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Cambridge Technicals

Engineering

Level 3 Cambridge Technicals Certificates in Engineering **05822, 05823**

Level 3 Cambridge Technicals Diplomas in Engineering **05824, 05825**

OCR Report to Centres June 2016

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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.

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Unit 1 - Mathematics for engineering

GcThis unit has six learning outcomes that are not equally weighted. Centres should not therefore expect that every question paper will always have six questions or that each question will contain an equal number of marks or that each question will assess just one learning outcome.

The six learning outcomes did not attract equal successful responses. It is hoped that the following points may help centres to prepare future cohorts of candidates for this unit.

Question 1. Algebra.
Most of the basic topics assessed in this question were understood by candidates who usually performed well. A few candidates had not got a good enough grasp of Algebra and made some quite elementary errors.
The part that was least well answered was part (d), changing the subject of a formula. When there are three terms, multiplying one term by, for instance, 2, requires every term to be treated similarly, for otherwise the equality ceases to hold. Typical errors were for instance, changing $s = ut + \frac{1}{2}at^2$ to $2s = ut + at^2$.

Question 2(a). Algebra solution of equations
This part was similar to question 1. Many candidates were proficient in solving this equation; others made a variety of errors, mainly involving signs.

Question 2(b). The use of the factor theorem.
This was the least well done topic within the Algebra section, While f(2) was calculated satisfactorily few candidates were able to use this to factorise f(x) into the factor ($x - 2$) and a quadratic factor. Those that did were able to finish the question though a number left the answer as f(x) in factorised form.

Question 2(c). Coordinate geometry.
The midpoint of AC was found quire easily. The demonstration that the two diagonals were perpendicular was mostly done well, though some candidates did it the "wrong way round" - in other words using the negative reciprocal of one to be the other without proving it.
The coordinates of B required candidates to appreciate that for this diagram the midpoint of AC was also the midpoint of BD.

Question 3. Exponential functions
This was the least well answered topic. Many candidates seemed to find difficulty in understanding the question. Exponential decay means that the temperature-time graph decreases steadily, "flattening out" as it goes, approaching but never reaching its limit. The limit in this case was room temperature, 20^0C so in part (iv) the graph started at 100^0C and approached 20^0C. This was not often seen.
The first 3 parts contained a number of algebraic errors, including from those who had gained good marks in Questions 1 and 2. In part (i) for instance the formula $T = 20 + (100 - 20)e^{-kt}$ often became $T = 20 + 100 - 20e^{-kt} = 120 - 20e^{-kt}$ rather than $T = 20 + 80e^{-kt}$ and this affected the answers of the remaining parts. Contrasting the responses here with those in Question 1 indicates that candidates may be able to manipulate letters according set rules but that applying this knowledge to real life situations causes difficulties.

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Question 4. Trigonometry

The form of the cosine rule, $\cos C = \frac{a^2 + b^2 - c^2}{2bc}$ was not well known; candidates usually used the form $c^2 = a^2 + b^2 - 2bc\cos C$ as it appears in the Formulae book which is much more prone to arithmetic errors. For instance, $14400 = 22100 - 22000\cos C$ often became $14400 = 100\cos C$ with inevitable failure.
Part(c) was also almost universally correct.

Question 5 (a) Calculus - Maximum value.
Some found the context of this question hard to grasp and made algebraic errors. The formula for the volume was given in part (i) so that candidates who were unable to obtain the formula could use what was given in the later parts. There were a couple of common errors to note:

- Some candidates wrote the formula given at the end of their solution possibly thinking that writing the required formula at the end of some inaccurate algebra would gain marks.
- Some candidates, who were unable to obtain the correct formula, used their own result in the rest of the question rather than that given in part (i).

Question 5(b) Calculus - Area under a curve.
There were clearly a number of candidates who had not covered this topic, but those that had were usually successful. Because of the symmetry of the curve it was possible to obtain the correct answer using the midpoint rule, but since the question demanded the use of calculus this was not given credit.

Question 6(a) Handling data
Most candidates filled in the table correctly, but many divided by 11 (the number of cells) rather than 80 (the number of items of data). The question said that the mean was 60, but some candidates interpreted this as being "approximately 60" and so were satisfied with their answer rather than look for an error.
In part (ii) the crucial piece of information from the stem was that the data was recorded correct to the nearest 0.2 mm. The largest value, therefore could have been as large as 61.1 and outside the range. A measurement of 59.0 could have been as small as 58.9 and this also was outside the range, but as there was no such value in the table any work at the lower end of the scale received no credit.

Question 6(b) Probability
The only way that the machine will fail during the day is if both components fail. It was therefore necessary to calculate this probability; many candidates added the two probabilities rather than subtract and a few demonstrated their lack of understanding of the topic by giving an answer greater than 1.

