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DESIGN TECHNOLOGY

Overall grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 13	14 - 26	27 - 38	39 - 49	50 - 60	61 - 72	73 - 100

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 14	15 - 28	29 - 39	40 - 51	52 - 62	63 - 75	76 - 100

General comments

The May 2009 session is the first based on the revised syllabus.

For teachers used to preparing candidates for the Design Technology papers, the significant changes concern Paper 3 and the IA assessment criteria. Teachers new to the IB have been able to prepare candidates without any preconceptions, though the use of past examination papers has been limited to the Specimen Papers. The revised IA criteria has been utilised with exemplar material contained on the Online Curriculum Centre (OCC), which seems to have been well received by the majority of teachers.

The team responsible for writing the revised syllabus wanted to make sure that the distinction between HL and SL study was related more to Technology than to Design so the AHL topics reflect this. Also, material which five or ten years ago was new to the study of Design Technology or not seen as integral to it, i.e. some of the previous AHL or Option material has now moved to the Core. This is a natural consequence of a subject which does not have such fixed boundaries of knowledge as some subjects and where the influences of Research and Development and social issues play such an important part. Consequently, the Core now reflects the importance of innovation as well as design. Evaluation of products and systems from different points of view is also given more prominence.

The revised IA criteria reflects aspects of the design cycle more than lab based scientific work and the increased marks for the design project reflect this.

The Objectives of the new syllabus have also been modified both to reflect the different content and aspects of the Learner Profile which underpins study for the Diploma. What has not changed is the use of the grade descriptors as they are based on the level of study rather than specific content. Grade descriptors are used to decide grade boundaries once all the marking has taken place. They may also be used by teachers when preparing candidates for examinations to ensure that marks given to candidates are commensurate with predicted grades. Some experience is needed in teaching the syllabus to get a feel for the application of grade descriptors and it is even more difficult to apply the levels accurately with a small number of candidates. Nevertheless, grade descriptors can be a useful tool for teachers, especially as they are common for all Group 4 subjects.

Internal assessment

Component grade boundaries

Higher level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 17	18 - 25	26 - 32	33 - 39	40 - 46	47 - 60

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 17	18 - 25	26 - 32	33 - 39	40 - 46	47 - 60

The range and suitability of the work submitted

The new programme of study for June 2009 proved a popular choice, with many new schools opting to offer Design Technology at Diploma level. Schools continue to offer a range of work, from small design and make activities through to laboratory based experiments, as well as some challenging project work. Those schools that are established in the teaching of IB Design Technology continue to do well when developing a course that meets the assessment criteria; however not all schools had taken note of the changes to assessment for June 2009. Some schools continue to adopt design and make activities for all investigations, which can be limiting when planning a course to cover the Core, AHL and Options, if to meet the time requirements specified for Internal Assessment. Where this is the case, schools should consider smaller tasks in which they can develop candidates' knowledge, values, attitudes and skills which will better prepare them for the design project. Schools are to be reminded that they do not have to assess each of the criteria for every task. It is advisable to use coursework as a support exercise in order to help candidates understand the theoretical nature of the subject where candidates will be able to develop project skills by concentrating on one or two assessment criteria. For instance a teacher could provide a brief, specification and some research material so as to enable the candidates to develop and model ideas to be assessed for Development. Small lab based investigations tend to require less time than design and make tasks (normally no more than 3-4 hours) and the integration of such assignments into the course structure is to be encouraged. Some schools do not adopt this approach.

The topics covered by coursework must be entered on the form 4/PSOWDT along with the time taken for each investigation and consideration of where ICT has been used. Please note that this is a different form to that used by other group 4 subjects. Teacher support materials, notes and project briefs should be attached to the sample of work. As marks need to be highlighted on the 4/PSOWDT form for each assessment heading, one of the marks must be for the design project and the other for any of the other investigations. Only the work that has been highlighted should be sent for moderation. Most samples were presented in an organized structure, but teachers are reminded that work for each criterion needs to be flagged.

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Teachers are encouraged to send an individual candidate sample per folder/folio with the form 4/ PSOWDT attached. Dividers should be used to indicate the start of different investigations and work sent to moderators should be in A4 format.

Candidate performance against each criterion

Planning (P)

The majority of candidates were able to achieve a minimum of at least a 'partial' for this criterion. However, some candidates did not perform so well, especially when repeating a common problem set by the class teacher or when submitting identical work of another candidate when completing a group task. When using the assessment criteria for a design project, candidates should consider the feasibility of the study, identify the user, analyse the situation, write a clear brief which identifies the intended goal and produce a detailed not generic specification. When completing a lab based investigation variables must be identified.

Research (R)

Not all candidates had considered the need to plan data collection from a variety of sources, and as a result collected data was either biased or missing critical information. For example, some candidates had been given the task to design a CD rack, but there was no evidence of data collection relating to the different size of CD jewel cases available. Tasks relating to the gathering and analysing of information before tackling the design project are to be encouraged. The annotation of data and a summary of data collected should aid candidates in the writing of a detailed specification. Candidates should fully analyze the brief in 'Planning' if they are to prioritize strategies in which to identify wider issues to be researched. Those that achieved a high mark in this section displayed evidence of focused research that had been annotated to indicate its relevance in order to solve the problem. Literature search and copying of textbooks is to be discouraged.

Smaller lab based investigations where candidates had to collect raw qualitative/quantitative data offered ample opportunity to address the assessment criteria, but not all candidates had processed the information correctly. Tables and graphs must be correctly labelled.

Development (D)

This criterion lends itself to design based activities, where candidates have the opportunity to generate and develop an innovative range of ideas using suitable techniques. Some schools had misinterpreted the criteria and submitted inappropriate work for the assessment of 'Development'. Literature search assignments, PowerPoint presentations and most lab based experiments are not suitable tasks for assessment of 'Development' if candidates are to have the opportunity to be able to achieve 6 marks.

Teachers should consider how card, manufactured boards, CAD and Styrofoam can be used to aid model development. The use of more techniques to optimise a solution is to be encouraged. Detailing for the solution to be realized needs to be detailed and presented in an appropriate format, such as engineering drawings or patterns for textile outcomes. Teachers should note that there should be a notable difference between the modelling stage and the final outcome if they are to be able to assess Manipulative Skills (MS).

Teacher led investigations which focus on this criterion alone will aid candidates in developing the necessary skills to tackle a design and make project.

Evaluation (E)

Candidates should be encouraged to devote more time to this criterion if they are to achieve high marks. Ideally candidates need to test their outcomes in the area or with the user for whom they had been designed. The more organised candidates did leave adequate time to address the criteria to a satisfactory standard. Projects which offer a limited outcome do not lend themselves well to addressing this assessment criterion, especially when it comes to testing, identifying weaknesses and suggesting realistic recommendations. Recommendations for the design project need to include a revised specification, sketched modifications and identify changes to the outcome for scaling up production. For lab based tasks, candidates need to evaluate the process of data collection and identify weaknesses in their methodology.

Manipulative Skills (MS)

Only a few schools had assessed this criterion incorrectly, having not noticed that it is now only assessed once for the Design Technology Project. In most cases thorough planning had taken place, but there is a need for some schools to be more detailed in their identification of materials and processes in order to plan time effectively. Photographic evidence of candidates carrying out procedures is to be encouraged.

Recommendations for the teaching of future candidates

The new assessment weightings and time allocations for Investigations and the Design Project need to be considered when developing a scheme of work in schools. The amount of time given to the Design Project has changed and this should be reflected in the level of candidate work produced.

When deciding on possible Design Project ideas, teachers and candidates should, where possible, consider the option that has or will be studied. Tying the project and option together in some way will reduce the workload of candidates and should allow some of the option to be taught through practical work. This would be deemed as best practice, as due to lack of knowledge and experience it could be disadvantageous for candidates to study an option, then attempt to tackle a project that is more suited to another area. For instance, if studying Textiles as the option, candidates would be ill prepared to complete a project based around electronics or food, however this does not restrict candidates to carry out a project that may just be linked to one option. If studying CAD CAM as the option, candidates may still want some form of textiles/food in their final project outcome. The manner in which they tackle this could include cutting the textiles on a laser cutter, or making vacuum forming moulds for food packaging on a CNC router. Another example may be a candidate studying Electronics but who needs to use CAM to make the packaging to house the PCB or even machine the circuit layout.

Please note that when assessing IA Investigations it may not be possible to use all of the assessment criteria for each investigation. The Development criterion is suited to IA Investigations that adopt a design and make approach.

Schools are reminded to flag work for moderation.

Use of the OCC exemplar material is to be encouraged by teachers in helping them to understand and meet the standards of assessment.

