OCR
Oxford Cambridge and RSA

Cambridge Nationals

Engineering

Level 1/2 Cambridge National Awards in Engineering **J831-3**

Level 1/2 Cambridge National Certificates in Engineering **J841-3**

OCR Report to Centres January 2018

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It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

OCR will not enter into any discussion or correspondence in connection with this report.

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OCR REPORT TO CENTRES

R105 Design briefs, design specifications and user requirements

General Comments

It is worth reiterating the point that has been included in the report to centres for almost all previous series; *'Centres should cover the entirety of the content set out in the specification. Once the content has been covered it is advised that centres spend some time preparing students for the examination using the specimen papers and, with growing availability, the past papers for the examination. This should allow students to answer the whole paper with sufficient understanding and depth. There are key areas of the specification where candidates understanding is not as fully developed as it needs to be to access the questions.*' This was evident in most of the previous series and has been clearly evident again in January 2018.

With less frequency than previously, but still apparent in some cases, candidates are not always addressing the command verbs in the questions. At times it is clear that candidates are not always answering questions in the style expected of the command verb. For example; when a question command verb is 'Explain' or 'Describe' candidates are answering with a one-sentence answer which limits their ability to access the full marks available for the question.

Comments on Individual Questions:

Question No. 1

Part 1ai of this question required candidates to complete a table, identifying common standard components. On the whole, the question was answered well, with a large majority of candidates achieving full marks.

In part 1aii, candidates had to name one other standard component. The vast majority of candidates were successful in this question. It is important for centres to emphasise to candidates that one *'other'* component means a repetition of any component in part i would result in no marks.

In part 1b, candidates were required to give two reasons why designers would use standard components in the development of new products. This was generally answered well, with most candidates able to give suitable reasons why designers would use standard components in the development of new products. Candidates clearly have a good understanding of why standard components assist product development and manufacturing.

In part c of question 1, candidates needed to develop their knowledge of standard components further by explaining why standard components improve the sustainability of new products. Many candidates were able to give responses that achieved marks, in most cases candidates were able to consider how standard parts allow for disassembly and disposal of materials. Some candidates managed to gain marks by considering the reusability of standard parts although these responses were inconsistent and sometimes vague. The strongest responses, gaining maximum marks, clearly understood how standard components allow for the easy disassembly for maintenance and repair or separation of materials for disposal and recycling.

Question No. 2

In question 2a candidates were asked to give two reasons why regulations and safeguards are important when developing new products. On the whole candidates were able to access marks here by giving valid responses. Candidates understood that regulations and safeguards ensure products are safe, meet relevant standards and are subsequently allowed to be sold.

Question 2bi required candidates to draw the symbol for the ‘European Conformity’ mark. Responses to this answer varied. Candidates were only awarded marks for representations close to the symbol below.

In part ii of question 2b, candidates then had to name two other examples of symbols that may be included on a product. Most candidates were able to identify at least one, if not two symbols, that would be used on a wide range of products. This was, on the whole, a well answered question.

Part c of question 2 required candidates to state what is meant by the term ‘registered’ design. Answers varied dramatically. On the whole, candidates have some understanding of registered design, but cannot be specific about the differences between a ‘registered’ design, ‘copyright’, ‘trademark’ or ‘patent’. This continued in part d of the question which required this distinction. It is clear that candidates do not know the major differences between ‘registered’ designs and ‘patents’. Centres are reminded to cover the specification in detail and ensure that in areas such as this one, candidates can discriminate between similar areas of content within the specification.

Question No. 3

Question number 3a required candidates to explain how a USB plug has been designed with consideration of error proofing. Candidate responses to this question were generally strong, demonstrating a vastly developed understanding of error proofing when compared to previous series. Candidates were able to explain how the USB plug could only be inserted one way whilst also considering subtle design features that aided its operation. Where candidates did not achieve marks here, error proofing was still associated with 'testing' which failed to gain marks.

Part b required candidates to state which phase of the design cycle would include testing of a product. Surprisingly, responses to this were varied. Testing is clearly stated in the 'validate' phase of the design cycle within the specification.

