold storage, addition of finings or silica hydro-gel or centrifugation as means of reducing solids content of beer prior to filtration and also correctly identified the safety hazards associated with CO_2.

However, not all candidates identified that levels of beer colour and bitterness can be adjusted on transfer to cold storage.

(c) Long Answer Questions

Candidates had to select one question from a choice of two. Two candidates elected to answer Question 1, with 4 choosing Question 2. In the main, the answers to question 1 were satisfactory, but most answers to Question 2 were somewhat superficial and rather disappointing.

Question 1 – Beer Filtration
a) Describe the theoretical basis of powder filtration techniques for the production of bright beer. [4]
b) Outline the designs of filtration systems available for powder filtration of beer and briefly compare their relative advantages and disadvantages. [8]
c) Write brief notes on the principles, and application to beer production, of:
(i) membrane filtration and [4]
(ii) cross-flow filtration. [4[

For part (a), the examiner was expecting candidates to be able to describe the essential features of Darcy's equation, explaining the relationships between flow rate, permeability, viscosity, filter surface area, differential pressure across the bed and filter bed thickness. A short explanation of operating procedures for pre-coating and the need to continually keep the surface of the bed open by addition of body feed powder was also anticipated.

In part (b), answers should have outlined the various designs of filtration equipment available, including candle, horizontal and vertical leaf, and plate-and-frame filters, with a short description of plant layouts (in-line chiller, pre- and post-filter buffer tanks, and trap filter), but also brief comparison of the relative benefits of the different designs.

For part (c), the answers should have included descriptions of membrane filter systems and their uses, both in (i) "dead-end" formats (especially for use in sterile filtration applications) and (ii) as cross-flow filters. The application of novel beer filtration systems now based on cross-flow was clearly not understood, whereas there have been several references to major company installations world-wide in recent years in many publications.

Question 2 – Beer Quality
Write notes on TWO of the following topics.
a) The influence of oxygen on beer flavour formation and stability during fermentation/maturation and throughout package shelf life. [10]
b) The principles of beer foam formation and factors influencing its stability. [10]
c) The production procedures which may be employed to stabilize beer against the formation of non-biological haze and the methods available for predicting the potential for development of such hazes. [10]

Options (a) and (c) were answered by the majority of the candidates, but in nearly all cases the responses were rather poor, with some low marks scored.

In section (a), all candidates were aware of the importance of dissolved oxygen control during beer processing and packaging in relation to resistance to development of stale flavour characteristics during storage of packaged beer. Also, the need to ensure package integrity (crown seals, can seams, keg spear seals) was discussed, some candidates noting the value of oxygen scavenging crowns for bottles. Very few candidates commented on the necessity for oxygen barriers for PET bottles.

Disappointingly, there was little commentary on the actual flavours associated with staling (such as papery, bready, cardboard characters and increased sweetness) and no information on the potential reactions involved.

Most answers discussed the benefit of low temperature storage of packages and identified some of the practical difficulties associated with widely varying ambient temperatures, especially the risk of freezing.

No candidates actually provided any information on beer flavour development during fermentation as a direct consequence of wort oxygen levels, for instance influencing the production of esters and no candidates mentioned flavour developments associated with bottle-conditioned products nor noted that bitterness tends to be reduced on prolonged storage, mainly due to oxidation of iso-α-acids.

For section (b), the examiner was expecting well balanced answers describing the formation of gas bubbles as a consequence of nucleation, with detailed discussion of stabilisation of bubbles leading to foam formation, by hydrophobic proteins, with contributions from glyco-proteins and iso-alpha acids. The influence of nitrogen generating smaller bubbles and hence enhancing foam stability is also relevant. A detailed discussion of foam positive and foam negative factors, derived from raw materials, exerting influences depending on brewing and packaging process operations was also expected, with comments of the impact of retail dispense procedures.

Surprisingly, section (c) was only poorly answered. Most candidates were able to identify the most likely sources of haze material in beer, with the correct emphasis on the role of oxygen in oxidising polyphenols and interactions between polymerised polyphenols and polypeptides leading to chill haze and permanent haze formation.

However, the 'meat' of the answer should have addressed production procedures employed to stabilise beer against haze formation and no candidates provided good responses. Only poor descriptions of the relevance of cold storage of beer prior to filtration were given and very few answers included details describing the use of silica gels (either hydrogels or xerogels) or tannic acid or papain to remove sensitive proteins/polypeptides or PVPP to remove polyphenols, which are, of course, the major factors to be involved in stabilising beer against haze formation!

Even worse knowledge (or, more precisely, lack of knowledge) was displayed with regard to methods available for predicting haze stability. These can include classical "forcing" tests, of which there are several, but all involve one or more cycles of alternating exposure of beer packages to elevated temperature (up to 60°C), followed by at least 24 hours at 0°C, finally measuring the haze developed by assessing turbidity. Most companies have their own favoured procedure for these "Prolonged Heating and Cooling Tests". Other methods involve measuring the amount of "sensitive" protein present in beer (such as, by precipitation with saturated ammonium sulphate solution), or measuring the polyphenol concentration (by reaction with PVP). Also rapid chill tests (such as the Chapon test) are also useful, involving addition of alcohol and holding the treated beer at -8°C for 40–60 minutes and measuring the turbidity.

David Taylor

Module 1:
Unit 3 – Beer Preparation, Micro Stabilisation for Packaging including Small Pack Filling Operation

(a) Unit 3 Assignment

For this assignment you will look at the advantages and disadvantages of switching from tunnel pasteurisation on small pack lines to another form of beer stabilization and make a case for the change.

In the assignment the financial, operational (including filling operations), safety and microbiological implications should all be explored.

The conclusion should give your clear recommendations as to what form of beer stabilisation your company could adopt in the future and why.

This was a well discussed topic due to the interest in reducing energy consumption and improving beer flavour through achieving a fresher taste. It is hoped that, in most instances, these studies will have provoked good discussion in the individual candidate's breweries.

In the main these studies were well researched and some interesting conclusions were reached. The comparisons were in most cases between tunnel pasteurisation, plate pasteurisation and sterile filtration. One candidate also mentioned laser infrared radiation (LIR) treatment which is not yet commercially available.

Poorer studies were not challenging enough and were limited in their scope and therefore analysis.

Jeremy Browne

(b) Short Answer Questions

Eight of the nine candidates passed this section of the exam. For the passing candidates, the strongest candidate attained 100% correct answers while the weakest only 50% correct.

The multiple choice questions examined candidates knowledge of the means by which beer is prepared for packaging. All candidates could identify factors which would affect filling volume and hence had an understanding of handling carbonated liquids. Many candidates did not seem familiar with the temperature dependency of pasteurisation and thus could not estimate PU accumulation by examining a time-temperature chart. Surprisingly, many candidates struggled to complete the diagram for a regenerative plate heat exchanger for flash pasteurization. Candidates had difficulty articulating the difference between nominal and absolute filter ratings. Most candidates could articulate the purpose of a widget but very few correctly presented the principle upon which the widget works.

(c) Long Answer Questions

Question 1 – Gas control

Discuss the potential impact on beer quality resulting from a lack of control over the concentrations of both CO_2 and O_2 during packaging. [10]

For a package format of your choice (large or small pack), list and then briefly describe the measures taken to control gas concentration as beer moves from a bright beer tank to the point at which the container is filled. [10]

Four candidates chose this question and all passed very well – averaging 84% of the marks.

The first part asked the candidates to discuss the implications for under- and over-carbonation as well as high dissolved oxygen levels and answers were very complete in this area. The second part was also well answered with the best answers methodically working from the bright beer tank all the way to filler discussing means of excluding oxygen or control carbon dioxide at each point.