Higher level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 14	15 - 18	19 - 22	23 - 26	27 - 30	31 - 40

General comments

Fifteen G2s were received for this paper. These comments were studied carefully at the grade award meeting and were used alongside other evidence, particularly candidate responses to the paper, to determine grade boundaries for the paper. At the grade award we are provided with a computer analysis of candidate performance, a difficulty index (DifI) and a discrimination index (DisI). DifI reflects the percentage of candidates getting the question right and can range from 0 to 100%. A higher DifI means that the question is easy, a lower DifI that the question is harder. In terms of DisI a negative discrimination index means that the better candidates found the question difficult and would prompt us to check the question carefully. Although for smaller entry subjects these statistics are less reliable than for larger entry subjects, the numbers of candidates for Design Technology are not growing to a point where the statistics are much more useful. We can remove questions from the analysis in the grade award meeting if we are unhappy with them although obviously we do not like to remove too many questions.

The Grade Award team are grateful for the input from teachers, through the G2 forms as it informs the process of boundary setting. 56% felt that this paper was of a similar standard to last year, with 33% finding it a little more difficult and 11% finding it much more difficult. 73% felt the difficulty of the question paper was appropriate. The syllabus coverage was considered good by 60%. 93% felt that the presentation of the paper was good.

There seemed widespread agreement that this year's paper one was very different, more difficult and less well-worded than the previous ones. Obviously this is a paper based on the new Guide and so there are new topics that were not in the previous Guide. One G2 comment suggested that there were *'many completely new and random questions that were very minimal in significance to the course content'* and another that *'questions were asked from areas that are of least importance in the Guide'*.

Another G2 commented that this was a difficult paper due to the number of questions based around a set of options (in some form of table) requiring a lot of time from the candidates. We agree that some table formatted questions are more difficult than others, e.g. Question 8 is more difficult that Question 11. Similarly, another general G2 comment suggested that we should not use tabled questions and went on to also suggest that we should not use multiple response questions or negatives in question wording as it makes questions harder to interpret and adds confusion. The examining team tries to limit these question types and will try to use them very carefully in future.

With regards to clarity of wording, 67% considered it to be satisfactory or good. One G2 commented that we should not use acronyms on the examination paper and referred specifically to the use of the terms JIT and LVL. Whilst we agree with the general principle of not using acronyms without defining we would argue that JIT and LVL are special cases and widely used.

One G2 commented that this paper was not suitable for ESL (English as a Second Language) candidates – another G2 pointed to Questions 1 and 2 in this regard.

One G2 commented that there were too many questions about green issues and sustainability. In determining the spread of questions we have a question grid that reflects the recommended hour loadings for each of the topics and this paper met the requirements of this matrix.

Individual question analysis

Question 1

There was a G2 comment that the word 'formalized' may have led candidates to think it was a way of leading to the design criteria for a product so it could be A or B. Candidates found this question relatively straightforward (DifI=74.10) and it was not negatively discriminating (DisI=0.18).

Question 3

G2 comments indicated that the presentation of information was confusing. The initial statistics on this question showed it to be difficult (DifI=32.70) although not negatively discriminating (DisI=0.10). As a result of the G2 comments about the confusing graphic we decided to accept A and C which changed the DifI to 70.51. We can see how the graphic may have confused candidates.

Question 5

One G2 comment was that this was ambiguous. Another comment was that there was not enough information to answer the question. One of the issues for lone inventors is that modern products often incorporate a range of technologies which pose challenges. This is reflected in C. A moderately difficult question with a higher discrimination index (DifI=57.09; DisI=0.48).

Question 8

One G2 comment was that there was no obvious answer. This question could have been better worded but the candidates did not have problem with it and it proved to be a fairly easy question with a moderate discrimination index (DifI=63.89; DisI=0.27).

Question 11

One G2 comment was that this was a confusing question and asked if the combination of characteristics was meant to be for both alloy and composites. For the right answer, the column entries are correct for both column headings. The candidates did not have a problem with this question and found it fairly easy with a good discrimination index (DifI=75.43; DisI=0.40).

Question 12

One G2 suggested that the answer could be C or D. Toughness and hardness are both important characteristics for floors. The question asks which characteristic is **most** important and hardness – the resistance to scratching - is most important for this design context. This was a harder question with a reasonable discrimination index (DifI=43.67; DisI=0.32).

Question 13

One G2 comment was that there was not enough information to answer this question and that either B or C would be appropriate. Again the question asked for the **most** appropriate response, which was B. Answer A was the most popular wrong answer. The question was very difficult with a low discrimination index (DifI=38.37; DisI=0.22).

Question 14

One G2 comment was that the photograph is confusing. The colour photo clearly shows the grain structure of the metal. Candidates recognised the issue of selectivity on achieving the requisite grain structure and D was the most popular wrong answer. This was a difficult question (DifI=27.60; DisI=0.25).

Question 19

One G2 comment was that there could be a variety of combinations depending on which product the candidate was thinking about. This question was not an issue for the candidates and more than half got it right. C was a more popular wrong answer than A or B (DifI=55.01; DisI=0.16).

Question 24

One G2 asked if the third force should be torsion. Another commented that whilst there is an obvious answer there are also two identical wrong answers. One G2 stated that the question uses the word torque but that the force should actually be torsion, which is the result of two forces rotating in opposite directions. Torque is a single rotating force. Apologies for the two identical wrong answers. Fortunately, the candidates found this question very easy (DifI=94.14; DisI=0.10).

Question 30

One G2 comment was that this was an odd question. A second asked 'compared with what? – all other forms of casting?' The wording could have been better for this question which candidates found reasonably difficult and was quite discriminating (DifI=53.12; DisI=0.32).

Question 40

One G2 comment was that this question is a little confusing as *'it could depend on the geographical location. Wind shear is a problem in tropical countries. Air over sea and hills may differ, so may be a case for B or C'.* A reasonably easy and but poorly discriminating question (DifI=78.26; DisI=0.19).

The following table provides a summary of the how each candidate answered each question, the resulting difficulty index and discrimination index.

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Question	A	B	C	D	Difficulty Index	Discrimination index
1	92	392*	36	9	74.10	0.18
2	137	72	211*	108	39.89	0.19
3	173*	117	200*	38	70.51	0.10
4	421*	39	17	52	79.58	0.35
5	124	66	302*	37	57.09	0.48
6	395*	0	16	118	74.67	0.21
7	189*	15	171	154	35.73	0.07
8	30	338*	85	76	63.89	0.27
9	28	26	24	451*	85.26	0.25
10	86	34	389*	20	73.53	0.14
11	399*	63	42	25	75.43	0.40
12	35	7	256	231*	43.67	0.32
13	265	122*	81*	61	38.37	0.22
14	102	47	146*	233	27.60	0.25
15	73	19	408*	29	77.13	0.30
16	249*	264	6	10	47.07	0.39
17	262	63	140	63*	11.91	0.06
18	34	104	42	349*	65.97	0.36
19	54	42	142	291*	55.01	0.16
20	74	287	149*	19	28.17	-0.02
21	296*	115	58	60	55.95	0.39
22	60	290*	162	17	54.82	0.32
23	153	21	3	350*	66.16	0.20
24	10	498*	17	4	94.14	0.10
25	75	62	363*	29	68.62	0.29
26	9	22	60	438*	82.80	0.23
27	229*	121	133	46	43.29	0.39
28	39	145	72	273*	51.61	0.18
29	17	3	62	447*	84.50	0.31
30	281*	16	205	27	53.12	0.32
31	72	253*	108	94	47.83	0.28
32	246*	22	22	239	46.50	0.39
33	96	33	311*	87	58.79	0.31
34	392	80	19	38	74.10	0.35
35	296	17	57	157	55.95	0.11
36	33	259*	125	110	48.96	0.27
37	5	511*	4	8	96.60	0,06
38	333*	31	81	80	62.95	0.08
39	30	317*	171	10	59.92	0.19
40	82	5	414*	27	78.26	0.19

Number of candidates 529

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Higher level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 6	7 - 13	14 - 17	18 - 24	25 - 30	31 - 37	38 - 60

General comments

Thirteen G2s were received for this paper. 75% of respondents considered the paper of a similar standard to last year with 25% split evenly between "a little easier" or "a little more difficult". 92% considered the level of difficulty appropriate, with 8% stating it was too difficult. These statistics indicate that most teachers thought that the paper was fair and matched their expectations. No respondent thought the paper poor in relation to syllabus coverage with 46% stating it was satisfactory and 54% good. Syllabus coverage is an emotive issue as teachers will inevitably give more emphasis to some topics than others depending on interpretation of the Assessment Statements and Teacher notes as well as style of teaching. It should be noted that paper one and paper two examine core and AHL topics. The comments for paper one indicate that the number of questions on the paper are in proportion to the recommended teaching hours for each topic and in this way syllabus coverage is maintained. Paper two questions are more diverse with 50% of the marks for Objective 1 and Objective 2 questions and 50% for Objective 3 questions. In Section B, 9 marks are allocated to the last part of the question so clearly syllabus coverage is restricted in relation to this. An holistic view is required therefore when assessing syllabus coverage for paper two.

