OCR
Oxford Cambridge and RSA

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 January 2018

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

Unit 1 - Mathematics for engineering

General Comments:

This is a mandatory unit across all qualifications in the Cambridge Technicals in Engineering suite.

It is hoped that the following points may help centres to prepare future cohorts of candidates for this unit.

Comments on Individual Questions:

Question 1 (Algebra)

While most candidates scored well on this question there were some very basic errors seen.

In (a) a significant proportion of candidates expanded $(4x+3)(x-2y)$ instead of $4x+3(x-2y)$.

In (b)(i) there was sometimes only a partial factorisation and in (ii) the signs were occasionally seen the wrong way round.

In (c) there were a large number of candidates who failed to solve the equation.

Question 2 (Trigonometry)

In (a) the conversion from radians to degrees and vice-versa was often muddled.

Part (b) was usually answered well, though some failed to use Pythagoras correctly.

In (c), the area of the semicircular rug was completed quite well, though there were the usual failures to use the radius rather than the diameter, and some forgot the halve the area of the circle.

Question 3 (Exponentials, logarithms and polynomial solutions)

The basic laws of logarithms in (a) were usually not known and correct answers were rare.

In (b)(i) the exponential calculation was usually done correctly, but the reverse, in (ii) was not usually correct. Some gained marks by finding the answer by trial and improvement.

Part (c) required candidates to solve a quadratic equation and is was disappointing to see so many candidates fail to get anywhere. One or two completed the square but for many it seemed as though the formula was not known.

In (d) a fair proportion obtained all 3 roots but a large number did not seem to know where to start.

Question 4 (Graphical understanding of equations)

In (a)(i) most candidates were able to calculate the required points and draw a smooth curve through the plots. They were then able in (ii) to write down the values of x where their curve cut the x-axis.

Part (b) was not well answered. While many understood the idea of perpendicular lines, finding the gradient of the given line defeated most.

Question 5 (Calculus)

The responses to this question were the weakest of the paper.

In part (a) many knew the indefinite integral but then failed to give the correct answer; it seems as though most candidates had their calculators in degree mode, being unaware that the result of the integration depended on the use of radians.

The context of part (b) is given in the specification but most failed to understand either the context or the method of solution.

In (i) there were a large number of candidates who tried to fudge the process, given that the end result was given. In such questions it is crucial that candidates work carefully through the process, writing down their steps carefully and clearly so that it is clear to the examiner that he or she knows how to achieve the end result.

A "show that" question is usually asked when the result is to be used in the next part. This means that what is given in the previous part can be used by candidates who are unable to show the result. However, in this question it was often the case that the result of (i) was not used in (ii). Some returned to the original expression for S and differentiated that, treating h as a constant.

This part question was worth up to 6 marks and consequently those who had not studied this topic in enough depth could not access the full 6 marks available.

Question 6 (Probability and Statistics)

In part (a) very few candidates tackled the problem the easiest way. The statement P (at least once) = 1 – P (not once) was not known; only a handful of candidates picked up 2 marks by doing the question this way. Many did get the correct answer using a probability tree diagram and adding the end results of three of the branches but this long-winded method had many pitfalls meaning that a large number of candidates did not complete the question correctly.

In part (b) the mean and standard deviation of a set of data were required. The simplest way is to use a calculator and many candidates did so, scoring the full 5 marks. It is worth noting that when the standard deviation is done this way, the input of an incorrect value will result in an incorrect answer. Where no working to a question is shown then an incorrect answer will get zero. However, in most cases, candidates who had used their calculator obtained full marks.

For those who worked this the long way there were various errors seen caused by misunderstandings. A significant number found a mean value by adding the six different values for the mass and dividing by 3, thus obtaining 3.25. Some knew that they needed to use the frequency column to get a total of 120.5 but then divided by 6 instead of the sum of frequencies (38), obtaining an answer that was outside the range of the data given.

Likewise there were many answers for the standard deviation that were well outside the range of values given.

Unit 2 - Science for engineering

General Comments:

In general candidates seemed to make good use of the answer space available for calculation questions and it was easier to follow the working. There were several candidates who had power of ten errors or omitted units to numerical answers.

Comments on Individual Questions:

Question 1:

Q1(a). Common errors were to put weight for mass and Celcius or degrees for temperature. A few candidates put minutes for time.

Q1(b). Some candidates understood the difference between precision and accuracy but a few did not write their explanation particularly clearly. A few candidates got the two the wrong way round. Many candidates were able to calculate the relative error. Common mistakes were to divide by 4.00 instead of 4.60, or to find the ratio 4.00/4.60.