Question 2 – Pasteurisation

Define the term Pasteurisation Unit and discuss how it was developed including the theoretical basis upon which it is founded. [8]

List typical pasteurisation specifications for various beverages that may be packaged in a brewery. [4]

Describe the basic principles of design, operation and control of a modern tunnel pasteuriser. [8]

Five candidates chose this question and four passed. Passing candidates averaged 65% of the marks on this question.

In the first section the examiner was looking for more than a historical presentation of who studied pasteurisation. Rather, the examiner wanted a clear definition a PU, explanation of the relationship between thermal death of an organism and its temperature sensitivity - a discussion of D and z values would have been very helpful to this discussion. A presentation of PU ranges for different products came straight from the

learning materials. For the last part, the examiner was seeking discussion of a tunnel pasteuriser's basic features (drawings helped), examples of temperatures and time, PU verification and control, as well as water treatments for chemical and biological control.

Tom Shellhammer

Module 1:
Unit 4 – Quality and Hygiene

(a) Assignment
For a packaged product of your choice, describe the Quality Management System in place that ensures that the product in trade, up to the best before date, is not only free from infection but also both the flavour and appearance are free from the effects of infection.
Provide details of the checks that are currently in place for both product and materials.
How could this system be improved towards achieving zero defects? (Please note as per the assignment guidance do not include direct copies of company procedures, statistics etc)

Eight assignments were submitted with two attracting good marks. It is important to ensure that the submission fully answers the assignment questions. There was a tendency for submissions not to concentrate on specific checks on the chosen packaged product. A specific analysis of how and when checks are carried out through the process was required. A review of complaints and product over time post packaging needed to be included. This would have enabled a critical review of how and when the current checks are carried out. Again references need to be referenced both in the reference list plus in the text using the Harvard convention.

Eric Candy

(b) Short answer questions

For the ten multiple-choice questions, the number of candidates' correct answers ranged from 2 to 7. The range was from 7 to 9 for the five short answer questions.

The multiple choice questions demonstrated the candidates general lack of knowledge on the details associated with plant CIP and design, with the only question completed well by all candidates linked to their knowledge of *Legionella* risks within the packaging process.

In general the short answer questions were very well handled, with candidates demonstrating a good knowledge of both CIP and health and food safety aspects connected with the process.

(c) Long answer questions

Candidates had to select one question from a choice of two. Question 1 was answered by two of the candidates, with the remaining seven choosing to answer question 2. Neither question was particularly well answered, with only three candidates managing to score more than half marks on either question in this section.

Question 1 – Production Hygiene Requirements
Compare and contrast the two main types of spray systems in use in a brewery for vessel cleaning. Include within the answer the best types of application for each, the factors affecting the choice of spray system and the maintenance regimes required for each. [12]
List the microbiological sampling schedule that should be in place to monitor the effectiveness of the CIP for a keg production line. [8]

The comparison of the two main vessel cleaning systems was generally not well covered by either candidate. A good answer would have covered the operation of both static and rotating spray ball systems, their best applications within the different areas of the brewery along with the different chemical and cycle regimes which can best be used with each style of application. In addition to this the comparison of the cost of each application as well as their maintenance requirements should have been included to allow an overall view to be portrayed.

Question 2 – CIP Systems
Draw the diagram of the CIP circuit for a bright beer tank in use on a packaging line. In the diagram identify all measuring devices and their positions. [10]
Explain the choice of chemical(s) used in the above CIP circuit, the strength at which they should be used and their frequency of use. [6]
List any safety considerations that should be in place during the above CIP in an operational production department. [4]

The diagram of the CIP circuit was generally very poorly completed by the majority of the candidates who attempted this question. A good diagram included the details of all of the vessels, devices and interconnections required to complete the circuit, including labelling of each item along with it's descriptor, and sizes of tanks and pipe diameters for the system.

For a bright beer system then the chemical selection was very poorly understood by most candidates, with many selecting very strange combinations of chemical selection and strength – with the worst being 5% hot caustic. A good answer would have covered the type of soil expected in a packaging bright beer tank, the best chemical to address this along with the type of cleaning mechanisms, frequencies and durations required, along with any non-standard cleans which may be required on a less frequent basis.

The safety considerations were generally addressed in a more structured manner by the candidates and included PPE, gas, chemical and risk awareness implications, hazard awareness of the chemicals being used, the purpose of the MSDS (Manufacturers Safety Data Sheet) for any chemicals used as well as the area of use.

Ruth Bromley

Module 2:
Unit 5 – Small Pack Handling Operations

(a) Assignment
Carry out a study of a small pack line in a packaging plant of your choice and identify the unit operations and personnel activities that take place during its operation.
Either:
If your selected line is non-returnable look at a single secondary packaging machine in detail. Demonstrate your understanding of the operational procedures (including changeovers), maintenance schedules and annual maintenance. Go through the records and establish the main reasons for downtime and see if the issues are being properly addressed through methods of operation and maintenance. Make a case for any improvements in order to reduce the downtime.
Or:
If your selected line is returnable, the study must cover unpacking, packing and crate/carton handling. Demonstrate your understanding of the operational procedures (including changeovers), maintenance schedules and annual maintenance. Go through the records and establish the main reasons for downtime and see if the issues are being properly addressed through methods of operation and maintenance. Make a case for any improvements in order to reduce the downtime.

This assignment was only reasonably well tackled. It was looking for an understanding of a chosen packaging line and then to take a closer look at a machine for non-returnable bottling or the un-packaging/packaging operation for returnable bottling.

There was one outstanding submission which would clearly have benefited the candidate's brewery, and that is ultimately what needs to be achieved with these assignments. One other gave excellent observations. The rest were rather ordinary. One submission read like a manual, another was muddled; others gave little or no analysis.

For assignments such as these, it is important to dig deep into detail and really find out what is going on. It is only when you understand the detail that you can really become an effective packaging manager.

Jeremy Browne

(b) Short answer questions

For the ten multiple choice questions, the number of candidates' correct answers generally ranged from 4 to 6, with only one candidate scoring 8. The general range was from 5 to 9 for the five short answer questions, with one candidate gaining full marks.

In the multiple choice section the candidates did not generally demonstrate a good knowledge across all the different types of small pack operations, with bottling knowledge being the weakest area – both returnable and non-returnable formats.

On the short answer questions the knowledge demonstrated was generally better, although the lack of bottling knowledge again let some candidates down on some fairly fundamental aspects of this format of packaging.

(c) Long answer questions

Candidates had to select one question from a choice of two. Question 1 was answered by three of the candidates, with the remaining six choosing to answer question 2. Question 2 was generally answered better by those candidates who selected it.

Question 1 – Returnable Bottling
Describe, with the aid of a diagram, the operation of a returnable bottle washer. Ensure each section is clearly labelled. [10]
What precautions must be taken to maximise the safety of personnel during the operation? [4]
List the key routine maintenance tasks and their frequency. [6]

The diagram of the returnable bottle washer was generally very poorly approached by the three candidates. A clear diagram explaining the different stages of the process would have helped the candidate, as the process description would have flowed through as the candidate would have the ability to walk the examiner through the process. Each stage of the washer has its own task and contributes a different quality aspect to the bottle cleaning process and this should have been clearly detailed by the candidates. In addition to the process description the candidates should also have included the chemical types, strengths, temperatures and timings at each stage should also have been included in a good answer.

The safety precautions which should be in place for the personnel were not generally well answered, which is a large concern as this is a direct impact on the welfare of the employees. The answer should have addressed training opportunities for staff; chemical, plant and material awareness; operational hazards and how the correct use of PPE could address or minimise these.