15% of G2 comments thought that the clarity of wording of the paper was poor. Although 39% thought it satisfactory and 46% good, this was the only category considered poor and probably refers to the context used for the data based question in Section A and specifically to words such as "submersibles", "ballast" and "jettisoning". The concept of a submersible was explained in the stem of the question and did not seem to be a problem for candidates. "Ballast" and "jettisoning" could have been more of an issue. Most candidates seemed to understand the references in relation to the data but it may be true that weaker candidates were confused by the wording.

77% of G2 comments stated that the presentation of the paper was good with 23% stating it was satisfactory. These are quite pleasing statistics as much effort has been made to try and improve the presentation of the papers over the past few years and this will continue to be a priority in the future. It is not always an easy task as question setters try to use interesting and varied contexts from a wide variety of sources and sometimes it is tricky to obtain good images suitable for formatting into an examination paper, as shown with Figure 6 for Question 9.

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The strengths and weaknesses of the candidates in the treatment of individual questions

Section A

Question 1

a) (i) This was a simple calculation which the vast majority of candidates managed correctly.

(ii) This question was generally answered well though some candidates did not go far enough in their answer to *outline* a limitation i.e., reference to the maximum load and why a user might want to exceed it, e.g. to take on board equipment.

b) (i) Most candidates scored at least one mark for this question but some merely restated the question.

(ii) A wide range of mostly acceptable answers were offered for this question.

c) The intention of this question was to ask candidates to focus on safety due to fogging of the dome, though answers relating to comfort were also relevant. As an Objective 3 question, candidates needed to prepare their answer carefully in order to *explain* why it is important to control the moisture. Questions such as this are designed to make candidates think about the situation carefully and what it would be like to take a journey in the craft.

d) This question was not well answered by the majority of candidates who suggested water pressure as a reason, showing that they did not understand that the specifications for the dome would have taken into account anticipated safety requirements so the high factor of safety was to cope with unforeseen circumstances.

e) (i) This was an easy question for the majority of candidates.

(ii) Another higher order question requiring candidates to consider the most important aspect of an emergency situation, i.e. getting to the surface as quickly as possible. Although some of the vocabulary may be unfamiliar, better candidates worked out that lead is heavy and would have an effect on buoyancy and that most emergencies would entail system failures.

(iii) This question follows on from (ii) asking candidates to consider safety and emergency situations again. Most candidates correctly identified the three systems for back-up but did not always plan their answer carefully enough to explain the sequence of events.

Question 2

a) This was answered correctly by most candidates.

b) Many candidates did not see the link between (a) and (b) and the progression from craft production to mechanisation and hence, mass production.

Question 3

a) LVL is a new addition to the syllabus and on the basis of the generally poor answers is not well known to most candidates.

b) The weak answers followed on from (a).

Question 4

    a)   This was an easy question for almost all candidates.

    b)   Most candidates knew enough to gain marks but only those who structured their response astutely to take into account effect on the environment gained all three marks.

Question 5

    a)   This question was not answered well by most candidates. It was apparent that many candidates had a reasonable understanding of a chain drive system but their answers were not precise enough. Many answers referred to a bicycle system not systems used in manufacturing.

    b)   The intention was for candidates to describe a basic system in (a) and then apply it to the bicycle, referring to interaction with the gear system.

Question 6

    a)   Although many answers were vague, most candidates were able to gain the mark available.

    b)   This was well understood by the majority of candidates, though answers were not always clear enough for full marks.

Section B

Question 7

    a)   (i) It was surprising that so many candidates did not get this question right as the stem led the way by reference to cocoa leaves and cola nuts. It may be that because the product is so well known, candidates did not bother to read the stem of the question properly.

        (ii) This question required higher order thinking and was designed to differentiate between abilities. Many answers referred to the use of glass and the logo rather than texture and shape (silhouette).

    b)   (i) Again, many candidates failed to read the question properly and did not relate a use to health and safety.

        (ii) Most candidates displayed a good awareness of the technique of blow moulding.

    c)   (i) Many answers failed to make the connection that glass is an appropriate material due to its effect on the environment.

        (ii) This question was poorly answered by the majority of candidates which affected their overall marks for Section B. One G2 comment stated this was not an appropriate question as "design classic" is not on the syllabus. The concept of a classic design should be known by candidates who have studied the course and understand about design evaluation and innovation. The stem of the question gives the date of 1916 for the original design and clearly it is still popular today. The point of the question was therefore to explore why this was so. Candidates needed to use their holistic knowledge of the course as well as their experience with project work where they often analysed products. Similar questions will be used in some future examinations though candidates do not need to choose such questions in Section B.

Question 8

a) (i) This question posed few problems.

(ii) Many answers were quite muddled – a compare question needs careful thinking before committing words to paper.

b) (i) Many candidates did not read the question carefully enough and listed general maintenance requirements for the product in use rather than consideration at the design stage.

(ii) Most candidates answered this question correctly.

c) (i) This question was quite straightforward for most candidates.

(ii) Candidates needed to refer to specific properties rather than just characteristics such as "durability". From knowledge of Topic Three, candidates should have been able to compile a list of properties and then identify which ones apply to the metal structure in relation to design requirements as part of their plan for the question. Candidates that managed this usually scored high marks.

Question 9

a) (i) The question is designed to explore the difference between on-site construction (mainly craft), and off-site (mechanisation and/or automation) which quite a few candidates understood.

(ii) This question posed few problems.

b) (i) There was a tendency to repeat aspects of the question stem rather than say how the roof operates intelligently, i.e. with the use of sensors.

(ii) Most candidates answered this question well.

c) (i) This proved a difficult question for most candidates and one G2 comment stated that it was an unfair question as *concept house* is not on the syllabus. Candidates who have studied the course should be familiar with a *design concept*. Previous examination questions have referred to concept cars without comment from teachers. It may be that the leap from a concept design relating to houses rather than cars is too much for most candidates but the principle remains the same. An important aspect of the question stem is the reference to the construction of the concept house, i.e. a prototype so it can be tested for potential to volume produce.

(ii) Answers to this question were mostly poor. The key aspects to consider are *cost-effectiveness* and *global innovation*. Candidates needed to reflect on their knowledge of global markets and multinational companies and relate this knowledge to the house design. There are clues in the stem of the question to help candidates focus on aspects of the design, e.g. a smart home is adaptable and the building is factory made. Candidates needed to consider economic, social, environmental and cultural needs for housing in different parts of the world.

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Recommendations for the teaching of future candidates

Despite criticism of the use of some of the vocabulary in Section A, the context for the data based question was accessible and candidates felt able to attempt the questions. It must be stressed that the point of including a data based question is that the context is not from the syllabus and the objective is that candidates can understand the data, identify relevant aspects to specific questions and successfully apply the data. This is consistent with the work of designers in different fields. Objective 3 questions in this section lulled many candidates into a false sense of security as the questions themselves are not inherently difficult but for the marks candidates had to think carefully how three different marks could be achieved. As part of their examination preparation candidates must become aware that marks will not be given for repeating parts of the given question or repeating answers in sub-parts of questions.

In Section B, Question 8 was by far the most popular question. Candidates need to use their reading time in the examination hall to peruse the paper carefully and make a reasoned choice of which Section B question to answer. Clearly some candidates did not do this and chose Question 7 because of the familiarity of the context without paying attention to the final (9 mark) question which they did not fully understand. The same can be said for Question 9. Ironically the context for Question 8 is far less familiar than that of Question 7 but most candidates felt more comfortable with the sequence of questions.

Higher level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 4	5 - 8	9 - 14	15 - 19	20 - 24	25 - 29	30 - 40

General comments

This session saw the first use of the new Paper Three format in which candidates were required to study just one option rather than two as before. Higher level options were marked out of 40 marks (see below). Of the options, E and C were the most popular followed by A, D and finally B.

Question	Comments	Mark allocation
1	A data question based on core material	6 (1, 2 and 3)
2	Syllabus coverage based on extension material	3 (1 and 2)
3	A data question based on core material	4 (2 and 2)
4	Syllabus coverage based on core material	6 (3 and 3)
5	Syllabus coverage based on extension material	6 (2, 2 and 2)
6	An extended response question based on extension material	6
7	An extended response question based on core material	9

This structure enabled the questions to explore the various topics in more depth than in the previous Guide and to provide more opportunity for extended responses than in previous papers. Hopefully this also allowed schools to specialise in terms of the resources to support curriculum delivery. The examining team did have some concerns as to whether options were being taught or whether candidates were expected to cover the material through self study. Candidates from some schools evidenced very poor performance on the options paper. This, coupled with the fact that for some schools, candidates attempted a range of different options (candidates from one school for example attempted four different options), suggested that some schools were just not teaching the options but allowing candidates to undertake independent study. This was not what was expected or required. It was anticipated that through an appropriate design of the scheme of work that teachers would be able to explore core material through the options. Obviously different options lend themselves to different topics to a greater or lesser extent. Candidates who are not taught their options are seriously disadvantaged.

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Fourteen G2s were received for this paper by the time that the grade award meeting was convened. 62.5% considered this paper to be of a similar standard to last year, with 86% considering the level of difficulty to be good. 100% regarded the syllabus coverage to be satisfactory or good. 93% considered the clarity of wording to be satisfactory or good and 100% found the presentation of the paper satisfactory or good.