Part c required candidates to give three considerations that a designer could include in a manufacturing plan for a new product. Response to this varied in quality and therefore marks achieved also varied. Where candidates achieved multiple or maximum marks they were able to give responses related to 'manufacture' and therefore differentiate between 'manufacture' and 'design'. Where candidates did not achieve marks their responses were focused on more generic design considerations, e.g. ergonomics, and not considerations at the stage of manufacturing.

In question 3 d, candidates were asked to explain why designers may validate a design before final production commences. The vast majority of candidates were able to achieve marks here with some understanding that testing or checking of the final design was important to ensure that large amounts of investment was not lost during production due to a faulty or substandard product.

Question No. 4

Question 4a required candidates to complete a table by adding the most appropriate function to products made from specific materials. Candidates demonstrated good decision skills in this question, clearly supported by a sound knowledge of material properties and applications. The vast majority of candidates were able to gain marks in this question.

Part b of question 4 required candidates to state two reasons why manufacturers should consider the supply chain during the development of products. The vast majority of responses here focused on the cost of material, which did ensure candidates gained some marks. The wider areas of supply chain involvement during development, not just production, were not as regularly observed despite their importance.

In part c, the availability of materials was considered, and candidates had to explain how availability may have an impact on design. Again, as per part b of this question, the vast majority of candidates focused on cost. The rarer a material the more expensive. Although there are elements of this that would gain marks, only a few candidates were able to consider how material availability would impact on available manufacturing processes and the subsequent design geometry associated with this. This was a question that highlighted some high-level understanding of the relationship between design and manufacture in some candidates.

Question No. 5

Question 5ai asked candidates to explain what is meant by the term ‘sustainable design.’ On the whole, candidates were able to achieve some marks here. There were some examples of higher level responses, achieving maximum marks, which demonstrated an in-depth understanding of what ‘sustainable design’ means. Most candidates were able to demonstrate some understanding. In some responses that achieved lower marks, candidates only associated sustainability with ‘long lasting’ products, which although partly accurate, failed to demonstrate the breadth of considerations associated with sustainable design. This continued into part 5aii, which required candidates to give two ways that designers could improve the sustainability of new products. Some candidates considered the wider areas of sustainability whilst others focused on the perceived strength of materials and subsequent lifespan. In part, this was true, but did not result in these candidates gaining maximum marks.

Part b of question 5 required candidates to state two environmental pressures that designers should consider when developing new products. This was well answered by most candidates, with the vast majority of responses achieving marks. Part c of this question required candidates to expand on their understanding of environmental pressures by explaining how designers can ensure they do not contribute to them. Candidates could generally build on their initial responses from part b and give valid responses that gained marks.

Question No. 6

Question 6ai required candidates to state two scales of production. Almost all candidates were able to access this question and subsequently gain marks.

Question 6aii, required candidates to develop their understanding of scales of production by giving reasons why these would be considered during the design stage. This question gave more varied responses than part i. Candidates focused on cost again without giving consideration to how the scale of production, and associated manufacturing method, would impact on component geometry.

Question 6b required candidates to show understanding of how the scale of production can have an impact on material selection. The quality of answers provided varied dramatically. Very few candidates gave responses that understood how the scale of production would define a production method, an associated material and therefore, design geometry. Where candidates failed to achieve high marks, responses lacked development. Candidates who gave strong responses were able to discuss how certain high-volume manufacturing processes used certain materials and could subsequently provide high quality, large scale output. A large number of responses were focused on the fact that small scale production used expensive materials and that high-volume production used inexpensive materials. This is not always the case, and candidates need to understand this. Some high-volume production uses expensive materials and the process is what makes it efficient. In addition, centres are reminded to ensure they cover the full scope of the specification in depth to ensure candidates achieve maximum marks. As mentioned previously, centres are reminded to develop candidates’ ability to write extended responses. Some responses were written in bullet point format which, although some excellent points were made, candidates could not achieve higher marks as they are being assessed on their ability to write extended prose and not just their knowledge of the topic in the question.