The key maintenance tasks should have covered off both shift based operating maintenance and observation tasks, as well as the operational and legal maintenance requirements which are required over weekly, monthly, six monthly and annual periods of time. There was a very limited recognition of the power that observation of the operational line could add to the preventative maintenance regime. Generally the answers submitted only looked at weekly engineering based tasks, and were very restrictive in their views. Only one of the candidates also recognised that the chemical analysis of the different stages of the bottle washer was also a critical part of the plant – as this could both damage the infrastructure of the equipment, whilst in parallel putting the quality of the bottle cleaning at risk if done incorrectly.

Question 2 – Canning
Draw a flow diagram of all of the key items of plant and equipment required on a canning line, including all relevant machine speeds. State any assumptions made in terms of can size and market format. [9]
Explain the key areas of loss in performance (beer, material or plant efficiency) that would be expected at each stage in the process, including typical performance figures within the answer. [7]
List any checks that are made in the packaging process to verify the product integrity before it is despatched to market. [4]

Most candidates demonstrated their knowledge of the key items of plant in the canning line and generally got them in the correct order. However the information provided regarding machine speeds and operational capability did not always relate to the can sizing and market format information. Better candidates also included a V-graph of the line operation and used this to explain the rationale behind the sizing of the different pieces of equipment, as well as their overall function when combined together as a line.

The second section of the question was looking for candidates to build on the detail provided in the first section to explain how the performances were affected both on each machine and then how these losses in performance are then multiplied together to determine the overall line performance.

Generally, most candidates only focused on the machine related losses, with limited commentary given to beer and material loss impacts – both in terms of time, performance and not least cost impact.

The product integrity checks detailed were varied – perhaps depending on how much time each candidate had left at this stage of the exam. These should have covered off beer quality, packaging quality, legal and regional requirements as well as visual checks on the pack prior to despatch.

Ruth Bromley

Module 2 : Unit 6a – Large Container Packaging Operations for Kegs

(a) Assignment
Select a system (e.g. pallet, locator board, cradles, etc) of your choice for unitising kegs and justify the selection of this system within a supply chain.
Describe how kegs are de-unitised and unitised on a packaging line of your choice. Discuss the alternative methods available and justify the selection of the chosen method. Recommend and justify any changes which could be made.
By monitoring performance, calculate the availability of kegs for both the de-unitising and unitising operations. Identify the reasons for any loss of availability. What recommendations would you make for potential improvements?
Draw up a maintenance schedule for this equipment identifying the frequency of each maintenance task.

Five assignments were submitted with two attracting good marks. Again it is important to ensure that the submission fully answers the assignment questions. Quantification of availability of de-unitising and unitising operations would have helped for more detailed analysis and evaluation. More detailed analysis and evaluation enables more detailed and specific conclusions and outputs. References need to be referenced in text in addition to reference list at end. Harvard referencing style must be used. Some assignments made good use of graphs and pictures with a good discussion and critical conclusions.

Eric Candy

(b) Short answer questions

For the ten multiple choice questions, the number of candidates' correct answers ranged from 3 to 7. The range was from 2 to 7 for the five short answer questions.

On the multiple choice questions, the candidates demonstrated a reasonable theoretical knowledge of the operation of a keg line, but showed large gaps in their application of this knowledge to the actual operation of the line – not knowing basic size change or steam sterilisation principles.

The short answer questions were generally poorly answered, with the exception of candidate's knowledge of the rationale for external washing. It is disappointing that candidate's knowledge regarding how the kegs are dispensed was virtually non-existent – with only one candidate scoring any marks on this question.

(c) Long answer questions

Candidates had to select one question from a choice of two. Question 1 was answered by four of the candidates, with the remaining three choosing to answer question 2. Both questions were generally well answered, although one candidate obviously found this section challenging.

Question 1 – Kegging Production
Choosing either a linear or rotary filler describe, with the aid of a diagram, the cleaning and filling process for a 50 litre stainless steel keg. Include all times, temperatures and details of any chemicals required. [14]
Describe the checks (automatic or manual) which should be carried out on the whole keg packaging line to ensure that the finished product complies with all local legislation and regulations. [6]

The description of the keg cleaning and filling process was attempted by all candidates, but with some only providing very restricted diagrams. A good answer would have shown a diagrammatic interpretation of the keg at each stage with an accompanying description of what was happening at the stage. By using the diagram at each stage this should have provided a prompt to the candidates to help with the description. The chemical, time and temperature data provided for each stage of the process was variable – with a good answer covering the information at each stage, as well as the risks of using the incorrect data.

Question 2 – Kegging Hygiene & Despatch
Explain the tasks and checks that should be undertaken to ensure that there is no microbiological contamination of the beer on a kegging line. Include the frequency of any checks and details of any corrective actions required if a breach of sterility occurs. [10]
Describe the different systems available for the palletization or transfer of filled kegs into the primary distribution system. Explain the advantages and disadvantages of each system. [10]

This first part of this question was looking for candidates to demonstrate their knowledge of the hygiene standards required to provide the correct quality environment for keg production. A good answer should have covered routine CIP regimes as well as the actions taken if the line has been stopped for a period of time, in parallel with the chemicals used for these processes. Presence of the operational actions of the plant operators was also expected in the answer, including monitoring of the pasteurizer and also any plant leak checks that were carried out on the plant.

The second section of this question was looking for candidates to explain the different palletisation methods – including flat pallets, locator boards, belly pallets loose kegs and cages. A good answer should have covered the benefits, risks and financials of each style of palletisation both at the production site, as well as the impact as the pallets move through each stage of the supply chain.

Ruth Bromley

Module 2:
Unit 6b – Large Container Packaging Operations for Casks

(a) Assignment
Select a system of your choice for filling casks and describe its operation.
Identify any issues that can arise from the operation of this equipment and how they may be controlled. This should include the control of cask contents and minimisation of beer losses. Using the issues identified, quantify how your chosen filling system is performing. Recommend and justify how the performance could be improved.
Critically review the maintenance schedule for this equipment. Recommend and justify any changes which could be made.

Two assignments were submitted. Again it is important to ensure that the submission fully answers the assignment questions. Quantification of system performance needed to include quantification of cask contents levels and variability plus quantification of beer losses and their variability. References need to be referenced in text in addition to reference list at end.

Eric Candy

(b) Short answer questions

For the ten multiple-choice questions, both candidates' had six correct answers. The range was from 6 to 8 for the five short-answer questions.

The multiple-choice questions demonstrated a mix of knowledge between both candidates, although both appeared weak on specific details regarding rousing, conditioning and finings.

In general, the short answer questions were again well answered between the two candidates, with no clear weaknesses identified for both parties.

(c) Long answer questions

Candidates had to select one question from a choice of two. Question 1 was answered by one of the candidates, with the other candidate choosing to answer question 2. Both questions were well answered.

Question 1 – Cask Washing & Filling
Describe the key actions which must be taken on a cask filling line to ensure that hygiene standards are maintained. [12]
Compare and contrast multi-station and single station cask washers. [8]

This question was exceptionally well answered and demonstrated the candidate's clear technical and operational knowledge of the process. The description of the key actions to maintain hygiene standards was excellent, and covered CIP regimes, cask washing processes, beer quality housekeeping and maintenance. The detail covered in each of these sections gave a clear overview of the wide variety of approaches and requirements to maintain hygiene levels to support the correct levels of cask quality.

The comparison provided between the multi and single station washers was clearly demonstrated in a tabular format with clear, descriptive explanations following on afterwards. This allowed the wide review of a number of areas from labour and safety through to revenue costs and capital investment, footprint and operational implications.