The strengths and weaknesses of the candidates in the treatment of individual questions

OPTION A – Food Science and technology

Question A1

This was a three-part data question worth a total of six marks and based on core material. The context for this question related to the environmental impact at different stages of the production of potato crisps.

Part (a) required that candidates state the total carbon dioxide emitted in the sowing and growing of the potatoes and transporting them to the factory. Candidates were required to include the units in the response to gain the mark. Leaving out the units resulted in the loss of the mark. This question was generally well answered by candidates.

Part (b) required that candidates state one example of primary processing and one example of secondary processing involved in the manufacture of the potato crisps. This was fairly straightforward for most candidates.

Part (c) asked candidates to suggest one way in which the carbon footprint of the potato crisps associated with Step 1 of the production process could be reduced. The markscheme answer related to on-farm processing to reduce the distance from farm to factory. Some candidates offered the use of hybrid vehicles as a response. Clearly this would also reduce the carbon footprint. The question was answered satisfactorily by many but not all candidates.

Question A2

Part (a) required a definition of undernourishment and needed to be reasonably precise for one mark. This was answered very poorly. Candidates were generally unable to answer Part (b) and few achieved two marks for this section of the question.

Question A3

This question was about the label on a bottle of vegetable oil containing vegetable oil and ascorbyl palmitate. Part (a) asked the role of ascorbyl palmitate in the vegetable oil. Ascorbyl palmitate is an antioxidant. Many candidates thought incorrectly that it was a preservative. Part (b) asked candidates to describe one influence of ascorbyl palmitate on the shelf life of the vegetable oil.

The antioxidant extends the shelf life of the vegetable oil by being more readily oxidised than the vegetable oil. Many candidates made what seemed to be a good guess and said the shelf life was enhanced. However few were able to offer an explanation for this.

It is important that candidates think about the answers and how they match them up to the different sections of a question. Some candidates leap in and answer without thinking and then when they reach the second part of the question where the first answer might have been more appropriate repeat themselves or provide an answer which would have been more appropriate to the first part.

Question A4

This question asked candidates to explain why a number of products which do not contain nuts are labelled with warnings that they may contain traces of nuts. Whilst there were a number of very good answers, this was by no means a feature across the board. Good responses were able to talk about processing issues and life-threatening allergies to nuts. There were many poor responses unfortunately.

Question A5

A three-part question focused on genetically-modified (GM) crops. Part (a) asked candidates to describe why consumer confidence is important in the development of new food products. The question required candidates to recognise the importance of markets to product success. Many candidates did not evidence their understanding of this.

Parts (b) and (c) focused specifically on FlavrSavr tomatoes. Part (b) asked candidates to describe one advantage of FlavrSavr tomatoes over traditionally-grown tomatoes. It was surprising how a number of candidates were unable to identify this. Part (c) asked candidates to describe how FlavrSavr tomatoes can be identified biochemically from other tomatoes. The question required candidates to be aware that kanamycin resistance is incorporated into FlavrSavr tomatoes along with the other genetic characteristics contributing to enhanced shelf life. Many, if not most, candidates were unable to answer the third part of this question. As an overall comment, teachers need to emphasise preparation for answering the questions which is as important as teaching the knowledge.

Question A6

This question was divided into two parts – (a) and (b) – each worth three marks. Part (a) asked candidates to explain one way in which good personal hygiene can help to prevent food poisoning. Part (b) asked candidates to explain one way in which the design of food preparation areas can help prevent contamination of food with food poisoning bacteria. This was an accessible question for the majority. Some candidates did not think about their answers before committing pen to paper and got muddled about the best way to respond to each part of the question and lost marks as a result. Candidates must target their responses to the different sections of questions appropriately to maximise their achievement.

Question A7

Candidates who were well structured in developing their responses to this question achieved better marks. The question required responses relating to three aspects of diet – fat, fibre and sugar and how health awareness would affect the intake of each. Good answers suggested how health awareness would impact on intake and explained why and how this might be achieved. Some candidates did extremely well on this question while others, particularly those whose answers lacked structure, floundered. Some candidates did very badly on this question.

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OPTION B – Electronic product design

Only a very small number of candidates/schools responded to this option and thus it is difficult to draw any significant conclusions about it. Obviously candidates had a detailed knowledge of electronics from practical work but lacked wider application of this to electronic product design as a global innovation. Many of the candidates answering this option demonstrated a physics approach rather than a design approach to electronic products.

Question B1

This was a three-part data question worth a total of six marks and based on core material. Part (a) asked candidates to state one reason why a digital control system is appropriate to this application. The question was looking for a statement that a yes/no decision was being made to turn the light on/off. Many, but by no means all, candidates were able to achieve one mark for this question.

Part (b) asked candidates to identify the key component in the light sensor. The answer required was that a light-dependent (LDR)/variable resistor was the key component and that it detects light levels rising or falling. Many candidates got one mark for this question but failed to provide a brief explanation and gain the second mark.

Part (c) asked candidates to identify the logic gate required to perform the function described and explain why it was suitable. The markscheme required candidates to identify that an AND gate was required and to explain this either using a truth table or in words. Many candidates were able to gain two or even three marks on this part of the question.

Question B2

Part (a) asked candidates to state one difference between a conventional and a smart home. This seemed a very straightforward question although candidate responses did not reflect this! Part (b) asked candidates to identify one reason for using smart technology in a smart home. This was answered better on the whole and many candidates got one or two marks.

Question B3

The first part of this two-part question asked candidates to draw the circuit for an additional amplifier comprising an operational amplifier and two resistors for an audio system to enable music to be played in any room. One mark was awarded for drawing the circuit and a second mark for adding the labels. Many candidates were able to complete the circuit appropriately labelled and achieve two marks. The second part of the question required candidates to identify resistors of suitable values to make the gain of the circuit equal to 10.

Many candidates were able to identify that the resistor in parallel with the operational amplifier needed to be ten times the value of the one connected to the negative input of the operational amplifier. The range of values selected by candidates for the resistors was often inappropriate so that many candidates did not achieve the second mark.

Question B4

This question was about the issues that should be considered by an aid agency trying to establish an electrical power supply in response to a humanitarian crisis in the developed world and a remote area in the developing world. The question was generally not well answered and few candidates achieved full marks, despite this question directly reflecting an assessment statement in the Guide.

Question B5

This question was about product stewardship. Part (a) asked one implication of product stewardship for manufacturers. This was generally poorly answered. Part (b) asked candidates to outline one way in which service costs reduce the life of a product and explored the issue of high maintenance costs, expense and unavailability of spare parts and the fact that it is often cheaper to replace than repair a product. This was generally well answered. Part (c) asked candidates to outline one way in which digital photography is more environmentally friendly than a conventional photograph. This question was relatively straightforward and answered well by many candidates.

Question B6

Part (a) asked candidates to discuss one impact of converging technologies on human performance. It was not well answered by many candidates. Part (b) asked candidates to explain how converging technologies could impact on human health. Again this was poorly answered by many candidates.

Question B7

This question asked for a discussion of three reasons why a manufacturer might consider programmable interface controllers (PICs) to be a sustainable technology. Those candidates identifying three distinct reasons and then providing detailed explanation of each reason in a clearly structured manner tended to achieve higher marks. For candidates not using a clear structure, there tended to be a lot of repetition in the answers and it was very rare then for candidates to acheve higher marks.

OPTION C – CAD/CAM

This was the second most popular option. One G2 commented: *'CAD CAM – very good question'*.

Question C1

The design context for this three-part data question worth a total of six marks and based on core material was the application of finite element analysis (FEA) to the development of a car design. Part (a) asked candidates to state one ergonomic consideration for the use of FEA in relation to a car crashing into a wall. A number of candidates were unable to relate FEA to ergonomic considerations. Part (b) asked candidates to outline one reason why designers need a range of data relating to the crash testing of a design to be able to produce an FEA simulation.

This was answered better and many candidates were able to identify that the production of an accurate FEA simulation considering the use of different materials, joints and shapes that might be used in the design would require a considerable amount of data. Part (c) was very badly answered. There were some very good answers identifying that FEA would be used in advance of any physical prototyping so that better designs could be produced more cheaply and quickly without the use of any physical resources. However, some answers were very poor.

Question C2

Part (a) of this two-part question asked candidates to state one characteristic of CAM that has improved quality control. Part (b) asked candidates to outline one way in which CAM has reduced waste in manufacturing and was looking for an answer which identified that the enhanced quality control and reduced manufacturing error would lead to less waste. Alternative answers might have focused on: the accurate tessellation of parts cut from larger pieces of material; that CAM is an important element of JIT so that products are only manufactured to order; the enhanced feedback and the ability to shut down a machine that is making defective products. This seemed a fairly straightforward question but was generally not answered well by candidates.