General comments on centre assessed units R106, R107 & R110

Samples from centres were generally received for moderation before the deadline date for the January series. Centres are reminded that work is required by the deadline date to enable moderation to take place efficiently

A completed Unit Recording Sheet (URS) was supplied for each candidate in the sample and marks had been clearly entered on the URS and correctly totalled. This is important as clerical errors can delay the moderation process.

Teacher commentary on the URS was generally useful where provided, but some instances would benefit from the inclusion of further commentary on the URS and learner work in order to assist with moderation. This should also include page numbers and annotation to identify clearly which pieces of each learner's work is being accepted against each learning outcome.

Where photographs are presented as evidence centres should ensure that these are annotated to indicate what they are showing.

Centres are reminded that learners must acknowledge all sources of information from which they extract material, and that collusion between learners is prohibited. A subject information update on how to avoid malpractice in Cambridge Nationals is available on the qualification page of the OCR website – under the 'Subject information updates' menu heading.

Centres are encouraged to use the witness statements to support and corroborate learner-generated evidence for example witness statements can support and corroborate how safely and competently learners worked, and how much assistance was required i.e. level of independence. However, centres are strongly reminded that witness statements should only be used to corroborate evidence generated by the learner and cannot be used as substitute and a sole source of evidence.

Conclusion and Recommendations

Centres are reminded to consult the assessment criteria within the unit specifications to ensure that learners are addressing the required elements. This includes elements of showing relationships, analysis and comparison where required.

Where practical activities are undertaken, learners should clearly show each stage of the process. This could be done using annotated photographic evidence. Centres are reminded that witness statements are useful in supporting and corroborating learner-generated evidence. They cannot, however, be used as a substitute for this.

R106 Product analysis and research

Comments on Individual Learning Outcomes:

Learning Outcome (LO).1
This LO requires learners to recognise and explain the relationships between commercial production and its impact upon product/component design, end of life influence upon product/component design, and the importance to conformity to legislation and standards with reference to the products being analysed. It was apparent that many learners could recognise the topics as discrete issues rather than interrelated issues. Analysis of products was often too generalised - relationships between commercial production and its impact upon product/component design was not adequately addressed. End of life considerations were also often isolated and not always related to the products being reviewed. Recognition of conformity to legislation and standards often lacked depth, and again, was isolated and not clearly related to the products reviewed.

LO.2
LO 2 requires learners to analyse existing products and to identify their strengths and weaknesses. Learners should communicate detailed information that demonstrates comparisons having been made, culminating with a summary of their research. To consistently access the higher mark bands, strengths and weaknesses need to be much more insightful, comprehensive in detail and explanation, and comparing the qualities of one product against the qualities of at least one other similar product. The LO should culminate with a detailed summary of the research. Many learners could identify characteristics and/or properties in a number of different pumps or other examples but did not clearly identify strengths and weaknesses, make comparisons, or adequately summarise their research. Research methods tended to be limited.

LO.3a and b
LO3a provides opportunity for learners to disassemble a product, following instructions, using tools and equipment effectively and safely, being fully aware of potential hazards. Learners should communicate their disassembly and clearly indicate how they have used tools, equipment and addressed the issues of safety and potential hazards. Sometimes learners produced minimal evidence to show that they had disassembled a product effectively using tools and equipment; some learners produced no evidence of a disassembly. Demonstration of an understanding of potential hazards and safety considerations was generally neglected. Centres are reminded that witness statements can be used to indicate each learner’s level of independence and/or competence when disassembling and using tools and equipment.

LO3b requires learners to communicate their knowledge and understanding of the components, assembly methods, materials, production methods and maintenance of the product they have disassembled. Learner responses tended to be descriptive, indicating or describing what they were disassembling and how, rather than analytical.

R107 Developing and presenting engineering designs

Comments on Individual Learning Outcomes:

Learning Outcome (LO).1
For this LO learners should produce a wide range of competent and accurate 2D and 3D sketches with appropriate rendering of shade tone and texture. Independent working was sometimes difficult to substantiate. A witness statement is an effective way to identify each learner's level of independence, which is a requirement for this LO.

