OCR
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CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

ENGINEERING

Cambridge TECHNICALS

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Unit 1 January 2020 series

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Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

You can now find the results awarded in 2018/19 for your Cambridge Technical subject area

As a centre approved to offer our Cambridge Technicals qualifications, we wanted to let you know we have now published the results awarded for 2018/19 Level 2 and 3 Cambridge Technicals (2016 suite). This information is helpful in allowing you to compare your centre achievements alongside national outcomes.

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ExamBuilder

Remember to keep your eye on ExamBuilder as we continue to update the bank of questions post exam series in line with our past paper policy. Therefore, you can be assured that new assessment material will continually be fed into ExamBuilder on an annual basis.

Online post series external feedback

Keep an eye out for updates on our post series feedback on Exams for Cambridge Technicals Webinars available in the autumn term.

Paper Unit 1 series overview

There is evidence that many candidates had not fully covered the syllabus set out in the unit specification. In particular the assessment of calculus (Question 6) and exponentials (Question 5) resulted in many candidates failing to secure marks for these questions.

Candidates should be encouraged to cover and practice all topics covered by the unit specification to be able to access all parts of the examination paper.

Question 1 (a)

1 **(a)** Solve the equation $3(2x - 3) = 1 - 4x$.

....

....

....

.... **[2]**

When answering this question, some candidates did not deal with signs properly. Weaker candidates found this equation challenging and there was evidence that the usual processes involved in solving equations was not well understood.

Question 1 (b)

(b) Factorise $2x^3 - 4x^2$.

....

....

.... **[2]**

This question was generally well answered, although many candidates did not factorise the equation fully, extracting only one or two factors.

Question 1 (c)

(c) Express as a single fraction $\frac{5x + 2}{3} - \frac{x + 1}{2}$.

....

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....

.... **[3]**

In responses to this question, dealing with signs caused candidates problems. Most candidates were, however, able to find the lowest common multiple (LCM).

Question 1 (d) (i)

(d) (i) Factorise $f(x) = x^2 - 8x + 15$.

....

....

.... **[2]**

Some candidates were able to produce an answer to this question without providing evidence of any working. A few candidates were not able to begin to attempt the question. Others who appeared to know how to solve the problem often wrote down the incorrect factors.

Question 1 (d) (ii)

(ii) Hence solve the equation $f(x) = 0$.

....

.... **[1]**

This question would have been straightforward for candidates who factorised f(*x*) properly. Many, however, who obtained the correct factors in (d)(i) were not able use these correctly to write down the solution to this equation.

Question 2 (a) (i)

2 (a) (i) Show that $(x - 2)$ is a factor of the function $g(x) = x^3 - 2x^2 - x + 2$.

....

.... **[1]**

The expected method to solve this problem was to show that g(2) = 0 which many candidates did successfully. Some tried g(-2), mostly writing "=0" at the end of their working even though this is clearly incorrect. Others proceeded to do a long division, thereby over complicating their attempted solution and producing far more working than the one mark for the question justified. Some completed the factorisation of g(*x*) fully by this means which benefitted them for the next part.

Question 2 (a) (ii)

(ii) Hence factorise g(x) completely.

[3]

Some candidates tried different values of x to find other factors with varying degrees of success. Others at this stage completed a long division solution correctly to obtain the answer. The working seen in part (i) of this question was accepted for reward here.

Question 2 (b)

(b) The kinetic energy, K joules, of a car with mass m kilograms which is moving at v metres per second is given by the formula $K = \frac{1}{2}mv^2$.

Rearrange this formula so that v is the subject.

[3]

The process of making v^2 the subject of the formula was not attempted well with almost all combinations of the variables seen. Some candidates who worked the rearrangement well often did not deal with the square root function properly, taking the square root of the numerator rather than the whole fraction.

	AfL	**Manipulating formula.** Candidates should be encouraged to practice manipulating formula and applying fundamental mathematical operations. This includes rearranging formula, factorising, finding the lowest common multiple and solving equations.