Question C3

This two-part question showed a picture of a Boxford CNC lathe and a part being produced with a CNC lathe. Part (a) asked how a CNC lathe is interfaced to a computer in a CAD/CAM system to produce the part shown. There were some excellent answers that identified that the 2-D image was converted from CAD into G-codes to represent the X and Y coordinates using post-processing software and transmitted to the CAM. Part (b) asked candidates to identify one reason why parts made on a CNC lathe can be generated from a 2-D CAD drawing. That the lathe rotates a block of material and therefore only X and Y coordinates are required to machine the part was not identified by many candidates. Notwithstanding this there were some excellent answers by a small number of candidates.

Question C4

This question asked candidates to discuss two ways in which CAD/CAM has benefited the design and manufacture of the jewellery shown in the figure. There were a number of good answers. A range of answers were possible. Better answers structured the response and so avoided duplication and achieved maximum marks.

Question C5

This question focused on the use of robots in manufacturing environments. Part (a) asked candidates to outline one advantage of using robots in manufacturing areas involving hazardous conditions. Many candidates were able to provide good answers to this question. The second part asked candidates to describe one impact that the introduction of robots to the workplace has had on traditional working practices and again candidates were generally able to provide good answers. The third part of the question asked candidates to identify one advantage of electrical robots over hydraulic robots. Some candidates, but not all, were able to provide an answer to this question.

Question C6

This design context for this question was the manufacture of a range of solid timber door and drawer designs. Part (a) asked candidates to discuss one advantage to the manufacturer of using CAM to produce the solid timber doors and was reasonably well answered. Again, structured answers identifying three clear distinct marking points and avoiding repetition achieved higher marks.

Part (b) asked candidates to explain one way in which CAM has changed the type and range of furniture made in solid timber available to consumers. There is a range of ways in which CAM has impacted, e.g. that it: aids mass customization; reduces lead times; enables JIT. Candidates were generally able to explain one way with structured answers generally achieving full marks.

Question C7

This question asked candidates to discuss three issues faced by manufacturers when choosing new CAD/CAM equipment. The nine mark questions require candidates to structure three (3 mark) responses and it is critically important that candidates do not just leap in and write down a stream of consciousness. Clear identification of three distinct ways is important, followed through by distinct points of explanation. Poorly structured answers are often repetitive and thus do not gain full marks.

OPTION D - Textiles

Question D1

This was a three-part data question worth a total of six marks and based on core material. The stem of this question was quite long and in future papers the examiners will strive to ensure that the stems for each option across the paper are of similar length. It also had six small images showing different stages in the production of a dress. The question focused on scales of production and why different scales of production might be used in combination. The first part of the question asked candidates to state one aspect of the production of the dress that is automated. The collection of body measurements and the cutting of the pieces are both shown in the diagrams to be automated processes. The second part of the question asked for one reason why some aspects of the production of the dress are mechanized. Unsurprisingly perhaps, the third part of the question asked why some parts of the manufacture of the dress might still be done by hand. This was perhaps the best answered part of the question and candidates were generally able to identify complexity, the quality of finish and the adding of prestige/price to the finished product as reasons for hand finishing.

Question D2

Part (a) asked candidates to define intelligent fabric. This was not answered well by many candidates who were unable to produce a reasonable definition of an intelligent fabric. Similarly many candidates were unable to describe the contribution of Elektex™ fabric to the production of wearable computing garments.

Question D3

This question showed Woolmark™ symbols which are used on woollen products to indicate their wool content. Part (a) asked candidates to outline one advantage to the consumer of the Woolmark™ symbols. This was straightforward for all but the weakest candidates. Part (b) asked candidates to outline one natural or synthetic fibre that can be blended with wool to enhance the characteristics of wool.

Whilst most candidates were able to name a fibre that could be blended with wool, many did not follow on to explain how the fibre would enhance the characteristics of wool. This 'outline' question was looking to award two marks – one for identifying a fibre and one for a brief explanation of how the fibre would enhance the characteristics of wool. Many candidates achieved only one mark for this question.

Question D4

This question asked candidates to discuss one positive and one negative impact of male and female modelling on the behaviour and health of adolescents. It may be that the use of headings explicitly on the examination paper helped candidates to structure their work but it was pleasing that many candidates were able to respond well to this question and to achieve a good mark.

Question D5

This question focused on the EU flower. Part (a) required candidates to describe the significance of the EU flower as an environmental quality mark. Many candidates were able to answer this question well and relate the mark to life cycle analysis and the minimization of environmental impact throughout the product life cycle. Part (b) required candidates to outline one benefit of the EU flower system for manufacturers. When the question specifies a particular perspective on an issue it is important that candidates focus on exploring the issue from that particular perspective. Thus a consumer benefit is inappropriate. Candidates must read and answer the question asked.

Question D6

Part (a) of this question asked candidates to discuss one impact of the introduction of mechanisation in the textile industry on the workforce during the Industrial Revolution. This question was answered reasonably well by candidates. Part (b) asked for an explanation of one benefit of automation. Again this question did not pose any particular issues for candidates.

Question D7

This question was clearly structured into three parts. It required candidates to name one biometric innovation. Most candidates who managed to name an innovation used the Speedo Fastskin swimsuit as their example. No marks were awarded for naming the innovation. They were then asked to explain how research and development has contributed to the development of the innovation. This section was poorly answered. Candidates were then asked to explain one advantage and one disadvantage of using the innovation in sports clothing. This was generally answered well.

OPTION E – Human factors design

There were G2 comments relating to Option E. One comment related to the poor diagram for Figure E3. One comment was that E1 (b) and E3 (a) were both about the collection of dynamic anthropometric data.

Question E1

This was a three-part data question worth a total of six marks and based on core material. It focused on the design context of a soapbox car. Part (a) of the question asked candidates to state one ergonomic reason why dimension A might vary. Many but not all candidates were able to identify the different width of riders as being the reason for this. Part (b) asked candidates to outline one strategy for collecting dynamic anthropometric data for the design of a soapbox car. Part (c) asked candidates to explain why there is a maximum but no minimum dimension for 'G'.

One G2 comment was that E1(c) was 'obscure'. This was intended as a more difficult question to see how candidates would interpret the data with which they were provided, relating to the centre of gravity and keeping it as low as possible to enhance the stability of the car. Many candidates were able to provide good answers to this question. Some weaker candidates were not able to do so.

Question E2

Part (a) of this question asked candidates to state the relationship between digital humans and motion capture. This seemed straightforward, i.e. that motion capture is used to provide data to develop digital humans. Many candidates confused the concept of a digital human with that of a robot. Part (b) asked candidates to outline how digital humans could be used to improve worker safety on a production line. Following on from the confusion with robots, a considerable number of candidates were unable to answer this question appropriately.

Question E3

This question focused on the design of the Ergogel bicycle seat. It asked why, (not how), dynamic anthropometric data would have been collected to inform the design of the seat. While there were some excellent answers there were also some very poor answers from weak candidates. Part (b) asked for a description of one effect of producing three models of the seat on product sales. Many candidates were able to identify correctly that the three models would widen the market for the seat and thus increase sales.

Question E4

This question asked candidates to provide an explanation of two methods that could be used to identify hazards faced by long distance truck drivers in order to help to prevent accidents. The markscheme was looking for scenario analysis, fault tree analysis and hazard assessment as responses. Some weaker candidates went into a stream of consciousness without any structure, repeated themselves and achieved very low marks. Better structured answers generally achieved high marks.

Question E5

This three-part question focused on designing for pleasure. The first part asked candidates to explain why designing for pleasure is designing beyond usability. Whilst this seemed straightforward many candidates struggled to describe this. Part (b) asked candidates to describe one reason why a designer would consider socio-pleasure as an important design criteria. One G2 felt that E5(a) and (b) were badly worded and discriminated against English as second language candidates and furthermore that E5(a) was obscure and did not relate to the specification. Presumably the term specification here means the Guide. There is a whole section in the new Guide on designing for pleasure and designing beyond usability so that this is deemed 'obscure' seems an odd statement. Part (c) asked candidates to identify one product that is an example of ideo-pleasure design.

The most common product identified was the iPhone. However many candidates did not follow through to provide a brief explanation of why the I-phone is an example of ideo-pleasure design. Two mark questions, such as 'outline' or 'identify', always require a brief explanation for the second mark. Teachers should explain the action verbs/command terms to candidates and their significance. This would make it easier for candidates to understand the requirements of the question in framing their answers.

Question E6

Part (a) of this question asked candidates to explain one way in which the conflicting design requirements of seating on public transport might be reconciled. One mark was awarded for identifying each of the two conflicting design requirements and one mark for stating how this conflict might be reconciled. Whilst there were some good responses to this question there were also some very poor responses. Part (b) asked candidates to describe one disability-related design context in which legislation prioritizes conflicting design considerations. The action verb/command term 'describe' is objective two, not objective three and it would have been better worded as discuss or explain which are objective three terms. Notwithstanding this many candidates were able to identify an appropriate design context, most often wheelchair access, and explore how legislation prioritized conflicting design considerations.