Question 2 – Cask Filling and Dispense
Describe the process from start of cask filling to fitting of the shive explaining each step of the process. Include in the description the process by which the cask fill levels are checked and how these can be optimised. [12]
List the number of movements that a cask goes through after being fined up to the point of dispense and explain the effect that these movements can have on the final product quality. [8]

The description provided of the filling process was well described and the supporting drawing helped with the explanation provided. A clear description of a manual filling process was provided in note form and would have benefited from a slightly broader description at each stage of the process. The additional information provided in the answer also provided a brief overview of the automated process which could have been expanded upon.

The detail provided on the movements of the cask from the point of fining through to dispense was weak and would have benefited from a better knowledge of the supply chain routes. However the description of the quality impact of the movements on the beer was clear and also linked into the levels of trade returns as well as the long term future of the brand.

Ruth Bromley

Module 2:
Unit 7 – Packaging Line Design and Performance with Capacity Planning

(a) Assignment
This assignment is designed to show that the candidate understands the key elements in achieving the right environment for an efficient and waste free operation.
The task is to redesign an existing packaging line of your choice to adopt current best practice.
For the assignment give a plan as to how you will approach this project both from the design (including layout, manning and

materials storage and ingress) and logistics view points so as to ensure a smooth and successful outcome.
Your discussion on logistics should include the supply and storage of materials and also the effect of storage and supply of finished product on the design of the line.

This assignment encouraged radical thinking in terms of what would be the best approach to achieving best practice in an existing packaging operation. No budget restrictions were given.

There was one outstanding assignment which went for a lean manufacturing approach with the use of the most up to date technology and systems to achieve this. The others were variable. The better ones gave a sensible appraisal of existing conditions and good proposals on how the operation can be improved. The poorer submissions gave a passionate list of all the items that were wrong but did not give a management type approach on how all the issues were going to be solved.

It is important that candidates carry out the work with the view that it could be used by their senior management in helping them to make decisions for the future. If the quality of the report does not lend itself to this sort of scrutiny, it is likely to be a poor assignment.

Jeremy Browne

(b) Short answer questions

For the ten multiple choice questions, the number of candidates' correct answers ranged from 6 to 9, with one candidate scoring full marks. The range was from 2 to 9 for the five short answer questions, demonstrating the differences in knowledge shown by the candidates.

The multiple choice questions demonstrated a good overall knowledge of the planning and line design process, although some weaknesses were demonstrated when testing candidate's knowledge regarding Management Information Systems and Value Stream Mapping tools.

In general the short answer questions that required descriptive answers were well answered, but the calculations were very poorly completed by the majority of the candidates – demonstrating a lack of knowledge of the application of the knowledge in the actual production environment.

(c) Long answer questions

Candidates had to select one question from a choice of two. Question 1 was answered by five of the candidates, with the remaining four choosing to answer question 2. Both questions were reasonably well answered, although the average score on the questions was only just above half marks.

Question 1 – Value Chain Analysis
Explain why a company would carry out a value chain and stream analysis of its business. [6]
List the seven areas of waste which should be addressed when targeting improvement in the value chain analysis of the business and provide a brief description of each. [14]

The explanation of the why a company would carry out a value chain and stream analysis should have covered the key principles behind these tools as well as their application to the workplace, leading to how the tools can then deliver the value through to the business. This was an area generally ignored by most of the candidates and those who did answer this section did not cover this with a good level of detail.

The second section of the question was looking for a candidate to provide details of the seven areas of waste and how they are related to the production environment. This should have been well covered by the candidates, but was generally weak, with most candidates generally not listing all seven areas, and the descriptions of each would have benefited from an understanding of the process.

Question 2 – Packaging Line Design
List the key production planning criteria which should be considered when designing a new bottling line together with a brief description of each. [6]
Describe how the choice of packaging materials can affect the design of a new bottling line. [4]
Explain the main operational factors which must be taken into account when designing the layout for a new bottling line. [10]

The key production planning criteria listed in the first part of the question should have started by defining the line layout before moving on to address the proposed beer type, pack size and formats, number of SKUs to run on the line and the implications of related changeovers, product seasonality factors, line efficiency, plant hygiene and maintenance strategies as well as taking into consideration the skill levels of the production teams. A good answer on this would have also detailed the proposed planning production schedule – be it weekly, fortnightly or monthly as well as the type of logistics planning system i.e. push or pull.

The section on packaging materials was generally poorly answered and should have covered off line complexity and materials quality, as well as linking different formats to the number of changeovers. The choice of returnable over non-returnable packs has a large impact on the line performance as well as the initial cost of the materials.

The final section expected candidates to explain the key operational factors which can affect the design and therefore output from a bottling line. These should have included line layout, bright beer capacity, returnable or non-returnable formats, materials delivery and collection, manning skills and levels coupled with required shift patterns, hygiene standards, maintenance programmes as well as addressing health, safety and environmental factors. Whilst some candidates gave a good response to this question, very few addressed all aspects.

Ruth Bromley

Module 2 Unit 8 : WCM, Maintenance, Safety, Utilities and Environment

(a) Assignment
Compare and contrast the design and operation of your company Health and Safety Management System with an internationally recognised System (such as the United Kingdom Health and Safety Executive publication HSG 65 "Successful Health and Safety Management").
Select and justify areas of your company Health and Safety Management System which you would describe as the best aspects of this system.
What changes would you recommend to make your company system 'world class'?

Health and Safety is clearly and pleasingly an area of considerable competence for the candidates. All produced highly satisfactory submissions with four very good reports.
As an alternative to HSG 65, candidates variously compared their company systems to the International Safety Rating System (ISRS), AS/NZS 4801:2001or AS/NZS 4804:2000. The majority of submissions were well organised with direct comparisons between the structure of their company's system with a recognised standard. Not all candidates used references effectively and attention must be drawn once again to the guidance notes. Discussion and the drawing of conclusions was generally good but for some could have been improved with wider investigation.

Within the reality of an operational environment most candidates recognised the importance of hazards and risk management. A number also explained the concept of "total loss" which, of course, includes any loss due to an accident or near miss. Disappointingly, a number of the reports lacked an index or contents section which would have immediately indicated to the examiner how the candidate was approaching the subject.

It is apparent that many candidates, occasionally a little arrogantly perhaps, imply that their companies are already performing at a "world class" level. No candidate had actually investigated examples of performance in industries outside brewing (apart from occasionally quoting some overall manufacturing accident statistics). It is generally recognised that the very best practice is demonstrated in a number of international chemical and pharmaceutical companies, some of which operate for years without a reportable or lost time accident. For them health and safety is demonstrably embedded at both a cultural and behavioural level from the top to bottom of the organisation with true empowerment being practiced.

Eric Candy and Robin Cooper

(b) Short Answer Questions

For the ten multiple choice questions, the number of candidates' correct answers ranged from 4 to 9. The range was from 0 to 4 for the five short answer questions.

The multiple choice questions on sustainable development, energy management, the Deeming cycle and preventative maintenance were generally answered correctly. The majority of the remaining multiple choice questions showed some weakness with no pattern to the answers. Disappointingly and surprisingly, less than half the candidates knew the correct long term exposure limit for CO_2.

Apart from a definition of risk (Q11), the short answer questions were not well handled. Only two candidates provided correct answers to Q12 on characteristics of effluent following the caustic clean of a bright beer tank (a rise in pH and a rise in COD). Less than half knew that an anaerobic effluent plant has lower energy consumption and lower biosolids than an aerobic plant (Q13) and just two candidates answered correctly that the compression process within the refrigeration cycle is of constant entropy (Q14). Finally, one sole candidate knew that for a process perfectly centred about the mean performance, the defect rate represented by six sigma is two per billion (Q15).

