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Examiners' Report

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Chief Examiners Report GCE Engineering June 2006 series

Overall

Generally, the paper seems to have worked well, eliciting a good range of responses with no particular problems being found.

The paper was broadly comparable to the published exemplar.

Unit 1 Engineering Materials, Processes and Techniques

Comments on Individual Questions:

1. This question, a table asking for specific materials and significant properties, was quite well answered. However, candidates were penalised for use of non-technical terms such as "light", "strong" or "heavy". The use of technical terms such as "swarf" was noticeably absent instead phrases such as "bits coming off" were widely used (and allowed).

2. Again, this was reasonably well answered. Only weaker candidates gave responses which confused hazards (eg soldering) with risk (eg burns), and gave muddled responses. A surprising number of candidates soldered wearing gloves!

3. The process of compression moulding was only clearly understood by a small number of candidates, with phrases such as "molten plastic/metal" being used, and no reference to themosets or curing.

4. Part a) was usually correct, but part b) produced responses such as "magnet core needs to be **conductive**") and c) poor - little understanding of the reason for the use of steel shaft.

5. Weaker candidates gave accurate answers for a), but poorer b) and c) eg "can't weld plastics". On the other hand, a good number referred to "friction/ultrasonic welding", and the effect of screws on weakening the structure.

6. This question, on the role of carbon fibre in a composite, produced either no response, or muddled with carbon-carbon bonding only (no matrix), for many candidates. A few were able to mention terms such as "matrix" or that two materials are involved.

7. Generally, only part a) well answered (eg marking out, sawing, drilling). In b), a reasonable number recognised that a different form of manufacture is needed. Part c) required 2 simple tests to distinguish between 2 materials: some candidates gave complex tests, eg Young's modulus rather than, eg a simple scratch test

8. About half candidates realised that bearings/bushes were needed to allow the generator to rotate. Slightly fewer were able to show a sensible way of fixing the lower mast to the support tube.

9. Despite the fact that the question specified the need for disassembly, for maintenance, many candidates said that Soldering/adhesives could be used to fix the two halves of the casing together (ie a permanent fixing). Nonetheless, some were able to give two methods, and describe their benefits/disadvantages.

10. This general "essay" question on using materials (for the tail fin) whose properties were given in a table, allowed most candidates to notch up some marks. Only a minority were able to relate desirable features (eg a swift response to change in wind direction) to actual properties of materials. Some weaker candidates spent time on irrelevant properties, eg thermal conductivity.

Popularity of Individual Questions

As indicated questions 1, 2, 4a, 7 and 10 produced good responses, but on the other hand questions 3, 4b, 6, 8 and 9(b) were clearly more problematic for candidates.

Unit 2: The Role of the Engineer

General Introduction

This was the first summer series of the Applied GCE in Engineering and the results for this unit were, in general, quite pleasing. Around 4 dozen centres submitted portfolios and the moderation team witnessed a full range of efforts, both by the centre assessors and their candidates.

There were several examples of inaccurate or inconsistent marking, and to a certain extent this is to be expected for a new qualification. Moderators were asked to be as constructive as possible with their feedback reports with the intention of helping centres appreciate what they could do to improve the achievement of their learners. There were also many examples of very good and accurate assessment.

It was felt, judging by the performance of some centres, that there may be some difficulty in being able to attend any of the INSET events or accessing the support material which is available from www.edexcel.org.uk.

Internet Searches

Most centres submitted work which the candidates had obviously downloaded from a range of websites. This is acceptable, and to be encouraged if the research is in preparation for a visit or as a follow up exercise after speaking with an engineer. What is not acceptable is to carry out an Internet or text search and use this as the sole means of addressing the criteria. In the introduction to this unit on page 21 of the specifications, paragraph 3 states 'you will investigate the role of a professional engineer..' which means a real, live person. A few centres allowed candidates to submit large amounts of web research, unabridged, with no attempt to personalise it or make use of it for any reason other than to keep the front and back pages apart. Without actually meeting and talking to an engineer, preferably one per candidate, it is very unlikely that a candidate will produce work which covers any more than the lowest mark band.