Question E7

This question asked candidates to explain three strategies a designer could employ to ensure an effective user-product interface. Well structured answers enabled candidates to avoid repetition. This was not a difficult question and at the heart of human factors design and was answered well by many candidates with the highest marks being achieved by those candidates structuring their responses well.

Recommendations for the teaching of future candidates

Now that candidates study only one option, rather than the two that were studied before, the examination papers are able to go into more depth than before. Thus, candidates need to be made aware of the theories and concepts underpinning the optional material and to be able to see how these theories and concepts impact on the real world and the design process through appropriate practical work. As mentioned elsewhere in this report, the Design Project should relate to the option selected so that the project and the option are synergistic and build on each other to reinforce learning and do not lead to an exacerbation of workload issues which would be to the disadvantage of the candidate. Teachers should spend some time in helping candidate to understand how to structure their answers, especially for six mark and nine mark questions. Poorly structured answers tended to gain fewer marks. If teachers look at the markschemes for the papers it can be seen that one mark is awarded for each distinct relevant correct point.

Standard level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 11	12 - 16	17 - 19	20 - 21	22 - 24	25 - 30

General comments

Eleven G2s had been received for this paper at the time of the Grade Award meeting. As for the Higher Level paper, these comments were studied carefully at the grade award meeting and were used alongside other evidence, particularly candidate responses to the paper as evidenced through the statistics (difficulty index (DifI) and discrimination index (DisI)), (see the section reporting on the Higher Level paper one for explanation of these terms), to determine grade boundaries for the paper.

The Grade Award team are grateful for the input from teachers through the G2 forms as it informs the process of boundary setting. 57% considered this paper to be of a similar standard to last year's paper, with 14% finding it a little more difficult and 29% finding it much more difficult. 82% considered the level of difficulty to be appropriate. 90% considered the syllabus coverage to be satisfactory or good. 55% felt that the clarity of wording was good and 73% considered the presentation of the paper to be good.

There seemed to be some G2 agreement that this year's paper one was very different, more difficult and less well-worded than previous ones. Obviously this is a paper based on the new Guide and so there are new topics that were not in the previous Guide. One G2 asserted that this was *'a very difficult paper with badly worded questions'*. As for the Higher Level paper there were negative comments about the table-formatted questions. Also there were the comments about the inappropriateness of the paper for ESL candidates. There were fifteen questions common to both the higher and standard level papers.

Individual question analysis

Question 1

There was a G2 comment that the word 'formalized' may have led candidates to think it was a way of leading to the design criteria for a product, so it could be A or B. A fairly easy question but only moderately discriminating (DifI=80.66; DisI=0.16).

Question 10

One G2 said: *'May be the most popular and may depend on how the car is being disposed of'.* Another G2 said: *'Would not the energy consumption be the most important consideration at both the utilization and disposal stages of the car's life cycle?'* A slightly more difficult question with reasonable discrimination (DifI=62.11; DisI=0.29).

Question 12

One G2 said: *'Given the glossary definition of 'reuse', what is the correct answer?'.* A reasonably easy question with moderate discrimination (DifI=70.51; DisI=0.22).

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Question 14

One G2 said: *'There could be two correct answers here'.*   A harder question with good discrimination (DifI=50.98; DisI=0.36).

Question 18

One G2 said: *'Urea-formaldehyde could be used for A, B and C and it is hard to know which is the most common'.*   A difficult question with low discrimination (DifI=23.83; DisI=0.17).

Question 27

The final four questions were all related to a small case study.   One G2 stated: *'A little confusing as it asks 'why do manufacturers have control over the costs …?' and the answers offered are a statement of types of costs. I assume it is B'.*   A difficult question with moderate discrimination (DifI=53.52; DisI=0.28).

The following table provides a summary of the how each candidate answered each question, the resulting difficulty index and discrimination index.

Question	A	B	C	D	Difficulty Index	Discrimination index
1	75	413*	13	11	80.66	0.16
2	38	31	414*	29	80.86	0.27
3	138	65	211*	98	41.21	0.17
4	22	135	306*	49	59.77	0.36
5	205*	91	154*	62	70.12	0.16
6	90	184*	159	79	35.94	0.25
7	385*	52	27	48	75.20	0.42
8	228*	121	35	128	44.53	0.13
9	370*	7	23	112	72.27	0.32
10	36	318*	107	51	62.11	0.29
11	33	53	44	382*	74.61	0.39
12	86	37	361*	28	70.51	0.22
13	340*	87	59	26	66.41	0.46
14	117	87	261*	47	50.98	0.36
15	53	14	217	228*	44.53	0.44
16	18	17	50	427*	83.40	0.26
17	130	61	93*	228	18.16	0.26
18	122*	52	258	80	23.83	0.17
19	92	21	372*	27	72.66	0.29
20	7	423*	33	49	82.62	0.26
21	239*	241	14	17	46.68	0.41
22	89	12	395*	16	77.15	0.11
23	41	130	48	293*	57.23	0.29
24	4	26	473*	9	92.38	0.17
25	57	54	118	283*	55.27	0.31
26	406*	23	65	18	79.30	0.13
27	64	274*	120	52	53.52	0.28
28	51	290*	133	34	56.64	0.44
29	15	7	468*	19	91.41	0.18
30	330	24	37	118*	23.03	0.33

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Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 5	6 - 10	11 - 12	13 - 17	18 - 21	22 - 26	27 - 40

General comments

Eleven G2s were received by the cut-off date. 72% of respondents thought the paper of similar standard to last year while 14% thought it a little easier and 14% a little more difficult. All respondents thought the level of difficulty was appropriate. These statistics indicate that the paper was fair to candidates of different abilities. For syllabus coverage 64% thought it was good, 27% satisfactory and 9% poor. Clearly with only eleven G2s the number of teachers who thought it poor was very small. The same reasoning applies to SL as made for HL in this respect – paper one and paper two examine the Core Topics, with paper one containing questions across all topic areas. The structure of paper two, with twelve marks allocated to a data based question in Section A which is non syllabus specific means that only eight marks are available for other questions in Section A for syllabus coverage. Section B questions are designed to be cross–topic but with nine marks for the last part of each question, only eleven marks are available for other questions. In order to maintain parity between each question in Section B the same structure is applied to each question. Question setters work to a pre-determined grid which states the marks allocated to each question and sub-parts. In this way the balance between questions based on Objectives One, Two and Three is achieved. Teachers may use this information to prepare candidates for the examination papers and particular styles of questions. 55% of G2 comments thought that the clarity of wording for the paper was good and 45% thought it satisfactory. The examining team will continue to try and ensure that this feature of the paper is improved upon. 64% of G2 comments thought that the presentation of the paper was good and 36% thought it satisfactory. Much effort goes into the presentation of these examination papers and is pleasing to note that they are generally well received by candidates and teachers alike.

The strengths and weaknesses of the candidates in the treatment of individual questions

Section A

Question 1

a) (i) This was a simple question which nearly all candidates answered correctly.

(ii) Many candidates did not scrutinise the graph carefully enough and interpreted the red line as level between 1988 and 1990. The question asked the candidates to state a specific year for one mark so they should have understood that a range was unacceptable and then this might have prompted them to look more closely at the graph.

(iii) Surprisingly, not many candidates achieved full marks for this question as the link between sales and fixed costs was not made.

b) (i) The majority of candidates failed to read the graph carefully enough and assumed that the green line between 1992 and 1997 meant zero sales of records. Clearly, if sales reached zero in 1992, the line would not have continued. Also, candidates did not appreciate that the vertical axis represented millions of sales and so although record sales bumped along the bottom of the graph they still amounted to a significant percentage of 100 million.

(ii) Although most candidates failed to achieve marks for (i), a good percentage were able to speculate that the availability of new technology caused obsolescence of records.

c) Many candidates failed to refer to specific data from the graph to support their statements and so did not achieve full marks for the question.

Question 2

a) A surprising number of candidates did not know of the term *design for manufacture* (DfM), as used in the Subject Guide.

b) Following on from (a) many candidates did not know specific strategies for DfM and just wrote about green product design.

Question 3

a) Most candidates knew about LCA, though not all related the life cycle to environmental issues. Some candidates still confuse life cycle analysis with product life cycle.

b) Most candidates understood the difference between eco and energy labelling but did not comment on how the labels affected consumer behaviour for the third mark.

Section B

There was a reasonable spread of choices between the three questions with Question 5 being the most popular followed by Question 4, then Question 6, though the disparity between the choices was not great.

Question 4

a) (i) Most candidates answered this question correctly.

(ii) Most candidates made a reasonable attempt to answer this question though some did not focus enough on tensile strength.

b) (i) This was a straightforward question for most candidates.

(ii) This question was generally answered well.

c) (i) Some answers to this question were quite vague and made reference to just making a profit but not to fixed and variable costs.

(ii) This question differentiated well between candidates abilities with all candidates managing to attempt the question, but the more able structured their responses carefully to ensue that they made three different points, well argued. As expected, weaker candidates displayed some knowledge but did not plan their answer carefully enough.