(c) Long Answer Question

Question 1 – Utilities and Utility Consumption
For a packaging line of your choice list, in addition to electricity, the utilities which are used. Against each utility, including electricity, show the unit of measurement by which consumption is monitored. [5]
Outline how each of the listed utilities is supplied and detail the quality requirements for each. [7]
It has been suggested that the electricity consumption for your chosen packaging line could be significantly reduced. Rank the uses of electricity in terms of consumption and prepare a plan of action for an investigation. [8]

Just one candidate attempted this question and produced a moderate answer.

The utilities used on the packaging line were listed satisfactorily but the units for measurement of consumption were not entirely correct. However the importance of using specific consumption (e.g. per hectolitre of production) for monitoring and improving performance was recognised.

Short descriptions of the supply of the utilities could have beneficially included some quantitative data on, for example, electricity voltage, steam pressure, compressed air pressure as well as other key quality requirements. Some options for water treatment could have also been listed.

The ranking of electricity users on the packaging line was generally satisfactory thereby correctly suggesting, although not stated, a Pareto approach to the investigation into excessive use. The importance of monitoring consumption of, in particular, the higher users was recognised as well as the need to assemble a competent team, including key line personnel, to carry out the investigation. The need to establish initially whether items of plant are operating to their original design specification was not included in the one answer (there may have been changes including, for example, conveyors not running freely, misalignment, lack of lubrication etc). Thereafter, improvements progressing from good management to plant modification and finally plant replacement would be the usual progressive approach. Investigating best practice is also vital in making step-wise reductions in electricity consumption.

The action plan arising from the investigation should include timescales, responsibilities and dates for reviewing progress.

Question 2 – Health and Safety
Describe how an accident resulting in an injury to an operator should be investigated and reported. Your answer must make clear how the investigation is structured together with important timings. [16]
What changes to the investigation are required if the accident resulted in an injury to a contractor employed by an equipment supplier? [4]

Eight of the nine candidates answered this question. All answers were satisfactory or better with several very good answers and one outstanding, near model, answer. Clearly the requirements of an accident investigation are basically well understood demonstrating a good level of competence in this important field. The check list for the accident investigation should include (remembering that the more serious the incident, the greater the depth of investigation that will probably be required):

Obtain basic facts
- names of injured, witnesses, people early on scene
- condition of any equipment
- any chemicals / substances in use or present
- layout of area
- place, time, conditions
- extent of injury / damage / disruption
- use of camera / sketches / measurements of undisturbed scene

Establish circumstances
- what was being done at the time and what happened?
- immediate causes
- events leading up to the incident
- any evidence linking case of ill health to work
- competence (extent of training before event, experience in job)
- had a risk assessment been carried out and documented
- what was the established method; was it adequate; was it followed?
- behaviour and actions of individuals
- supervisor's role: did the supervisor request the task to be done or did those involved in the accident act on their own initiative?
- what was the worst that could have happened?
- has it happened before?
- could it happen again?

Identify preventative measures
- review the risk assessment of the activity
- what precautions should have been in force?
- what training should those involved have received?
- what precautions were actually taken and what training was actually given?

Was the first response to the accident adequate?
- was prompt and appropriate action taken? (e.g. making safe any continuing risk; electrical isolation; suitable fire fighting; effective first aid; correct spillage procedures).

Identify underlying causes e.g.
- management or supervision failure
- lack of competence
- inadequate training
- shortcomings in original design of equipment
- absence of maintenance system

Determine action needed to prevent a recurrence e.g.
- improve physical safeguards
- introduce better test and maintenance arrangements
- improve work methods
- provide and use personal protective equipment
- change supervision and training arrangements
- review similar dangers elsewhere in packaging operations
- review procedures involving external contractors
- improve inspection systems

In determining the course of action the Health and Safety Policy must be considered – Is it adequate? Is it being ignored? What needs to be changed to make the policy effective at preventing accidents and maintaining health and safety at work?

The differing national and local reporting requirements for serious and less serious accidents were well explained as was the importance of carrying out the investigation procedure as soon as possible after the incident.

In the case of an injury to a contractor employed by an equipment supplier, the investigation should be no less rigorous. Essential additions include:
- the requirement to involve officials from the contractor's company from the outset
- checks on the suppliers training
- checks on the individual's competence (training and experience)
- was a risk assessment carried out and a safe method of working agreed?
- was the brewery's or packaging line's induction training programme followed and signed off as having been received?
- was there a contractor's safe working code to be followed?

Robin Cooper

GENERAL CERTIFICATE IN BREWING AND PACKAGING EXAMINATION

November 2008 Report

The Autumn series of examinations for the General Certificates in Brewing and Packaging (GCB, GCP) was held on 14 November 2008 at 50 centres in 21 countries.

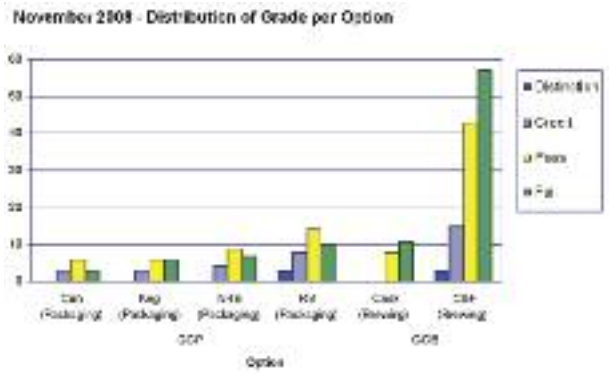
This was the seventh of the new multiple-choice examinations with specialist options for brewing and packaging variations, i.e. C&F, Cask, Keg, RB (Returnable Bottles), NRB (Non Returnable Bottles) and Can.

There were 219 entries, with an overall pass rate of 57%, not quite as good as the 63% achieved at the previous May examination.

The break-down between GCB and GCP results is shown below:

Exam	Option	Distinction	Credit	Pass	Fail	Total
GCP	Can (Packaging)	0	3	6	3	12
	Keg (Packaging)	0	3	6	6	15
	NRB (Packaging)	0	4	9	7	20
	RB (Packaging)	3	8	14	10	35
GCB	C&F (Brewing)	0	0	8	11	19
	Cask (Brewing)	3	15	43	57	118

Diagram 1 below is a graphical distribution of pass grade by option.



Comments

Overall the pass rate for GCB was 50%, with three distinctions (90%) and 15 credits (80%): this was a significant drop in standards since the May examination, notably in the 'cask beer' paper, with a pass rate of only 42%.

For GCP, however, the figure was, at 68%, much improved, with three distinctions (all in RB) and 18 credits being awarded.

Topics answered poorly included:
for GCB, CIP, process gases, environmental issues.
for GCP, quality, environmental issues.

As ever, weaker candidates, especially those taking the brewing papers, were well-versed in the subject-matter of their working areas, but tended to be unsure of 'peripheral' issues.
It was disappointing to see that questions in the latest syllabus revision area, the environment, were so poorly answered.

Colin McCrorie

May 2009 Report

The Spring examinations for the General Certificates in Brewing and Packaging (GCB, GCP) was held on 11 May 2009 at 50 centres in 17 countries.

This was the eighth of the new multiple-choice examinations with specialist options for brewing and packaging variations, i.e. C&F, Cask, Keg, RB (Returnable Bottles), NRB (Non Returnable Bottles) and Can.