Question 3 (a)

3 **(a)** Find the equation of the line that passes through the points (1, 2) and (7, 5).

....

....

....

.... **[3]**

There are several ways of finding the equation of this line; most candidates found the gradient and then used the equation $y = mx + c$, finding the value of c by substituting the coordinates of one of the given points. Some candidates incorrectly obtained the value of the gradient to be 2 rather than $^1/_2$

Question 3 (b)

(b) Find the equation of the line through the point (2, 1) which is parallel to the line $y = 3x - 1$.

....

....

....

.... **[2]**

Most candidates knew that the required equation would be of the form $y = 3x + c$, although some took the negative reciprocal of the given gradient, hence finding the equation of a line that was perpendicular rather than parallel to the line. When substituting the coordinates (2, 1) into the equation $y = 3x + c$ to find c the most common error was to substitute $y = 2$ and $x = 1$ rather than the correct way around.

Question 3 (c) (i)

(c) (i) The points A and B have coordinates (1, 3) and (5, -3) respectively. Find the coordinates of the midpoint of AB.

....

....

....

.... **[2]**

Candidates that knew the correct formula had no difficulty in finding the coordinates to solve this problem. Many, however, did not know the correct formula obtaining answers such as (-2, 3).

Question 3 (c) (ii)

(ii) Calculate the distance AB.

....

....

....

.... **[2]**

Again, candidates who could recall the correct formula had little difficulty in obtaining the correct answer. Full marks were given for the exact answer in surd form (e.g. $\sqrt{52}$ or better, $2\sqrt{13}$) or any correct decimal. A surprising number of candidates gave the answer (4, 6).

Question 4 (a)

4 **(a)** A wheel in a machine is rotating at 5 radians per second.

Calculate this in revolutions per minute.

....

....

....

.... **[3]**

A significant number of candidates were able to find the number of radians per minute and were then able to convert radians into degrees. Proceeding to find the number of revolutions, however, proved somewhat more challenging.

Question 4 (b) (i)

(b) A corner support for a frame is a triangle ABC made of metal. In the triangle, angle A = 25°, angle B = 90° and AC = 8 cm.

Find

(i) the length of the side BC,

....

....

....

.... **[2]**

For this question, most candidates were able to determine the answer using the correct ratio.

Question 4 (b) (ii)

(ii) the area of the triangle.

....

....

....