Preparation and Contact with Engineers

Where centres had managed to spend time studying the specifications and the Teacher Guides, as well as taking part in INSET events, their standards and scores were generally high. It was also evident that where centres had arranged effective and relevant contact between their learners and practising engineers, the higher ranking engineers the better, the portfolios tended to contain material which had the potential to address the assessment criteria across all 3 mark bands.

It cannot be over emphasised that the most important underlying requirement for the successful delivery and assessment of unit 2 is the need for collaboration with a practicing engineer. If this presents some difficulty due to location or geography, the Internet provides a means of finding the contacts – for example; the local Chamber of Trade or Commerce, the local or regional SETPOINT contact, Education Authority advisors, IIE and IEE (now combined to create the IET) websites contain contact details.

Many contain the personal contact details of local engineers.
Engineers like to help recruit the next generation of engineers, so please be advised to make use of them.

Once contact has been established, and possible visits arranged, a large amount of guidance and support must be provided by the teaching staff to help ensure that the engineers chosen are aware of the criteria and that they can provide the opportunities for the learners to address the full spread of criteria across all the mark bands, allowing the learners to achieve their maximum potential. It is also important to note that the specification requires that all the criteria are covered using the research into the engineer responsible for a product or service, and the same product or service must be used to generate all the evidence. Hence careful planning and initial questioning is essential.

Presentation of a portfolio

The unit specification advises the use of A4 paper, and it is preferred that the pieces of paper are bound together using either 'one treasury tag', 'one staple' or a 'paper clip'. This removes the need for any unnecessary bulk, large folders, binders metal clips, etc, which also tend to make the work difficult to lie flat on a desk in order to mark or moderate. A brief introduction to 'set the scene' often helps, but should be limited to a short paragraph. Anything more than half a page, giving the company history, the engineer's 4 years at university, or pages of description about the different possible careers in engineering, etc – are all very interesting, but not relevant. If something relevant happens to be included within such a long introduction, it will no doubt be overlooked as the moderator skims through it looking for 'section A – the activities of my chosen engineer' (or words to that effect).

The use of 6 sections given headings which directly reflect the 6 outcomes 'a' to 'f' is a perfect way of presenting the work. References were fair, but not in all cases, and many portfolios contained large appendices which might have been remotely relevant, but were not referred to in the main report, so would have been ignored.

Coursework Authentication Sheets (CAS) and Mark Record Sheets were not included by all centres. Without the inclusion of these documents, particularly the CAS, the work may not be accepted as the candidate's work in the near future.

Assessment criterion (a)

Most candidates showed that the requirements of this criterion had been understood. It was, though, quite obvious which candidates had spent the most time effectively with their chosen engineer, but a weakness in many portfolios was that very few of them had pushed their inquiries far enough to obtain evidence to cover mark band 3 – justifying and explaining why their engineer undertook certain activities which were specific to the product or service under investigation. A handful of learners listed things which an engineer 'would be expected to do' – indicating that they had tried to complete their research on the Internet and probably never met an engineer. The communication skills required by a 16 or 17 year old learner, to interrogate a professional engineer, are challenging and may need teaching in the early stages of the programme, or the linking with key skills communications could see some development of these skills.

Assessment criterion (b)

The 'technology' which needs to be investigated should be that which the engineer uses whilst carrying out her or his work on the product or service they are involved with. The specification indicates (on page 22) what this could include - CAD/CAM, software applications, control systems and communications – and some portfolios contained some very thorough detail of a wide range which addressed this criterion well. A few candidates described the machines which were in the factory where their engineer worked, whether they were relevant to the product or service under investigation or not.

Some candidates seemed to find it easy to cover mark band 3 by giving detailed explanations which detailed why email had advantages over letters and faxes, how mobile phones allowed immediate and worldwide access to colleagues and clients, CAD produces clear, reproducible drawings which can be easily modified, and they can be emailed, etc. or downloaded into CAM equipment to produce rapid prototypes, etc.

Assessment criterion (c)

The difference between 'c' and 'd' seems to be becoming a bit clearer. 'c' requires details of legislation and standards which affect the product or service which the engineer is responsible for providing, whereas 'd' is about the health and safety standards which affects the way they carry out their work.