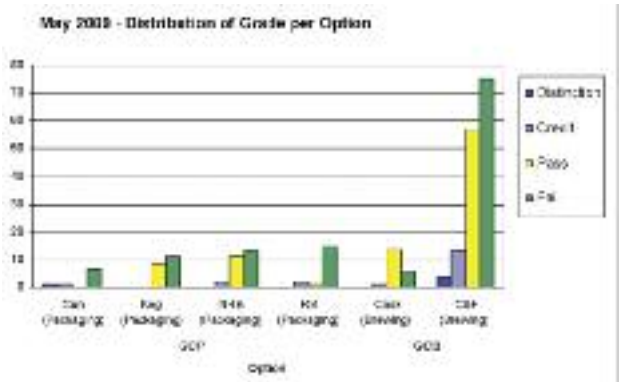
For the first time, the examination was taken 'on-line' at six centres across the world, three of them being outside the UK and Ireland.

There were 243 entries, with an overall pass rate of 47%, not as good as the 57% achieved at the previous November examination.

The pass rate achieved by candidates sitting the examination 'on line' was almost identical to that achieved on the paper-based examination. The break-down between GCB and GCP results is shown below

Exam	Option	Distinction	Credit	Pass	Fail	Total
GCP	Can (Packaging)	1	1	0	7	9
	Keg (Packaging)	0	0	9	11	20
	NRB (Packaging)	0	2	11	13	26
	RB (Packaging)	0	2	1	15	18
GCB	C&F (Brewing)	4	13	57	175	149
	Cask (Brewing)	0	1	14	6	21

Diagram 1 below is a graphical distribution of pass grade by option



Comments

Overall the pass rate for GCB was 52%, with four distinctions (90%) and 13 credits (80%): this represented a slight rise in standards since the November examination, due entirely to the 'cask beer' paper, with a pass rate of 71%. There was no change in the pass rate (50%) for the 'C&F' paper.

For GCP, however, the figure had, at 37%, declined significantly from the 68% achieved in the November '08 examination, with only one distinction (can) and five credits being awarded.

It was of some concern to note that questions asked in the 'elective' sections, especially within the packaging papers, were among the most poorly answered.

There was a depressing similarity in the most probable causes of this generally poor performance, insomuch that many candidates appeared to have been ill-prepared for the examination, which given the breadth rather than depth of the syllabus required considerable application by the candidates and support in the form of study time and a mentoring facility from their companies.

There was a pattern of results within certain organisations that strongly supported this view.

Colin McCrorie

General Certificate in Distilling

Examiner's Report 2009:

In November 2008, only 11 candidates sat this second multiple-choice Certificate examination; eight passed (73%), which is virtually the same pass rate as the first MCQ (Multiple Choice Questions) paper in May 2008, but is improved on the pass rate of 63% of previous years using the old format exam. There were, however, no Distinction or Credit grades obtained. The low number of candidates was probably due to this being the first time that the GCD exam has been held twice a year and most entrants may have been candidates who were unsuccessful in the May exam.

However, a record number of entrants sat the GCD in May 2009, all studying the "Cereal" option. Of the 156 candidates who sat this paper, 96 passed (62%), with one Distinction grade and five Credit grades. This is the highest number of recorded candidates achieving the GCD in one year.

The rather disappointing number of unsuccessful entrants may indicate that the changed style of examination to MCQ is still causing problems for some candidates.

Multiple choice questions are designed to give a range of degree of difficulty and this is achieved by altering the level of plausibility of the "distracters" within the questions. Perhaps for some of less prepared candidates some of these distracters were too plausible. Another factor may be that candidates did not read the questions carefully enough to appreciate exactly what was being asked and this point has been expressed by the examiners for other MCQ papers, such as GCB and GCP.

Essentially, it can not be stressed enough that candidates must read each question very carefully, plus any associated graph, sketch or table, to understand what is required. Of course there has never been any intention to mislead candidates, but for some questions the response to a less than thorough reading might not be correct and the degree of difficulty of questions will expose the level of candidates' preparation. Finally, the examiners are hopefully that there will candidates in the future who will wish to elect the 'Molasses' and 'Grape' options for this qualification.

David Taylor

Successful Candidates

The successful candidates from the 2009 Diploma and Master Brewer Examinations, who meet all IBD criteria, are listed as follows:

MASTER BREWER EXAMINATIONS

Module 1 passes

Chan, Ching Fook	Asia Pacific
Giblin, Ciaran	Southern
Hadley, Tully Ceman Patrick	Asia Pacific
Hammond, Peter Clark	Southern
Kelly, Robert Patrick	Irish
Kelly, Richard	International
Kentish-Barnes, Edward	Southern
Kwarciak, Dominika	Great Northern
Ogu, Solomon Sila	Africa
Parsons, Patrick Roy	International
Robertson, Rachel Yvonne	Asia Pacific
Yeoh, Bun Hooi	Asia Pacific

Module 2 passes

Audet, Travis	International
Broadbent, Jonathan Paul	Midland
Chan, Ching Fook	Asia Pacific
Coulson, Adam Nathaniel	Asia Pacific
Hammond, Peter Clark	Southern
Kelly, Robert Patrick	Irish
Kentish-Barnes, Edward	Southern
Kilcullen, Stephen	Irish
Kirkton, William James	Midland
Leslie, Michael Patrick	International
Oates, Neil Anthony	International
Pitso, Gabriel	Africa
Stewart, Neil Sedaka	International
Yeoh, Bun Hooi	Asia Pacific

Module 3 passes

Bajner, Robert Erno ++	Africa
Bell, Irene ++	Asia Pacific
Broadbent, Jonathan Paul	Midland
Du Toit, Malcolm A ++	Africa
Engelbrecht, Vanitha ++	Africa
Gilleland, Emma-Jane	Midland
Hall, Martin	International
Kenyon, Andrew P ++	Great Northern
McLean, Kevin Ian Maurice	International
Nisbet, Robert Patrick ++	Southern
O'Connor, Fearghal Patrick	Irish
Parkinson, Philip James	Midland
Siaw, Yon Miaw	Asia Pacific

Module 4 passes

Audet, Travis	International
Bajner, Robert Erno ++	Africa
Britt, Alison ++	Southern
Brown, Tracy ++	Great Northern
Coulson, Adam Nathaniel	Asia Pacific
Engelbrecht, Vanitha ++	Africa
Herholdt, Tanith ++	Africa
Kabila, John Ilunga	Africa
Kelly, Richard	International
Mahesh, Rajamanickam	Asia Pacific
McLean, Kevin Ian Maurice	International
Morley, Shane Kelvin	Asia Pacific
Ngubane-Ngwenya, Blessing ++	Africa
Wright, Brad ++	International

Module 5 passes

Bajner, Robert Erno ++	Africa
Bell, Irene ++	Asia Pacific
Britt, Alison ++	Southern
Brown, Tracy ++	Great Northern
Engelbrecht, Vanitha ++	Africa
Gilleland, Emma-Jane	Midland
Harrington, Criona Threase	Irish

Herholdt, Tanith ++	Africa
Kenmogne, Maurice	Africa
Kilcullen, Stephen ++	Irish
Ngubane-Ngwenya, Blessing ++	Africa
Nisbet, Robert Patrick ++	Southern
Wright, Brad ++	International