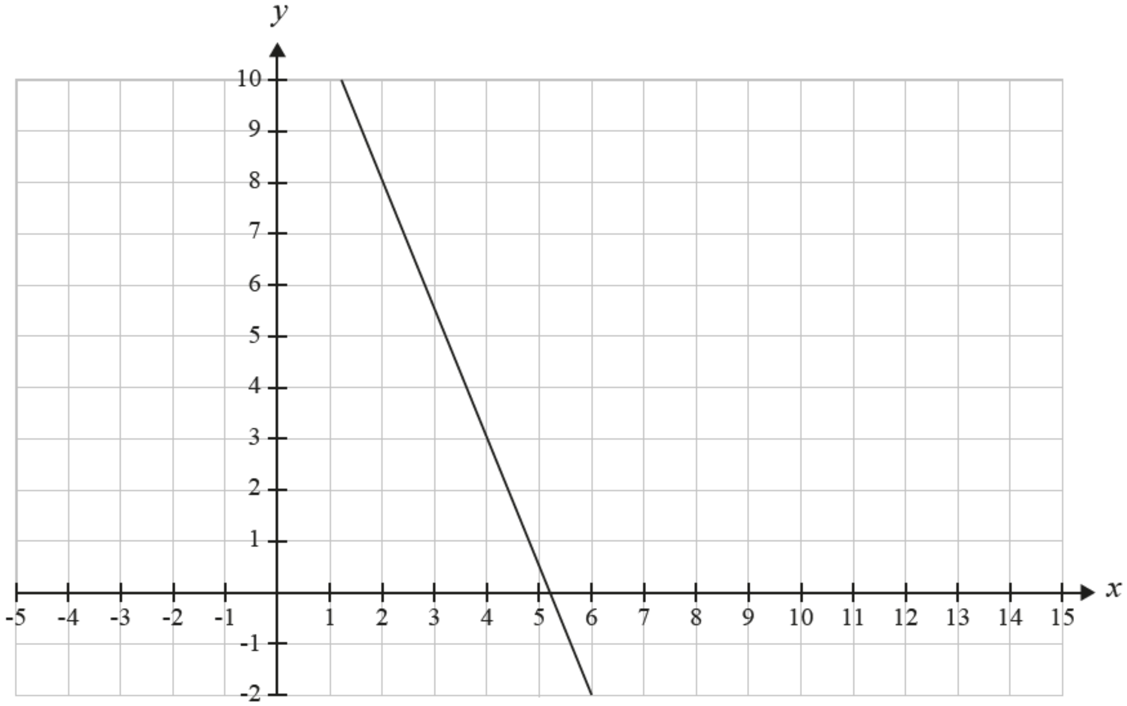
.... **[2]**

This part of the question was generally less well done. Around half of all candidates found the third side using Pythagoras' Theorem and then used the formula $Area = \frac{1}{2}bc$. Unfortunately, Pythagoras' Theorem was applied incorrectly with many not realising that the length 8 was the hypotenuse. The remainder used the formula $Area = \frac{1}{2}bc\sin A$ with very mixed levels of success.

Question 4 (c) (i)

(c) Ahmed wants to find a value for x and y that satisfy two equations.
The equations that he has are $5x + 2y = 26$ and $y = x - 1$.

On the grid below is drawn the line $5x + 2y = 26$.



(i) On the same grid plot the line $y = x - 1$.

[2]

The majority of candidates were able to draw the correct line onto the graph.

Question 4 (c) (ii)

(ii) Using your graph, write down the values for x and y that satisfy both equations.

....

.... **[1]**

This question followed on from (c)(i). Many candidates, however, started afresh, attempting to solve the two equations simultaneously. This required much more work than the one mark given indicated and did not use the graph as instructed. However, it did mean that some candidates were awarded the mark for obtaining the correct answer even though the line in (c)(i) was incorrect.

Question 5 (i)

5 A beaker of water used in an experiment is heated and removed from the heat when it has reached a temperature of 100 °C. The temperature of the water, T °C, after it has been removed from the heat is given by the formula

$$T = A + 80e^{-kt}$$

where t is the time in minutes and A and k are positive numbers.

(i) Write down the value of A.

.... **[1]**

Unfortunately, the whole of this question was poorly answered. In this first part, candidates did not realise that they needed to set t = 0.

Question 5 (ii)

(ii) What is the long-term temperature of the water?

.... **[1]**

"Room temperature" was accepted as a valid answer to this question, however, the understanding that e^{-kt} tended to 0 for any k as t increased seemed to be unknown by most candidates.

Question 5 (iii)

(iii) After 10 minutes the temperature of the water is 70 °C. Show that $k = 0.0470$, correct to 3 significant figures.

....

.... **[3]**

This was a "show that" question meaning that all working needed to be shown. Many candidates seemed unaware that this requirement needed to be satisfied to secure marks. In a number of cases the end value did not tie in with any working seen. Candidates need to be aware that "show that" and "verify" are two different demands often posed in mathematical questions.

	AfL	**Showing working to calculations.** Candidates should be encouraged to show all stages of working when solving problems, especially where this is asked for in the question. By showing working, they might be able to secure marks even if an incorrect final solution is presented.

	OCR support	Candidates could be directed to the OCR Cambridge Technicals Command Verbs guidance document available from the OCR website: https://www.ocr.org.uk/Images/273311-command-verbs-definitions.pdf This explains the meaning of command verbs and their use in assessments, along with examples.

Question 5 (iv)

(iv) Find the temperature after 20 minutes.

....

....

....