Question 5

a) (i) This was a straightforward question.

(ii) Most candidates were able to answer this question correctly.

(iii) Some candidates confused ductility with malleability and many did not link the property to the manufacturing technique *extrusion* stated in the stem of the question.

b) (i) A straightforward question.

(ii) Most candidates referred to the shape based on the paperclip but did not go on to develop their answer to explain the different form of the material used.

c) (i) Although this might have seemed a very difficult question to many candidates the clue was given in the stem of the question where the high price was stated. Candidates could also have speculated on the appeal of the unusual design to particular market segments.

(ii) Candidates who scored highly on this question planned their answer carefully to not only make three distinct points but ensure that in the discussion of each point, form and function were linked.

Question 6

a) (i) Most candidates failed to understand the definition of *robust design* and link it to the main objective of the design of the Roberts radio, which is retro styling.

(ii) Many answers were not specific enough in referring to digital technology and its effect on the design and merely referred to new technology.

(iii) The majority of candidates identified from the stem of the question that the Pam radio was portable and were then able to develop this answer. Although many other answers were acceptable, candidates would have needed to be able to relate to the social and economic conditions of the 1950s.

b) (i) Many answers to this question failed to make reference to the manufacturer.

(ii) Most candidates were able to consider the fact that the PAM radio was new and so there were fixed costs to be covered before making a profit though not many candidates developed their answer sufficiently to identify the type of costs involved.

c) (i) Candidates displayed an understanding of user research but many did not read the question carefully enough to relate the purpose of user research to the design brief, i.e. establishing the needs of the target market.

(ii) Most candidates restated what they had already written for other parts of the question referring to the new technology and multitude of stations available. Few candidates understood the main appeal of the Roberts radio to consumers in relation to style and why this might be so. Consequently, few candidates scored well on this question.

Recommendations for the teaching of future candidates

There are two key features of this paper which were crucial to candidates achieving a high score. One was looking very carefully at the graph for the data based question in Section A and fully understanding the magnitude of the axis and the relationship between the three types of innovation represented. The other was their choice of question for Section B and in particular, the ability to answer the nine mark question well. The application of grade descriptors during the Grade Award meeting to decide on the grade boundaries focused heavily on these key aspects. Not all of the Section B questions will appeal to candidates as the contexts are so diverse and question (c)(ii) for each requires candidates to apply knowledge gained from various parts of the course, but the diversity offers a range of choices.

Standard level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 3	4 - 7	8 - 9	10 - 14	15 - 18	19 - 23	24 - 30

General comments

This session saw the first use of the new Paper Three format in which candidates were required to study one option rather than two as before. Standard level options were marked out of 30 marks (see below). The new format allowed for more in-depth exploration of the topic areas. As for the higher level paper, options E and C were the most popular followed by A, D and finally B.

Question	Comments	Mark allocation
1	As higher level question 1 - a data question based on core material.	6 (1, 2 and 3)
2	Syllabus coverage based on core material.	3 (1 and 2)
3	As higher level question 3 – a data question based on core material.	4 (2 and 2)
4	Syllabus coverage based on core material.	6 (3 and 3)
5	As higher level question 4 - an extended response question based on core material.	6
6	As higher level question 7 - an extended response question based on core material.	9

One of the worrying issues was the poor performance by candidates from some schools on the options paper. This, coupled with the fact that for some schools, candidates attempted a range of different options, (candidates from one school, for example, attempted four different options), suggests that some schools are just not teaching the options but allowing candidates to undertake independent study. This was not what was expected or required. It was anticipated that through an appropriate design of the scheme of work that teachers would be able to explore core material through the options. Obviously different options lend themselves to different topics to a greater or lesser extent. Candidates who are not taught their options are seriously disadvantaged.

Eleven G2s had been received for this paper by the time the grade award meeting was convened. There was an even distribution between those who found this paper of a similar standard, a little more difficult or a lot more difficult than last year's paper. 100% found the level of difficulty to be appropriate, however. 45% considered the syllabus coverage satisfactory and 55% good. 64% found the clarity of wording good and 64% considered the presentation of the paper good.

The strengths and weaknesses of the candidates in the treatment of individual questions

OPTION A – Food Science and technology

Question A1

This was a three-part data question worth a total of six marks and based on core material. The context for this question related to the environmental impact at different stages of the production of potato crisps.

Part (a) required that candidates state the total carbon dioxide emitted in the sowing and growing of the potatoes and transporting them to the factory. Candidates were required to include the units in the response to gain the mark. Leaving out the units resulted in the loss of the mark. This question was generally well answered by candidates.

Part (b) required that candidates state one example of primary processing and one example of secondary processing involved in the manufacture of the potato crisps. This was fairly straightforward for most candidates.

Part (c) asked candidates to suggest one way in which the carbon footprint of the potato crisps associated with Step 1 of the production process could be reduced. The markscheme answer related to on-farm processing to reduce the distance from farm to factory. Some candidates offered the use of hybrid vehicles as a response. Clearly this would also reduce the carbon footprint. The question was answered satisfactorily by many but not all candidates.

Question A2

Part (a) asked candidates to define gelatinization. Part (b) requires candidates to identify one way in which the process of gelatinization affects the properties of bread. Answers to this were very poor by many candidates.

Question A3

This question was about the label on a bottle of vegetable oil containing vegetable oil and ascorbyl palmitate.

Part (a) asked the role of ascorbyl palmitate in the vegetable oil. Ascorbyl palmitate is an antioxidant. Many candidates thought incorrectly that it was a preservative. Part (b) asked candidates to describe one influence of ascorbyl palmitate on the shelf life of the vegetable oil. The antioxidant extends the shelf life of the vegetable oil by being more readily oxidised than the vegetable oil. Many candidates made what seemed to be a good guess and said the shelf life was enhanced. However few were able to offer an explanation for this.

It is important that candidates think about the answers and how they match them up to the different sections of a question. Some candidates leap in and answer without thinking and then when they reach the second part of the question where the first answer might have been more appropriate, repeat themselves or provide an answer which would have been more appropriate to the first part.

Question A4

This question asked candidates to list two drivers for new food products. A range of answers were possible and all but the weakest candidates were able to achieve the allotted marks.

Question A5

This question asked candidates to explain why a number of products which do not contain nuts are labelled with warnings that they may contain traces of nuts. Whilst there were a number of very good answers, this was by no means a feature across the board. Good responses were able to talk about processing issues and life-threatening allergies to nuts. There were many poor responses unfortunately.

Question A6

Candidates who were well structured in developing their responses to this question achieved better marks. The question required responses relating to three aspects of diet – fat, fibre and sugar and how health awareness would affect the intake of each. Good answers discussed suggested how health awareness would impact on intake and explained why and how this might be achieved. Some candidates did extremely well on this question while others, particularly those whose answers lacked structure, floundered. Some candidates did very badly on this question.

OPTION B – Electronic product design

Only a very small number of candidates/schools responded to this option and thus it is difficult to draw any significant conclusions about it. Obviously candidates had a detailed knowledge of electronics from practical work but lacked wider application of this to electronic product design as a global innovation. Many of the candidates answering this option demonstrated a physics approach rather than a design approach to electronic products.

Question B1

This was a three-part data question worth a total of six marks and based on core material. Part (a) asked candidates to state one reason why a digital control system is appropriate to this application. The question was looking for a statement that a yes/no decision was being made to turn the light on/off. Many, but by no means all, candidates were able to achieve one mark for this question.

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Part (b) asked candidates to identify the key component in the light sensor. The answer required was that a light-dependent (LDR)/variable resistor was the key component and that it detects light levels rising or falling. Many candidates got one mark for this question but failed to provide a brief explanation and gain the second mark.

Part (c) asked candidates to identify the logic gate required to perform the function described and explain why it was suitable. The markscheme required candidates to identify that an AND gate was required and to explain this either using a truth table or in words. Many candidates were able to gain two or even three marks on this part of the question.

Question B2

This two-part question was relatively straight forward and was answered well by the small number of candidates who attempted Option B. Part (a) required candidates to state the value of a resistor coded with two red, one brown and one gold stripe. Part (b) required candidates to calculate the power dissipated by the resistor when connected to a !0V DC power supply.

Question B3

The first part of this two-part question asked candidates to draw the circuit for an additional amplifier comprising an operational amplifier and two resistors for an audio system to enable music to be played in any room. One mark was awarded for drawing the circuit and a second mark for adding the labels. Many candidates were able to complete the circuit appropriately labelled and achieve two marks. The second part of the question required candidates to identify resistors of suitable values to make the gain of the circuit equal to 10. Many candidates were able to identify that the resistor in parallel with the operational amplifier needed to be ten times the value of the one connected to the negative input of the operational amplifier. The range of values selected by candidates for the resistors was often inappropriate so that many candidates did not achieve the second mark.

Question B4

This question offered two points for each distinct correct point in a description of the effect a second speaker would have on the current drawn from an amplifier. The question was not answered well by many candidates.