++ has passed all modules of the Master Brewer by accumulation

DIPLOMA IN BREWING

Module 1 passes

Ambepitiya, Thushara	International
Adebola, Rukayat Yetunde ++	Africa
Aistrope, Melissa Anne	Asia Pacific
Akhigbe, Akhabue	Africa
Antonio, Manuel Florindo	Africa
Badger, Dan ++	International
Bah, Damien Nchia	Africa
Barron, Nicholas ++	International
Berg, Eric	International
Bledsoe, Anthony	International
Brown, Damian ++	International
Burke, Eimear	Irish
Burrows, Chad William	Asia Pacific
Byrne, Dermot	Irish
Caine, Susannah	Southern
Carrazzone, Louis	International
Casey, John Thomas ++	Irish
Cashell, Niamh Eileen	Irish
Chan Mei Sim, Gisselle	Asia Pacific
Chansa, Timothy	Africa
Clarijs, Paul	International
Clarke, Matthew	Great Northern
Cocker, Corey	International
Conway, Neil Oliver	Irish
Crenshaw, William ++	International
Dada, Ayodeji Peter	Africa
Dale, James Andrew	Asia Pacific
Dalton, David	International
Daniels, David Paul	Africa
Daniels, Tanya Maria	Asia Pacific
Daun, Gilberto ++	International
Delaney, Deirdre	Irish
Delaney, Stephen	Irish
Dirks, Rebecca	Africa
Doniach, Samuel ++	International
Du Preez, Chad Marcelle	Africa
Egan, Lawrence	Irish
Enjem, Stefan	International
Flocco, Timothy	International
Fowler, Emma Jane	Irish
Franzini, Bianca Paraluppi ++	International
Freedberg, Amichi	International
Freeman, Julia Louise	Asia Pacific
Gadsden, John James	International
Gallis, Zafeirios	International
Gibbs, Lincoln	Asia Pacific
Goodall, Adam Anthony	Midland
Gorham, Kristopher	International
Govender, Previn Nadason	Africa
Graham, Damian	International
Graham, Aiji	International
Grant, Tameika Rachelle	International
Grootendorst, Carl Eric Oliver	International
Gunn, David Dale	International
Henney, Mathew	Southern
Hewitt, Michael	International
Hioe, Margaretta	Asia Pacific
Hodgkins, Rupert Howard	Southern
Hollering, Paulien	International
Hooper, Andy	International
Horacio, Priscila De Souza	International
Hudson, Tamara	International
Hulama, David ++	International
Hunter, Andrew Wallace	Great Northern
Inchley, Matthew James	Asia Pacific
Jones, Andrew Edward	Asia Pacific
Juergen, Christopher ++	International
Kandelova, Martina	Southern
Kerr, Jenny	International
Kerruish, Daniel William ++	Great Northern
Kidd, Ross	Irish
Kraglund, Hans-ole Rovsing	International
Lamberti, Kelvin Robert ++	Africa
Laverty, Tyler ++	International
Leather, Paola	Southern
Ludwig, Karl ++	Africa
Marriott, Louise	Southern
Martin, Carmen Estelle	Africa
Martin, Remy	International
Mazurina, Elena	International
McCarthy, John	Southern
McEvoy, Thomas	Irish
McLeod, Gayann Camille McKnight	International
Middleton, Anna Violet	Irish
Minihane, Shane ++	Irish
Mishra, Suresh Chandra	Asia Pacific
Mofokeng, Themba Ernest	Africa
Monahan, Christopher Michael	Asia Pacific
Moreels, Johannes Gerardus	International
Mua Tem, Peter	Africa
Murphy, Matthew	International
Ndifon, Leo Tabe	Africa
Nelson, Erica	International
Ngatia, Catherine Wairimu	Africa
Ngoumela Fokou, Georgine	Africa
Nteso, Lerato Gideon	Africa
Ogilvie, David	International
O'Neil, Jeffrey	International
Pedder, James	Southern
Prior, Claire Marie	Irish
Reilly, John	Irish
Reilly, Christopher	International
Richard, Jason	International
Richmond, Michael ++	International
Roep, Barbara Christine Antoinette ++	International
Romao, Zacarias Francisco	Africa
Rotherham, Andrew	Great Northern
Rutland, Luke	Asia Pacific

Ryan, Martin	Irish
Salter, Genevieve Corinne	Midland
Samara, Walid	Africa
Schuurman, Harry Dirk	Africa
Searle, Bradley David	Asia Pacific
Sharpe, Sheldon	International
Sheils-Ryan, Paula	Irish
Shore, Brett Michael	Asia Pacific
Sidubi, Fezile ++	Africa
Smith, Marc	Great Northern
Smith, Michael	International
Sonar, Sanjay Chintaman	Asia Pacific
Spencer, Thomas	Midland
Stonier, Michael John	Asia Pacific
Stull, Thomas	International
Swanepoel, Pieter	Southern
Takurukura, Gordon	Great Northern
Thiyagarajan, V	Asia Pacific
Thomson, Nathan Edward	Asia Pacific
Tingay, Jennifer Alison	Southern
Tummers, Rob Mathieu Johan	International
Twomey, William Richard	Southern
Uwajeh, Chinedu Francis	Africa
Van den Berg, Thomas Hendrik	International
Van der Werf, Hilbert	International
Van Dieren, Teunis ++	International
Vespa, Geremi	International
Victor, Gyme Kim	International
Walker, Daniel Christopher	Asia Pacific
Ward, Jonathan Christopher	Midland
Watson, James	International
Way, Holly M	International
Willcock, Chris Joel	Asia Pacific
Williamson, Samuel George	Asia Pacific
Wills, Alyson Doreen	International
Wilson, Steven Dennis	Great Northern
Winneker, Brandon ++	International
Wood, Iain James ++	Irish
Wright, Kevin ++	International
Yeboah, Samuel Asiamah	Africa
Ziefflie, Brad	International

Module 2 passes

Adebola, Rukayat Yetunde ++	Africa
Andre, Marine	International
Badger, Dan ++	International
Badura, Michael	Irish
Baldry, Dawn Marie	Southern
Barron, Nicholas ++	International
Bellham, David John ++	Midland
Benson, Michael Andrew	Great Northern
Bergin, Ailish	Irish
Billig, Marcus Charles	Midland
Brown, Damian ++	International
Calman, Nathan Garth ++	Asia Pacific
Carrazzone, Louis	International
Chan Mei Sim, Gisselle	Asia Pacific
Chauvin-Schera, Celine	International
Coffey, Dayton Joseph	Asia Pacific
Cook, Jamie Harold	Great Northern
Cooney, Carl ++	Irish
Coup, Thomas Matthew ++	Asia Pacific
Crawford, Lindsay Matthew	Asia Pacific
Crenshaw, William ++	International
Daun, Gilberto ++	International
De Jager, Louis Richard ++	Africa
Dirks, Rebecca	Africa
Doniach, Samuel ++	International
Franzini, Bianca Paraluppi ++	International
Gupta, Vishnu ++	Asia Pacific
Harper, Eric A ++	International
Hioe, Margaretta	Asia Pacific
Hodgkins, Rupert Howard	Southern
Howley, Joann	Irish
Hulama, David ++	International
Juergen, Christopher ++	International
Kaporina, Elena++	International
Kerruish, Daniel William Michael ++	Great Northern
Lamberti, Kelvin Robert ++	Africa
Lanthois, Ben Kevin	Asia Pacific
Laverty, Tyler ++	International
Lienhart, Sylvie	International
May, Chloe	Southern
Merrington, Peter Anthony	Asia Pacific
Mishra, Suresh Chandra	Asia Pacific
Morgan, Haydon Peter ++	Asia Pacific
Morgan-Jones, Andrew	Asia Pacific
Ngoma Mapenda, Esther	Africa
Nine Rey, Maria Victoria	Great Northern
O' Riordian, Colman	Irish
Richmond, Michael ++	International
Rodriques, Nicolene	Africa
Roep, Barbara Christine Antoinette ++	International
Seddon, Lewis	Asia Pacific
Sidubi, Fezile ++	Africa
Sturman, Anna Victoria	Great Northern
Symons, Sean Robert ++	Asia Pacific
Tang, Samuel Chei-kit ++	Asia Pacific
Thiyagarajan, V	Asia Pacific
Tripathi, Arijit	Asia Pacific
Uherova, Alexandra	Irish
Van Dieren, Teunis ++	International
Watson, James	International
Welby-Solomon, Marvin ++	Africa
Winneker, Brandon ++	International
Wood, Iain James ++	Irish
Wright, Kevin ++	International
Ypenburg, Dirk Jan Nicolaas ++	International
Ziefflie, Brad	International