.... **[2]**

The final part of this questions was better attempted than the previous parts. Given the values in the question it was possible to attempt and solve this part despite previous parts being incorrect.

Question 6 (a)

6 **(a)** Find $\int (x^2 + 4x^3)\,dx$

....

....

....

.... **[2]**

As with Question 5, this question was often poorly answered. In this first part, integration of both parts were necessary including the addition of the arbitrary constant of integration, although $\frac{4x^4}{4}$ was accepted for the second term. A number of candidates incorrectly applied differentiation rather than integration.

Question 6 (b) (i)

(b) A sheet of metal, 60 cm wide is to be bent to form a trough with vertical sides AB and CD and horizontal base BC. The cross-section is to be symmetric with AB = CD = x cm, as shown in the diagram.

(i) Write down the length of the base, BC.

....

.... **[1]**

The remaining parts of this question depended on the fact that the lengths of AB and DC were unknown. The majority of candidates wrote down a numerical answer, such as 60 cm, 40 cm or 30 cm. To find the length of BC, candidates needed to subtract the given lengths of x cm from 60 cm to give 60 – 2x.

Question 6 (b) (ii)

(ii) Hence find an expression for the cross-sectional area of the trough.

....

.... **[1]**

The answer to this question was the area of the rectangle ABCD which required candidates to multiply their answer for (b)(i) by x. This was accepted even if wrong only if the expression in (b)(i) was algebraic.

Question 6 (b) (iii)

(iii) It is required to choose x so that the cross-sectional area is a maximum.

Using calculus, find the value of x that makes the cross-sectional area a maximum and find this area. Give the units for your answer.

....

....

....

....

....

.... **[5]**

Candidates without a quadratic expression for the area could not attempt this part and only a handful of candidates were able to secure marks. They should differentiate the quadratic expression in (b)(ii) to give a linear expression. Setting this equal to zero gave the required answer.

It was not necessary to demonstrate that this value for x gave a maximum area even though a few did differentiate again to give a negative value and hence determine a maximum.

The question then asked for the area together with its units be presented. Few of those who obtained the correct value for x lost the final mark because of the failure to complete the question correctly.

Question 7 (a) (i)

7 **(a)** Anita and Paul are quality control engineers and they are asked to sample a consignment of components that are packed in boxes each containing 10 components.

Anita decides to choose one box at random and check all 10 components in that box.

Paul chooses 10 boxes at random and then chooses one component at random from each box.

(i) State which one of them is using a random sampling method.

.... **[1]**

The purpose of this question was to determine whether the whole consignment was being sampled. This Paul did by choosing 10 boxes, therefore choosing one box only was not an adequate sample of the whole consignment.

Question 7 (a) (ii)

(ii) Say why the other sampling method is not random and may not be representative of the whole consignment.

....

.... **[1]**

In this part of the question it was necessary to explain why Anita's sample was not representative of the whole consignment which most candidates were unable to explain adequately.

Question 7 (a) (iii)

Paul and Anita weigh each of the components that they choose. One day Paul recorded the following masses, correct to the nearest gram.

Mass (gram)	25	26	27	28
Frequency	2	3	4	1

(iii) Write down the mode for these data.

.... **[1]**

Most candidates understood the definition of Mode, thereby securing full marks for this question.

Question 7 (a) (iv)

(iv) Calculate the mean mass for this sample. A blank row has been added to the table for any intermediate working.

....

.... **[3]**

Finding the mean of the sample was not well understood by candidates. Many ignored the fact that there were 10 items rather than 4 which gave an incorrect answer of 26.5

Question 7 (b)

(b) In a production line components are subject to a quality check. The probability of passing the quality check first time is 90%. If a component fails the first check it is reworked and then checked again. The probability of passing the second check is 70%.

Calculate the probability a component passes.

....

.... **[2]**

Most candidates misunderstood the concept of two events with the second dependant on the first. The modal answer therefore was 0.63. In order to gain any marks, candidates needed to demonstrate they understood that it was only if the first check failed was the second check carried out.

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