LO.2
In this LO learners should label their 2D and 3D sketches to identify detail. It would be useful to encourage learners to expand the level of information given to fully identify and explain detail in their designs. As learners progress and develop their designs they should be encouraged to use IT CAD software to modify and enrich their proposals, indicating appropriate detail, through to a final solution. IT CAD drawings and images that receive credit in this LO cannot also receive credit in LO.3. The learning objective offers the opportunity for learners to demonstrate relevant skills, knowledge and understanding from other units in the specification, and this should be explicitly identified.

LO.3
Learners are required, in this LO, to present their design proposals through accurate 2D and 3D engineering drawings, hand drawn and CAD, which conform to industry standards. The drawings should be appropriately labelled and annotated to allow a third party to work from them to make the proposal. Appropriate information could include scale, dimensions, materials, part lists, sections, specific relevant notes and annotations. Learners must use a minimum of two 3D and two 2D techniques to attain marks in the high mark band (see the assessment guidance section in the unit specification).

Recommendations

This unit requires corroboration from the centre on the amount of learner independence in LO1. Centres are reminded that witness statements are useful in supporting and corroborating learner-generated evidence. This includes the independence with which a learner has worked.

Centres are reminded to consult the assessment criteria within the unit specifications to ensure that learners are addressing the required elements. For example, in this unit this includes the number of 2D and 3D drawings required in LO3.

R109 Engineering materials, processes and production

General Comments:

The majority of candidates attempted all of the questions on the paper but knowledge of some sections of the specification appeared to be quite limited in a number of cases. This was made apparent by a significant increase in the number of questions to which no response was given. In a number of cases it was apparent that candidates had not read questions carefully enough before giving their answers, resulting in a loss of marks.

Responses to questions relating to basic engineering materials and processes were disappointing in the main. In questions that asked for one example of a material or process, some candidates gave more than one, this being known as a 'scatter gun approach'. It should be pointed out that, in cases such as this, only the first example can be accepted as the response and any additional examples cannot be considered.

Responses to questions relating to applications and procedures in manufacturing also indicated an area where some improvement is needed. In questions where candidates are asked to explain processes or procedures, it should be noted that justified responses need to be presented in order to gain the higher marks available. One-word or overly simplistic answers are not suitable responses to this type of question.

Specific examples and details of these points are given later in this report.

Comments on Individual Questions:

Question No.

1(a) Most candidates scored well on this question, but a considerable number demonstrated rather limited knowledge of the material types and appeared to choose their examples at random. Where marks were lost on the question, this was often as a result of mixing up ferrous metals and non-ferrous metals, and/or giving incorrect examples of smart materials. In some cases, candidates did not give specific examples of materials, but gave brief descriptions of the material types. One example of this is a response stating that 'ferrous metals contain iron' – thereby gaining a mark by default for the reference to iron.

1(b)(i) This question was not well answered. Marks were awarded for reference to recyclability, but only a limited number of responses mentioned other factors, such as the ease of forming into complex shapes. In many cases, candidates had suggested that thermoplastic products could be 'heated up and reshaped if they came out wrong'.

1(b)(ii) The most frequently given correct examples of products made using thermosetting plastics were saucepan handles and electrical plug sockets. Where candidates appeared to be uncertain of the difference between the two types of plastics, any item made from plastic was given as an example, such as lego bricks, children's toys and food containers.

2(a) Most candidates attempted this question, but only a limited number were able to name a ceramic material correctly. Glass and tungsten carbide were the most frequently seen correct responses, but ceramic bearing material was also given in a small number of cases. In many cases, examples seem to have been chosen by guesswork, and metals or plastics were occasionally incorrectly given as examples of ceramic materials.

2(b) Responses to this question were rather varied, with knowledge of the properties of engineering materials being quite limited in many cases, and only the higher achieving candidates scored more than half marks on the question overall. Elasticity was the most frequently well described property, but marks were often lost on ductility, where candidates merely stated that it meant the material could be drawn into thin wire, without mentioning the fact of it not breaking. Most candidates gave inappropriate descriptions of resistivity, suggesting that materials were able to resist most things, such as force and bending, but few candidates mentioned resistance to the flow of electricity or heat.