Module 3 passes

Adebola, Rukayat Yetunde ++	Africa
Badger, Dan ++	International
Barron, Nicholas ++	International
Basu, Lasat	Asia Pacific
Berg, Eric	International
Bhardwaj, Sharad ++	Asia Pacific
Bledsoe, Anthony	International
Brown, Damian ++	International
Calman, Nathan Garth ++	Asia Pacific

Cameron, Owen	Asia Pacific
Casey, John Thomas ++	Irish
Chansa, Timothy	Africa
Chilongo, Suzyo ++	Africa
Cocker, Corey	International
Crenshaw, William ++	International
Currie, Margaret Lilian ++	Asia Pacific
Dalton, David	International
Daun, Gilberto ++	International
De Jager, Louis Richard ++	Africa
Della Vedova, Tomaso	Irish
Dolbel, David ++	Southern
Doniach, Samuel ++	International
Flocco, Timothy	International
Ford, Antony Trevor	Asia Pacific
Franzini, Bianca Paraluppi ++	International
Fray, Sean	International
Gadsden, John James	International
Heary, Aaron Joel ++	Asia Pacific
Hooper, Andy	International
Horacio, Priscila De Souza	International
Hulama, David ++	International
Jayawickrama, Janaka	International
Joshi, Atul Kumar	Asia Pacific
Juergen, Christopher ++	International
Kerruish, Daniel William Michael ++	Great Northern
Kirby, Aeveen	Irish
Kumar, Arvind	International
Lamberti, Kelvin Robert ++	Africa
Laverty, Tyler ++	International
Lester, John	Irish
Martin, Remy	International
McKibbin, Samuel Alan ++	Irish
Medronho, Paula Alexandra ++	Africa
Mgabadeli, Xolile Neville ++	Africa
Minihane, Shane ++	Irish
Mogorosi, Mildred	Africa
Mohoto, Kgadi Alex ++	Africa
Morgan, Haydon Peter ++	Asia Pacific
Muiruri, Michael Mwaura ++	Africa
Murphy, Gerard Robert	Irish
Murphy, Matthew	International
Musonda, Wellington ++	Africa
Nyada Nyada, Rogatien	Africa
O'Brien, John ++	Irish
Ogilvie, David	International
O'Halloran, Catherine Louise	Great Northern
Ortega, Luis	International
Pandey, Rajesh Kumar	Asia Pacific
Pradeep, Sinha Kumar ++	Asia Pacific
Pradhan, Rabinarayan	Asia Pacific
Pretorius, Barend Johannes Voster ++	Africa
Reilly, John	Irish
Reilly, Christopher	International
Richmond, Michael ++	International
Roep, Barbara Christine Antoinette ++	International
Rogers, David ++	Asia Pacific
Schrama, Inge Joanna	International
Sharma, Raj Kumar ++	Asia Pacific
Sheen, Kerryn Louise	Asia Pacific
Sidubi, Fezile ++	Africa
Simpson, Peter	Irish
Sproats, Christopher ++	Asia Pacific
Stull, Thomas	International
Thadel, Manoj Parameshwara ++	Asia Pacific
Thomas, Louise ++	Southern
Thorn, Ian John ++	Southern
Uwajeh, Chinedu Francis	Africa
Van der Werf, Hilbert	International
Vespa, Geremi	International
Vickers, Jemima Victoria ++	Southern
Welby-Solomon, Marvin ++	Africa
Winneker, Brandon ++	International
Wiseman, Geoffrey	International
Wright, Kevin ++	International
Yeboah, Samuel Asiamah	Africa
Ypenburg, Dirk Jan Nicolaas ++	International

++ has passed all modules of the Diploma in Brewing by accumulation

DIPLOMA IN DISTILLING

Module 1 passes

Brown, Alan T	Scottish
Cattanach, Susan	Scottish
Crow, Matthew	Scottish
Cruickshank, Keith James	Scottish
Donnell, Rodney	Irish
Hodge, Kirsty	Scottish
Hofsli, Carl	International
Hooper, Paul	Scottish
Jack, Frances Ruth	Scottish
Livingston, Andrew ++	Scottish
McWilliam, Robert	Scottish
Milton, Sam	Scottish
More, Carol	Scottish
Murphy, Bill	Irish
Nexmark, Christer Anders ++	International
Russell, Ian Alexander	Irish
Schurman, Timothy ++	International
Sneddon, Scott	Scottish
Walker, Emma-Jane	Scottish
Warren, Gregor	Scottish
Wotherspoon, Robert	Scottish

Module 2 passes

Carson, James	Scottish
Clark, Christopher Anthony	Scottish
Crow, Matthew	Scottish
Flaherty, Aaron Charles Frederick ++	Scottish
Harrison, Elaine	Irish
Harrison, Barry Macdonald	Scottish
McNally, Darryl Joseph	Irish
Nexmark, Christer Anders ++	International
Schurman, Timothy ++	International
Simpson, Claire Louise	Scottish
Stephens, Jeremy Matthew	Scottish

Module 3 passes

Anderson, Russell Ian, ++	Scottish
Burns, Graeme James	Scottish
Conway, Niall ++	Irish
Hall, Stephen John ++	Scottish
Hofsli, Carl	International
Livingston, Andrew ++	Scottish
Macinnes, Norman MacLean ++	Scottish
McCarthy, Noirin Ide ++	Irish
McGuigan, Frank ++	Irish
McIntyre, Sandy	Scottish
McNair, Ian Alexander	Scottish
Morehead, Peter++	Irish
Nexmark, Christer Anders ++	International
Power, Michael ++	Irish
Schurman, Timothy ++	International
Sneddon, Scott	Scottish
Thompson, Marie Anne ++	Scottish
Wright, Holly Annabell	Scottish

++ has passed all modules of the Diploma in Distilling by accumulation

DIPLOMA IN BEVERAGE PACKAGING

Module 1 passes

Callison, Andrew	Midland
Davies, James	Asia Pacific
Egan, Bryan	International
Etheridge, Ashley	Midland
Gregory, Tupo	Asia Pacific
Kwaku, Isaac	Africa
Quinn, Christopher	Midland
Rattan, Jagdish	Asia Pacific

Module 2 passes

Appleby, James	Midland
Elson, Robert	Midland
Morris, Steve	Southern
Paul, Lachlan	Asia Pacific
Rathbone, Sean	International
Schleyer, Samantha	Asia Pacific
Thiong'o Nduati, David	Africa
Townsend, Alexandra	Midland

There were no passes for Module 3 this year and no candidates accumulated passes in all modules.

The Institute of Brewing & Distilling

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Fax: +44 (0) 20 7499 1156

Email: exams@ibd.org.uk

or visit the IBD website at

www.ibd.org.uk

International Brewing Convention

Manchester UK
18-20 October 2010

Ahead of the Curve

IBD BFBi

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With the overall theme of 'Ahead of the Curve' the Convention Programme will present strategies to deliver and secure value creation in a changing consumer landscape including:

- **Consumers: Predicting Preferences**
- **Materials Revolution**
- **Sustainable Resources and Waste Management**
- **Value from Co-Products**
- **Energy**
- **Design for Safety**

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Please join our mailing list to receive regular convention updates via the website or e-mail the Convention Secretariat at:

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