Criterion 'c' seems to be the most easily misinterpreted. Suggestions on how to address the legislation and standards which influenced the product or service is described in detail in the Teachers' Guide. Perhaps the learners need more encouragement to question their engineers about the legislation which they are guided by and which they must adhere to. For instance, any British Standard (BS or BS-EN) which the engineer refers to, or works in accordance with, is the aim of this criterion. Do they use 'as fitted' drawings, or some other documentation system? Is there a final inspection report carried out before 'handing over' the work to the client?

Also, many products are manufactured using materials which have changed following modern legislation and standards, such as refrigerant gases used in refrigerators and air conditioning. Could any such standards and legislation be involved with the engineers being investigated by your students? Other suggestions could include 'how is the expired article disposed of at the end of its life?' All these may be avenues for investigations which would push the candidates' work towards mark band 3. The engineers might be interested to talk about the 'cradle to grave' lifespan of the products they make or provide, but never thought to suggest it.

Assessment criterion (d)

Health and Safety standards are generally set by employers, using the legislation as the minimum acceptable standard. All employees must abide by the Health & Safety at Work Act 1974, but not all candidates mentioned this. Some mentioned 'risk assessments', but failed to mention the Management of Health and Safety at Work Regulations (1999) which outlines the requirements for them. Asbestos Regulations and COSHH, etc, were referred to in a few cases, but in most cases, the candidates failed to fully address mark band 3 by reporting on how the engineer ensured that appropriate standards had been met. Some candidates appeared to have asked, but had been told 'I just know they do' which is unhelpful.

Assessment criterion (e)

Evaluation of the product or service to ensure 'fitness for purpose' continues to cause the most problems. Some evaluation was carried out by the candidates, but many used reports from their engineer without 'doing' any testing or evaluating themselves. The evidence generally lacked depth on the actual tests made because very few included details of how the product or service was checked to ensure fitness for purpose. One simple, but effective way in which this was addressed by at least one candidate was to check the production rate of certain articles. They counted how many were produced in a few minutes, then converted this to articles per hour as a production rate. They checked this with the engineer's claimed production rate and discussed this and section 'f' with the engineer, almost fully addressing all the mark bands. The teachers need to ensure that the engineers involved are aware of the assessment grid before and during the candidates' investigation and reporting. Evaluation is a difficult task, particularly for someone new to the world of engineering.

Assessment criterion (f)

Very few students scored well on this criterion. To suggest improvements to a product or service possibly needs more background information and practice investigations throughout the year. As with the previous criterion, expecting a candidate to have gained sufficient experience and knowledge to be able to suggest modifications, with justifications, is a real challenge for all but the most determined of candidates.

Unit 3: Principles of Design, Planning and Prototyping

The June series of examinations was the first opportunity for all centre entering candidates for the AS level in Unit 3: Principles of Design, Planning and Prototyping to submit work for moderation after completion of their AS studies.

Perhaps not unexpectedly, many candidates unfamiliar with the assessment criteria and its application limited their achievement through not being able to target marks effectively.

Despite most centres setting appropriate tasks for candidates that potentially provided opportunities to access the full range of marks, the overall view of moderators was that the quality of coursework submitted for moderation by centres was disappointing, with many candidates failing to meet the demands of the AS level standard.
Many centres appeared not to appreciate the requirement for a greater level of demand in coursework projects one year on from GCSE and an accompanying rise in levels of response from candidates. Much of the work seen was better suited to the GCSE standard, but was credited highly by centres when applying the AS assessment criteria.

In setting problems for candidates, many centres limited the choice of tasks to one or two design briefs and a significant number of centres focused all candidates on the same initial task. This strategy enabled planning and resources to be centralised and teacher input to be effective and relevant to all candidates. However, this approach resulted in some instances in replication of evidence, especially research, which appeared in several candidates design folders. Where candidates were allowed to identify their own design brief, this frequently resulted in low levels of performance, particularly where electronic projects were pursued. Where teacher intervention was effective, candidates were much more focused and more likely to achieve success.