Question 2:

Q2(a). Many candidates were able to calculate the vertical component of velocity correctly, but then did not use that value calculated in part (i) in the subsequent calculations. Although many candidates chose a suitable SUVAT equation from the formula booklet, some did not use the acceleration of gravity = 9.8 ms^{-2}, which is given on the front page of the question paper.

Q2(b). The concept of torque was not well understood, and many calculations were not clearly laid out in this section. Despite that, some candidates were able to gain credit for the correct numerical answers.

Question 3:

Q3(a). Most candidates knew the relationship between voltage, current and resistance as Ohm's Law, but very few gained the second mark for including reference to a constant temperature.

Q3(b). There were a variety of different responses to this question. Some candidates did show that resistance of a thermistor decreased with temperature, but usually they drew a straight line instead of one with decreasing negative gradient.

Q3(c). Most candidates correctly identified the sample of iron, but the explanations were not detailed enough. In order to gain the mark they needed to link the data given in the question about the relative currents flowing in the two materials to the fact that iron is a better conductor than silicon.

Q3(d). Most candidates were able to use the correct equations, but many omitted the unit, or failed to realise that the charge was given in milli-Coulomb. A few used an incorrect factor to convert milli-Coulomb to Coulomb. Some candidates used an incorrect equation (V = W/Q) in part (ii).

Question 4:

Q4(a). Candidates were able to better identify the stated property with the materials rather than the shape of the force-extension curve.

Q4(b). Many candidates did not attempt this question, but some were able to gain credit for realising that the area under the graph = ½ Force x extension, and for stating the equations used for finding stress and strain. Another mark was sometimes gained for substituting into the equation.

Q4(c). In general candidates found it difficult to explain why materials are tested, and most only gained one mark for describing one difference between non-destructive testing and destructive testing.

Question 5:

Q5(a). This was generally well answered.

Q5(b). Many candidates realised that they needed to find the pressure exerted by the water above the container, but most did not calculate the average depth of the container as 4.7m, but were able to gain the rest of the available marks. Some omitted the unit. Those who did not understand how to calculate the force were able to gain some of the marks for finding the area of the hatch and for putting the correct unit on the answer line. Some candidates did not gain any credit in part (ii) as their explanation required changing the dimensions of the container or the hatch, which is not an option in the scenario given in the question.

Question 6:

Q6(a). Some candidates did not convert the temperature into Kelvin and a few used an incorrect conversion. In part (i) there were several power of ten errors for the pressure with some candidates leaving the pressure in bar, some converting to kPa, and a few incorrectly used a pressure of 100kPa instead of 230 kPa. It was pleasing to see many candidates include the unit in this question. Many candidates used the ideal gas equation (PV = mRT) again in part (ii), and some attempted to use the pressure law with mixed success. Many of these did not use the relationship correctly as they just calculated pressure/temperature or used volume as the constant. Part (iii) was well answered with most candidates using a temperature change in the equation correctly. A few used the temperature change of 288 instead of 15. Some candidates omitted a unit in their final answer. Some candidates incorrectly attempted to use the latent heat equation here instead of the specific heat capacity equation.

Q6(b). This was generally well answered, with only a few candidates making mistakes

Unit 3 – Principles of mechanical engineering

General Comments:

As in previous series, most candidates show room for improvement in their presentation of answers to calculation questions. Such candidates would benefit from showing evidence of; the equation (or principle) used; rearranging; substituting; stating clearly their answer to an appropriate number of significant figures; including appropriate units. Many candidates are losing marks due to missing or incorrect units and powers of ten errors.

Some candidates' responses to questions 3, 4aii and 6a & 6b indicate they continue to struggle to apply the principle of moments successfully and that are unable to draw a bending moment diagram correctly. Most candidates were unable to apply the principle of conservation of momentum correctly.

Comments on Individual Questions:

Question 1:

Most candidates were able to show correctly some of the forces on a free body diagram and to find the horizontal and vertical components of a force. However, the majority were unable to add the forces in a particular direction correctly and this contributed to difficulties in applying Newton's 2^{nd} Law. Many candidates failed to include correct units in their responses.

Question 2:

Most candidates seemed to be familiar with simple gear calculations, but many struggled to deal with the compound gear in question 2a. Most candidates cited acceptable uses of "rack and pinion" in 2b.

Most candidates scored well on question 2c which demonstrated an ability to deal with the very simplest moment questions and ideas of velocity ratio & mechanical advantage, although a significant number of candidates thought that the class of lever shown was "class 3".