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Unit 2 - Science for engineering

General comments:
Candidates in general coped well with questions requiring calculations but sometimes did not include units in their final answer which in some cases meant that full marks could not be given. Centres should ensure that candidates know to always include units in their answers to these questions. Candidates seemed better equipped to answer questions covering learning outcomes 1 and 2, and seemed to struggle with using the correct scientific terminology for questions covering learning outcomes 4 and 5. Questions 1 and 3 were the highest scoring questions whilst questions 5 and 6 showed the greatest differentiation.
Nearly all the questions were attempted by the majority of candidates.

Question 1:
Q1(a) Most candidates showed familiarity with basic units for mass and time, and many correctly identified the unit for temperature correctly. However only a few correctly chose inductance for the unit *henry.* Common errors were capacitance, resistivity and voltage.
Q1(b) Most candidates correctly calculated both absolute correction and relative correction, but many showed misunderstanding of relative correction by including the unit *V*.
Q1(c) Many candidates misinterpreted this question and gave the incorrect response of using both an ammeter and a voltmeter in a circuit to find the resistance. Some candidates who used a multimeter incorrectly put a power source into the circuit as well.

Question 2:
Q2(a) Most candidates were able to correctly identify both a scalar and a vector quantity.
Q2(b) Most candidates were able to draw two forces at 60° to one another, but some omitted arrows to show that they were forces or were not drawn to scale. However many candidates were unable to add the two vectors correctly by drawing and measured the incorrect diagonal of their parallelogram. Those who calculated the magnitude of the resultant force using trigonometry usually got it right but many then gave the angle between the 3 N force and the resultant instead of the one between the 4 N force and the resultant.
Q2(c) Many candidates were able to correctly draw and label both the axes and the line on the graph grid. However some candidates struggled with the scale and their *x* axis started at 1 s, so the line was then incorrectly drawn. A few candidates inverted the axes to put time on the *y* axis and velocity on the *x* axis. Most candidates were able to correctly calculate the acceleration.

Question 3:
Q3(a) Most candidates were able to explain electrical resistance, either by defining it as potential difference divided by current or by referring to opposing electron flow. There were a few candidates who did not use correct terminology such as opposing electricity.
Q3(b) Most candidates correctly drew a straight line through the origin.
Q3(c) Most candidate correctly added the three resistance values to give the total resistance, but some omitted the unit. Some attempted to use the resistors in parallel rule.
Q3(d) Most candidates correctly calculated the current using the correct equation from the booklet, but again some omitted the unit or used an incorrect unit.

Question 4:
Q4(a) Few candidates achieved both marks in this question, and there was a wide variety of incorrect responses. Some candidates did not know that Hooke's Law was to do with materials, and some gave an explanation of elastic deformation.
Q4(b) Very few candidates answered this question correctly. Many calculated the gradient of the graph or attempted to calculate strain. Candidates who understood the term 'strain energy' were able to answer this question.

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Q4(c) Most candidates got at least one of the properties correct, with ductility being the most common correct response. Some candidates got toughness and hardness the wrong way round and some confused endurance and hardness.
Q4(d) Many candidates correctly answered this question. There were two fairly common errors; to explain that it was the maximum force rather than maximum stress, and instead of material failure some candidates put plastically deforming or yielding.
Q4(e) This question was also well answered, but some candidates' explanations were unclear.

Question 5.
Q5(a) Many candidates achieved one mark in this question for identifying that particles within a fluid move, but the description of how they move was not often well explained.
Q5(b) This was a fairly straightforward question which most candidates answered correctly. There were a few candidates who did not include a unit.
Q5(c) A straightforward question, but some candidates used the wrong calculation and some omitted the correct units.
Q5(d) Many candidates answered this question correctly, but a common error was to say that viscosity was a measure of the ability to flow, rather than a ability to resist flow.
Q5(e) Many candidates answered both parts of this question correctly.

Question 6:
Q6(a) Many candidates showed that they were able to use the relationship that temperature is proportional to volume of a gas. However many candidates did not realise that this relationship is only true for temperatures measured in Kelvin so they did not convert the temperature in Celsius to Kelvin.
Q6(b) Many candidates were able to correctly calculate the new volume, but the working was not always laid out well, so if there was an error in calculation they were unable to gain any credit.
Q6(c) This question was well answered with most candidates answering correctly.
Q6(d) Many candidates were able to carry out this calculation correctly but often used an incorrect unit. However, many candidates did attempt to convert the temperature gain of 60°C into Kelvin in this part of the question where it was incorrect to do so.

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OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Facsimile: 01223 552553

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