Most centres submitted samples of work on time, but many failed to include authentication sheets. Most centres submitted marks appropriately, but some used copies of the assessment criteria photocopied from the subject specification and wrote marks on these. Where this occurred, there was no accompanying annotation, which hindered moderation. Some centres used their own assessment grids to record marks, which were often difficult and awkward to follow.
Many centres with larger cohorts sent more than ten samples of work, but this was sometimes because more than ten asterisks appeared on the OPTEMS to identify the sample for moderation.
Moderators complained of poor packaging of samples from some centres. Loose, unidentified pages, several pages in one plastic sleeve, folders containing manufacturer's brochures, worthless in terms of credit, were all avoidable issues that added to the burden of moderation.
Teacher assessment was often inaccurate but consistent, which is understandable in a new qualification where large numbers of marks are attached to some assessment criteria. It was disappointing however to see so many centres unable to match the performance of their candidates to performance descriptors in the assessment criteria.

Assessment criterion (a)

Almost all candidates were able to produce engineering drawings of some description, using some industry standard symbols and drawing conventions. Many drawings however were limited and candidates did not appear to understand what the requirements of a 'range' of engineering drawings involved, failing to take the opportunity to use detailed pictorial views, assembly drawings, exploded views etc. Some drawings lacked important dimensions, while others were not always drawn to scale. Many candidates produced several high quality engineering drawings, but failed to include enough information to enable the successful manufacture of the designed prototype. Where CAD was used, this was often carried out competently, but a significant number of candidates used the power of CAD packages to automatically generate orthographic projections from 3D CAD sketches, which is not an acceptable practice. A disappointing number of candidates failed to reach acceptable standards in their engineering drawing and were unable to produce any recognisable conventions or methods of graphical projection.

Assessment criterion (b)

When planning their project, most candidates were able to produce some realistic timing with reference to processes and the established design brief. Planning usually included a time chart or Gantt chart, but some planning lacked details and understanding of the necessary sequence of events required to achieve a successful outcome within a realistic time span. Many candidates presented retrospective 'diaries' of events instead of forward looking 'plans', while others included the whole of the design process in their time charts instead of focusing only on the manufacturing of their product and where this occurred, plans lacked appropriate detail.

The quality of specifications presented by candidates varied in content and detail. Most candidates were able to identify key points that were considered important, but not many attempted to justify specification statements with additional information. For example, the statement "nylon bearings should be used in the device" is not justified or properly valid until the additional information "as they are self-lubricating and quiet in use" is added to qualify the first part of the statement. Many of the specification points presented were superficial, lacking technical and quantitative information that could have been used to evaluate the final outcome against, and research information was hardly ever used to inform the specification effectively. Many candidates appeared not to understand how to structure a technical specification which resulted in a rambling and disorganised group of statements that lacked continuity and cohesion. Candidates would benefit in future from using appropriate sub-headings to present linked information logically.

Assessment criterion (c)

In this assessment criterion, the standard of performance was particularly disappointing and many candidates failed to gain access to the higher range of marks available, although many centres gave high levels of credit where there was not enough evidence to support the marks awarded. The vast majority of candidates failed to grasp the 'Engineering' approach to their work and missed opportunities to explore and apply scientific and mathematical justification to their design choices and decisions. Most candidates adopted the Design and Technology approach, placing emphasis on form rather than function and hardly any candidates used their research to inform their ideas and not many used formative evaluation to review their design ideas against their product specification. Where electronic circuitry was included in project work, it was usually of very low level and was always based on a 'found' circuit that candidates had not developed at all. Most candidates managed to present a range of alternative design ideas relating to their chosen project using some appropriate design strategies, but design ideas were not often well analysed in terms of possible materials and processes that could be used in their manufacture and there was little evidence of research information being used in the designs presented. Many ideas were of a low level, lacking a true understanding of the problems involved and in many cases candidates appeared to have already decided what their final solution was going to be and did not explore their problem fully. Although it is expected that candidates will produce a range of alternative ideas to solve the problem in hand that focus on its technological content, it is not always necessary to produce a complete solution in a proposed design idea; it is acceptable that candidates consider the sub-systems that make up the intended product and focus on these as alternative ideas too.
The review of alternative ideas was generally not well done and many candidates failed to evaluate their design ideas against points of specification, or use the specification as a basis for their alternative designs.