Question B5

This question was about the issues that should be considered by an aid agency trying to establish an electrical power supply in response to a humanitarian crisis in the developed world and a remote area in the developing world. The question was generally not well answered and few candidates achieved full marks, despite this question directly reflecting an assessment statement in the Guide.

Question B6

This question asked for a discussion of three reasons why a manufacturer might consider programmable interface controllers (PICs) to be a sustainable technology. Those candidates identifying three distinct reasons and then providing detailed explanation of each reason in a clearly structured manner tended to achieve higher marks. For candidates not using a clear structure there tended to be a lot of repetition in the answers and it was very difficult then for these candidates to achieve higher marks.

OPTION C – CAD/CAM

This was the second most popular option.

Question C1

The design context for this three-part data question worth a total of six marks and based on core material was the application of finite element analysis (FEA) to the development of a car design.

Part (a) asked candidates to state one ergonomic consideration for the use of FEA in relation to a car crashing into a wall. A number of candidates were unable to relate FEA to ergonomic considerations. Part (b) asked candidates to outline one reason why designers need a range of data relating to the crash testing of a design to be able to produce an FEA simulation. This was answered better and many candidates were able to identify that the production of an accurate FEA simulation considering the use of different materials, joints and shapes that might be used in the design would require a considerable amount of data. Part (c) was very badly answered. There were some very good answers identifying that FEA would be used in advance of any physical prototyping so that better designs could be produced more cheaply and quickly without the use of any physical resources. However, some answers were very poor.

Question C2

The first part of this question asked candidates to define fuse deposition modelling. Although there were some very good answers one had to wonder if some candidates had heard of fuse deposition modelling. There were some very creative guesses as candidates tried to use the words to inform their answers! The second part of the question asked candidates to outline how a CNC vinyl cutter could be used to make a 3-D outcome. A good response would have identified that a 3-D CAD image would be sliced into many layers and these layers would be glued together to form a 3-D model. There were some very good responses but these were out-numbered by some very poor responses.

Question C3

This two-part question showed a picture of a Boxford CNC lathe and a part being produced with a CNC lathe. Part (a) asked how a CNC lathe is interfaced to a computer in a CAD/CAM system to produce the part shown. There were some excellent answers that identified that the 2-D image was converted from CAD into G-codes to represent the X and Y coordinates using post-processing software and transmitted to the CAM. Part (b) asked candidates to identify one reason why parts made on a CNC lathe can be generated from a 2-D CAD drawing. That the lathe rotates a block of material and therefore only X and Y coordinates are required to machine the part was not identified by many candidates. Notwithstanding this there were some excellent answers by a small number of candidates.

Question C4

This two-mark question asked candidates to list two benefits of using rapid prototyping to develop cosmetic product packaging. This was answered extremely well by some candidates.

Question C5

This question asked candidates to discuss two ways in which CAD/CAM has benefited the design and manufacture of the jewellery shown in the figure. There were a number of good answers. A range of answers were possible. Better answers structured the response and so avoided duplication and achieved maximum marks.

Question C6

This question asked candidates to discuss three issues faced by manufacturers when choosing new CAD/CAM equipment. The nine mark questions require candidates to structure three (3 mark) responses and it is critically important that candidates do not just leap in and write down a stream of consciousness. Clear identification of three distinct ways is important, followed through by distinct points of explanation. Poorly structured answers were often repetitive and thus did not gain full marks.

OPTION D - Textiles

Question D1

This was a three-part data question worth a total of six marks and based on core material. The stem of this question was quite long and in future papers the examiners will strive to ensure that the stems for each option across the paper are of similar length. It also had six small images showing different stages in the production of a dress. The question focused on scales of production and why different scales of production might be used in combination. The first part of the question asked candidates to state one aspect of the production of the dress that is automated. The collection of body measurements and the cutting of the pieces are both shown in the diagrams to be automated processes. The second part of the question asked for one reason why some aspects of the production of the dress are mechanized. Unsurprisingly perhaps, the third part of the question asked why some parts of the manufacture of the dress might still be done by hand. This was perhaps the best answered part of the question and candidates were generally able to identify complexity, the quality of finish and the adding of prestige/price to the finished product as reasons for hand finishing.

Question D2

The first part of the question asked candidates to define biocompatibility. There were few candidates who seemed to understand this concept and provide reasonable definitions. The second part of the question asked candidates to identify a reason why regulatory bodies approve medical devices for specific purposes rather than materials in isolation. This was answered by only a very small number of candidates and there were some bizarre answers from weak candidates who demonstrated considerable ingenuity in attempting to respond to a question for which they clearly did not have any idea of the answer!

Question D3

This question showed Woolmark™ symbols which are used on woollen products to indicate their wool content. Part (a) asked candidates to outline one advantage to the consumer of the Woolmark™ symbols. This was straightforward for all but the weakest candidates. Part (b) asked candidates to outline one natural or synthetic fibre that can be blended with wool to enhance the characteristics of wool. Whilst most candidates were able to name a fibre that could be blended with wool, many did not follow on to explain how the fibre would enhance the characteristics of wool.

This 'outline' question was looking to award two marks – one for identifying a fibre and one for a brief explanation of how the fibre would enhance the characteristics of wool. Many candidates achieved only one mark on this question.

Question D4

This seemed to be a reasonably straightforward question requiring a description of the cocoon of a silkworm. Weak candidates found this difficult. All but the weakest candidates were able to provide a reasonable answer to the question.

Question D5

This question asked candidates to discuss one positive and one negative impact of male and female modelling on the behaviour and health of adolescents. It may be that the use of headings explicitly on the examination paper helped candidates to structure their work but it was pleasing that many candidates were able to respond well to this question and to achieve a good mark.

Question D6

This question was clearly structured into three parts. It required candidates to name one biometric innovation. Most candidates who managed to name an innovation used the Speedo Fastskin swimsuit as their example. No marks were awarded for naming the innovation. They were then asked to explain how research and development has contributed to the development of the innovation. This section was poorly answered. Candidates were then asked to explain one advantage and one disadvantage of using the innovation in sports clothing. This was generally answered well.

OPTION E – Human factors design

Question E1

This was a three-part data question worth a total of six marks and based on core material. It focused on the design context of a soapbox car. Part (a) of the question asked candidates to state one ergonomic reason why dimension A might vary. Many but not all candidates were able to identify the different width of riders as being the reason for this. Part (b) asked candidates to outline one strategy for collecting dynamic anthropometric data for the design of a soapbox car. Part (c) asked candidates to explain why there is a maximum but no minimum dimension for 'G'. One G2 comment was that E1(c) was 'obscure'. This was intended as a more difficult question to see how candidates would interpret the data with which they were provided relating to the centre of gravity and keeping it as low as possible to enhance the stability of the car. Many candidates were able to provide good answers to this question. Some weaker candidates were not able to do so.

Question E2

Part (a) of this question asked for candidates to state one way in which the design of a lift incorporates audible feedback. This was answered very well by many candidates but some did not seem to know what audible feedback was, surprisingly. Part (b) asked candidates to describe door signage affordance. Clearly some candidates were unfamiliar with the term affordance and thought it was something to do with costs! There were some good answers from some candidates and some very poor answers by weaker candidates.

Question E3

This question focused on the design of the Ergogel bicycle seat. It asked why, (not how), dynamic anthropometric data would have been collected to inform the design of the seat.

While there were some excellent answers there were also some very poor answers from weak candidates. Part (b) asked for a description of one effect of producing three models of the seat on product sales. Many candidates were able to identify correctly that the three models would widen the market for the seat and thus increase sales.

Question E4

This question asked the scale type used for measuring thermal comfort. The answer was looking for an interval scale to measure degrees. This was very badly answered by many candidates.

Question E5

This question asked candidates to provide an explanation of two methods that could be used to identify hazards faced by long distance truck drivers in order to help to prevent accidents. The markscheme was looking for scenario analysis, fault tree analysis and hazard assessment as responses. Some weaker candidates went into a stream of consciousness without any structure, repeated themselves and achieved very low marks. Better structured answers generally achieved high marks.

Question E6

This question asked candidates to explain three strategies a designer could employ to ensure an effective user-product interface. Well structured answers enabled candidates to avoid repetition. This was not a difficult question and at the heart of human factors design and was answered well by many candidates with the highest marks being achieved by those candidates structuring their responses well.

Recommendations for the teaching of future candidates

Now that candidates study only one option, rather than the two that were studied before, the examination papers are able to go into more depth than before. Thus, candidates need to be made aware of the theories and concepts underpinning the optional material and to be able to see how these theories and concepts impact on the real world and the design process through appropriate practical work. As mentioned elsewhere in this report, the Design Project should relate to the option selected so that the project and the option are synergistic and build on each other to reinforce learning and do not lead to an exacerbation of workload issues which would be to the disadvantage of the candidate. Teachers should spend some time in helping candidate to understand how to structure their answers, especially for six mark and nine mark questions. Poorly structured answers tended to gain fewer marks. If teachers look at the markschemes for the papers it can be seen that one mark is awarded for each distinct relevant correct point.