2(c) In most cases this question was not well answered, and a significant number of candidates gave no response to it at all. Marks were often lost where candidates had described a non-destructive test such as dye penetrant or ultrasound testing, and also where testing of products was described. A regularly seen example of this was the crash testing of new vehicles. Marks were awarded where an appropriate testing method was suitably described but not correctly named.

3(a) The whole range of marks from zero to six were awarded across the cohort. Very few candidates identified the tap wrench/holder, and the junior hacksaw and the hacksaw were often too simply named as a ‘saw’.

3(b)(i) This question was not well answered generally, with very few candidates scoring more than one mark on it. In many cases a single mark was given for the first stage of drilling the holes for the rivets, but this was then followed by a brief description of ‘pop’ riveting rather than the use of solid countersunk rivets. Only a limited number of candidates scored two marks or more on the question overall.

3(b)(ii) Most candidates answered this question correctly, with adhesives and threaded fasteners being used as examples of ‘cold‘ joining processes. Where marks were lost, this was normally as a result of giving heat processes such as welding or soldering, but occasionally candidates repeated the use of rivets or ’pop’ rivets.

4(a) Most candidates were able to give at least one surface finishing process suitable for use on mild steel parts and many gained full marks on this question. A surprising number of candidates appeared to have little or no knowledge of surface finishing, however, and gave unrelated processes such as 3D printing, casting and vacuum forming, or no response to the question at all.

4(b) Although most candidates attempted this question, very few demonstrated any real knowledge of risk assessment procedures, and only the higher achieving candidates scored two or more marks for their responses. In many cases candidates simply related their responses to basic health and safety precautions, and a number of overly simplistic one-word responses were also seen.

4(c) It was disappointing to see that very few candidates were able to name all four of the centre lathe parts labelled in the diagram, and quite a number of candidates did not even attempt the question. The only part correctly named with any regularity was the toolpost/toolholder, although the saddle and the cross slide were also identified in some cases. A number of candidates simply gave the same answer for each of the four parts, in the hope that one of them might be correct.

5(a)* Most candidates attempted this question and some good responses to it were seen. In many cases, however, candidates made the assumption that the CNC machines had already been installed, and proceeded to base their responses on the benefits of using CNC machining in production. A number of candidates presented factors in list or bullet point form rather than as a discussion, thereby limiting the number of marks attainable for the question overall.

The candidate's Quality of Written Communication (QWC) was assessed in this question, and marks were awarded where relevant technical content was somewhat limited.

5(b) This question was generally not well answered, with most candidates not addressing the focus of the question, this being the use of CNC machining in the development of new engineered products. Some candidates were able to pick up a single mark for reference to the manufacture of prototypes, but in most cases responses were based on the use of CNC machining in quantity production. Only the higher achieving candidates scored two marks or more on the question.

5(c) Most candidates attempted this question and by far the most popular example of an additive manufacturing process was 3D printing, although SLS was also seen in some cases. It was quite apparent, however, that some candidates had no knowledge of additive manufacturing, and more conventional processes were given, such as welding, injection moulding and soldering.

6(a) This question was quite well answered generally, and full marks were scored by a number of the higher achieving candidates. Frequently seen benefits of automation in production included better consistency through lack of human error and increased profits from higher output. Where marks were lost, this was normally as a result of overly simplistic responses with too little detail, and many lower achieving candidates scored one mark only for each benefit given.

6(b) Details of the JIT method of manufacture were not well understood generally and a significant number of candidates did not attempt to answer this question. The most commonly quoted benefit was the fact that storage space for parts and materials was not required, and the effects of late delivery of parts was also well covered. Where candidates had no real knowledge the method, responses were often made up around the term 'Just-in-Time', with some candidates suggesting that products could be of lower quality due to having been 'rushed'. Only the higher achieving candidates produced appropriate responses that gained two or more marks out of the four available for the question.