Candidates should explore a range of approaches to their work in this section, using their knowledge of technical detail, materials, techniques and processes to produce realistic design proposals that match the points of specification.
As work progresses, alternative designs and their details should become linked and strands of continuity should be seen in higher quality responses as one idea moves to the next to be improved upon.
Communication skills are important in conveying ideas and candidates are encouraged to use any appropriate means of illustrating their work that they are comfortable with, as long as the results are clear and easily understood.
Effective annotation is an important feature of this section to enable candidates to explain details of design thinking and to offer evaluative statements regarding their design proposals.
In evaluating each alternative idea, it is important that candidates refer to points of specification objectively and avoid using tick-boxes or marks out of ten as a deciding factor in which design to select for further development.
Health and safety issues were not well considered by most candidates and where this did take place, considerations were usually focused on the use of machinery and processes employed during manufacture of the product and did not consider the health and safety issues linked to product design proposals.

Assessment criterion (d)

Most candidates succeeded in producing a practical outcome to their chosen problem that reflected their final design proposal, although making skills were generally modest and the majority of candidates were over-rewarded for their efforts. Hardly any products appeared as if they would function as they were supposed to and many were incomplete, or crudely put together. Clear photographic evidence of manufactured outcomes was usually supplied by centres, but this often lacked the detail necessary to illustrate the complexity of task and the higher level skills recognised by centre assessors. It is essential that good quality photographic evidence is presented in order to support the marks awarded by centres. In many cases, poor photographic evidence was presented, which was not helpful to the moderation process. A minority of centres submitted no photographic evidence of practical work at all, relying on witness statements to justify their marks, which is unacceptable, particularly where such a large number of marks are involved. All marks for manufacturing must be supported by explicit evidence in the form of clear photographs.

Not many candidates provided details of materials and their selection based on mathematical or scientific reasoning. Candidates would benefit in future from consulting materials data/performance information, or referring to the knowledge and understanding they have accumulated via their study of Unit 1 when specifying and justifying their choice of materials and processes to be used during product manufacture. Some candidates were aware of safe working practices during manufacture and recorded their assessments, while others gave little or no consideration to this feature.

Choice of project is crucial to the success of this course for candidates and centres must ensure through teacher intervention that individuals are working at a level of response appropriate to their abilities and that they are able to realise their potential within the demands of time and task set.

In this assessment criterion**,** candidates are asked to produce a high quality product that meets the requirements of the specification and fully matches the final design proposal in terms of function, sizes, finish etc.

During manufacture, candidates should demonstrate their understanding of a range of materials by selecting, justifying and using those that are appropriate to their needs in terms of properties and working characteristics that were detailed in the specification and work-plan.

Candidates must show demanding and high-level making skills in order to achieve the high category of marks in this section, so it is essential that the product under construction offers enough complexity to allow access to high marks. The level of complexity will already have been established at the design development stage, so it is important that candidates who have high potential are guided towards appropriate levels of response at an early stage in their work to ensure their success.
As evidence of the quality of manufacture, clear photographs must be submitted that show enough detail to support the credit awarded during centre assessment. As photographic evidence is the only proof of manufacturing quality, it is essential that images convey details of levels of difficulty and complexity of construction, so it is unlikely that a single image will achieve this. A series of photographs taken over a period of time during manufacture is the ideal way of highlighting processes used and providing examples of precision and attention to detail that may not be readily noticeable in an image of the finished product.
Photographic evidence can also be employed to support a candidate's awareness of health and safety issues when working.

Assessment criterion (e)

Most candidates provided appropriate evidence of oral presentations, which included hard copies of Powerpoint slides, CD Roms and teacher witness statements, which were generally informative and provided useful annotation regarding individual candidate performances.

Statistics

6931 Engineering Materials, Processes and Techniques

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	90	69	61	53	45	38
Uniform boundary mark	100	80	70	60	50	40

6932 The Role of the Engineer

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	60	45	39	33	28	23
Uniform boundary mark	100	80	70	60	50	40

6933 Principles of Design, Planning and Prototyping

Grade	Max. Mark	A	B	C	D	E
Raw boundary mark	60	48	42	36	30	24
Uniform boundary mark	100	80	70	60	50	40

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