Question 3:

Most candidates struggled with this question about a plate in equilibrium. Most were unable to "take moments" correctly about appropriate points when several forces were involved, although some credit was given for attempts with missing terms or incorrect directions.

Most candidates were able to calculate the resultant force by adding the vertical and horizontal components.

Question 4:

In 4a, most candidates demonstrated an ability to calculate the coordinates of the centroid of a plate. Many candidates and Centres use a tabular approach to show workings for the individual parts that the plate is broken down into and this is good practice. The best candidates also included summary equations before clearly stating the coordinates.

4b provided further evidence of difficulties in applying principle of moments to a plate in equilibrium.

Most candidates were able to use the length and strain of a steel bar to find the change in length although there were very many ‘power of ten’ (POT) errors.

Question 5:

In 5a, most candidates were able to calculate correctly the density of the cylinder although once again there were many POT errors. There were also many instances where candidates did not include correct units.

In 5b most candidates were able to apply simple suvat equations and to calculate Kinetic energy, potential energy and work done. Many candidates failed to include correct units in their responses.

Most candidates were able to calculate correctly the area of a plate although there were some careless errors – for example forgetting to multiply the area of 1 hole by the number of holes. Almost all candidates realised that adding a 5th hole at the centroid does not change the position of the centroid.

Question 6:

Very few candidates were able to recall the correct name for the type of beam shown. A significant minority were unable to calculate either the vertical reaction force or the bending moment at the wall. Most candidates struggled (as in previous sessions) to draw a labelled bending moment diagram correctly. This was compounded in a minority of cases by the absence of clear labelling of axes.

Most candidates were unable to apply the principle of conservation of momentum correctly.

Unit 4 – Principles of electrical and electronic Engineering

General Comments:

Questions on the fundamentals of electricity and electronics (1,2 & 5) were generally answered well. Questions on systems (3, 4 & 6), with a greater reliance on understanding, explanation and recall were not answered so well.

There was widespread misuse of the key words *current, charge, voltage, power, phase*, indicating a less than certain grip on the nature of electricity. It would seem that more time spent early on to embed these ideas would lead to more successful outcomes.

There were a number of missing or incorrect units being used for numerical answers.

A large number of pupils were able to correctly substitute values into the appropriate formulas but then calculated the incorrect answer. Usually these candidates were not applying the BODMAS rules when using their calculators.

Comments on Individual Questions:

Question 1:

(a) The question called for identification of key characteristics of the operational amplifier. The majority of candidates contented themselves with identifying/repeating the names of aspects of the diagram and consequently scored low marks.

(b) (i) This was handled successfully provided the rearrangement was done correctly. **190 kΩ**

(b) (ii) This was a straightforward use of the generalised voltage gain formula. **0.2V**

Question 2:

(a) This was answered well provided 3.3 µ was correctly interpreted as 3.3 x 10^{-6}. **965 Ω**

(b) (i) There was generally correct use of the formula. **985 Ω**

(b) (ii) As above there was generally correct use of the formula. **78.3°**

(b) (iii) Very few candidates were able to construct all elements of the phasor diagram and a signification number did not indicate an alignment of phasors in the correct vector formation.

Question 3:

(a) This question required recall that Kirchhoff's first law is about current, for one mark, and its conservation at nodes for the second. It was rare to see both marks earned.

(b) (i) This was a searching question on resistor combination that was usually handled competently provided time was taken to plan the three phases of the calculation. Most candidates recognised the need to use both formulae as appropriate. Combining two resistors on either side of an ammeter proved a challenge for some candidates. **0.492 mA**

(b) (ii) The above remarks apply here too, and additionally there were many occurrences of 'sharing' the 6V potential difference as 2V to each leg. **1.67 mA**

Question 4:

(a) (i) (ii) Part (i) was straight recall of the DC power supply system and found approximately half the candidates wanting. The single mark for (ii) was rarely earned.

(b) Few candidates showed appreciation of the purpose of load regulation.

Question 5:

(a) This was generally well answered but the Boolean expression presented some difficulty.

(b) (i) This was well answered although labels for inputs and output were often overlooked.

(b) (ii) The truth table was handled well by most although correct tabulation of the 8 input combinations would have helped some.

Question 6:

(a) Few candidates were able to recall the four essential features of the self-excited series wound DC generator, viz. armature, field winding, output voltage and armature resistance.

(b) (i) Many candidates were applying inappropriate formulae. **476V**

(b) (ii) As above. **486.5V**

(c) The advantage of lower internal resistance eluded the majority. The disadvantage of an additional voltage supply was better known.

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