R110 Preparing and planning for manufacture

Comments on Individual Learning Outcomes:

Learning Outcome (LO).1a and b
For this LO there was often evidence of some good interpretation of both 2D and 3D drawing. It is noted in some cases, however, this lacked detail. Planning was often quite detailed with most of the required elements present. There were several instances where a tabulated plan was not produced, rather a descriptive plan for manufacturing of the part. In these cases, the planning was difficult to follow and was often missing elements such as Health & Safety, tooling required, processes and timings. Centres can provide learners with a blank tabulated and headed planning sheet for them to complete.

LO.2a and b
Witness statements used to support this LO were often weak or missing annotated photographic evidence to show the stages of the manufacturing process. Sometimes, just a photo of the final item was provided. Health and Safety appears to have been adequately covered by most learners. Quality control checks of items manufactured against the requirements of the drawing were often evidence, but sometimes a little unconvincing.

There was some evidence of learners being awarded marks where only a witness statement was present. Centres are reminded that a witness statement can be used to support and corroborate learner-generated evidence, however, cannot be used as a substitute for this. Learners should be encouraged to keep a detailed photographic diary (with annotated photos) showing stages of making and testing.

LO3
Learners generally attempted this LO by considering some factors required to scale production. Further considerations might include: ordering stock of the correct dimension, use of standard components and batch production in order to scale manufacture. It is required in this LO to modify the original plan in order to scale production and this was sometimes not carried out (especially where there was no detailed original plan produced).

R113 Electronic principles

General Comments

Most candidates attempted all six questions.

In some cases candidates had clearly failed to read the question fully and went on to provide a response that was not actually relevant to the question. Candidates should be advised to read the complete question before attempting a question.

There are times when candidates are not addressing the command verbs in the question. When a question command verb is 'describe' or 'explain' candidates are answering with one word responses which limits their ability to access the full range of marks available.

Comments on Individual Questions:

Question 1

(a) Generally well answered but the unit for e.m.f. and inductance was not well known.

(b)(i) The formula for calculating the total resistance of parallel circuit was generally well known with a high proportion of candidates obtaining high marks.

(b)(ii) The formula for calculating the total power used in the circuit was reasonably well known with a number of candidates being awarded full marks.

Question 2

(a) The difference between a polarised capacitor and a non-polarised capacitor was reasonably well known.

(b)(i) The type of capacitor shown was well known.

(b)(ii) The feature that the shorter leg indicates the negative leg/cathode was well known.

(c)(i) The voltage rating on a capacitor is the maximum amount of voltage that a capacitor can be safely exposed to was reasonably well known but a minority of candidates confused voltage with a number of other quantities.

(c)(ii) The meaning of tolerance in a capacitor was reasonably well known.

(d) Generally well answered with a high proportion of candidates achieving maximum marks.

Question 3

(a) All parts of this question were generally well answered with many candidates achieving high marks.

(b) All parts of this question were generally well answered with many candidates achieving high marks.

(c) A high proportion of candidates did not give a reason why the heater is not connected directly to the comparator. A few candidates tried to explain that because the current from the comparator is low it would not turn the heater on but could not continue with the concept of using a relay to complete the circuit.

Question 4

(a) The majority of candidates stated correctly the full names of the switches given as initials.

(b)* This question was not a well answered. A high proportion of candidates gave a very limited understanding of the function a momentary switch and a latching switch. The applications named by the candidate were wide ranging and mostly incorrect. In general terms it seemed that the use of spelling, punctuation and grammar had improved in this area.

Question 5

(a) A high proportion of candidates completed the table correctly identifying the four items of test equipment that could be used to test an electronic circuit for faults.

(b) This question was not answered well. A high proportion of candidates gave a very limited description of how a continuity test could be carried out on an electronics circuit. The use of a multimeter did not seem to be well known.

Question 6

(a) The benefits of the pick and place robot in the manufacturing process was generally well known with a high proportion of candidates being awarded high marks.

(b) The formula for calculating the current was well known with many candidates achieving high marks.

(c) The formula for energy = power x time was not well known. The most straightforward solution was W = Pt = 4 x 10 = 40 kWh.
Candidates however chose many obtrusive methods often resulting in very limited marks. The units of energy do not seem to be well known i.e. J, Ws, Wh and kWh.

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