CAMBRIDGE TECHNICALS

OCR
Oxford Cambridge and RSA

Examiners' report

CAMBRIDGE TECHNICALS LEVEL 3 (2016)

ENGINEERING

OCR Level 3 Cambridge Technical in Engineering Principles

Certificate: 05822

OCR Level 3 Cambridge Technical in Engineering

Extended Certificate: 05823

Foundation Diploma: 05824

Diploma: 05825

Extended Diploma: 05873

Unit 1 Summer 2025 series

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 and the mark scheme can be downloaded from Teach Cambridge.

Unit 1 series overview

As usual, a good range of responses were seen, including marks in single figures and full, or nearly full, marks.

Candidates grasp of algebra seemed better this series and the mean mark will consequently be higher. However, the question on logarithms and exponentials and the calculus question were not, in general, done well.

When a calculation question results in an irrational answer it is standard to correct it to 3 significant figures. In some questions this is stated as a requirement (e.g. 2 (a) (i)) and when the response is not given in accordance with this demand then a penalty is applied even when it is given to a greater accuracy. When such a demand is not made the rubric says, 'Give your final answers to a degree of accuracy that is appropriate to the context'. In such cases a response that rounds to the correct 3 significant figure approximation is allowed, even though the response may include all digits given on the calculator.

There will be one or more questions where the units of the answer are required. So, for instance, the answer for the cost of a paintbrush (Question 5 (b)) of 1.8 was not accepted. Such errors are likely to be because the candidate has not read the question carefully enough.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• were confident in their knowledge of all the topics, particularly Exponentials and logs (LO3) and calculus (LO5). Questions to assess these topics are usually set in context and usually carry more marks than other questions.	• were often unable to attempt all questions, indicating that their understanding of some topics was not sound • lost marks available by not reading question carefully.

Question 1 (a) and (b)

1

(a) Factorise $6x+2y$.

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..... **[1]**

(b) Remove the brackets and simplify $4(x+2)+(5-x)$.

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..... **[2]**

The ability to manipulate expressions algebraically is an important skill and it was encouraging to see so many candidates manage 1 (a) and 1 (b) effectively.

Question 1 (c)

(c) Express as a single fraction $\frac{2x+3}{4}+\frac{x-3}{5}$.

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..... **[3]**

A small number of candidates were unable to understand that in order to add two fractions the denominators have to be the same by finding the lowest common denominator; many just added the numerators and denominators separately, giving a single fraction with a denominator of 9.

Question 1 (d)

(d) Solve the equation $2(4x-1)=1+2x$.

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..... **[3]**

As with questions 1 (a) and (b), this question was done well, although a small number manged to turn $6x = 3$ into $x = 2$.

Question 2 (a) (i)

2

(a)

(i) Solve the equation $x^2-6x+7=0$. Give your answers correct to 3 significant figures.

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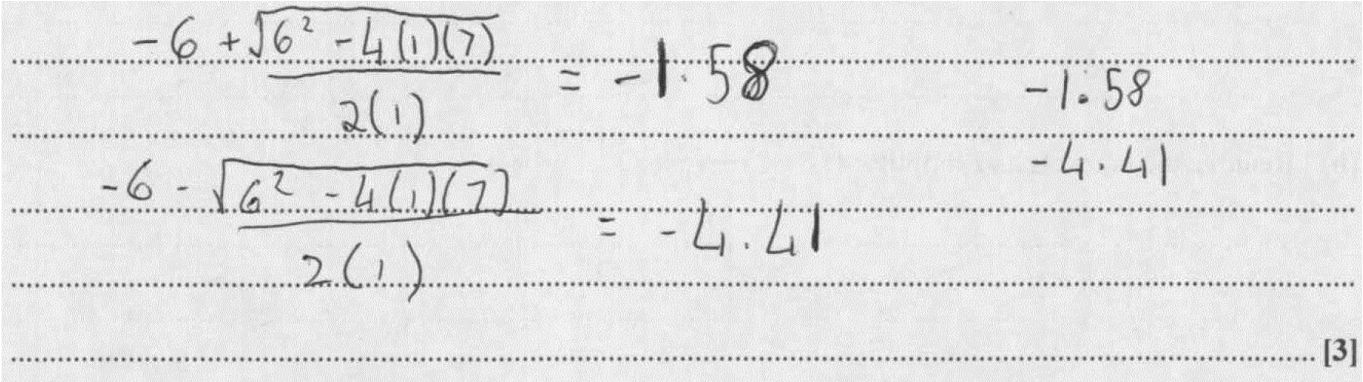
..... **[3]**

The request to give roots to 3 significant figures should be a clue that the quadratic function did not factorise, but a number of candidates spent time trying.

The most significant error was to use the formula given in the formulae booklet, but with $b = 6$ rather than $b = -6$..

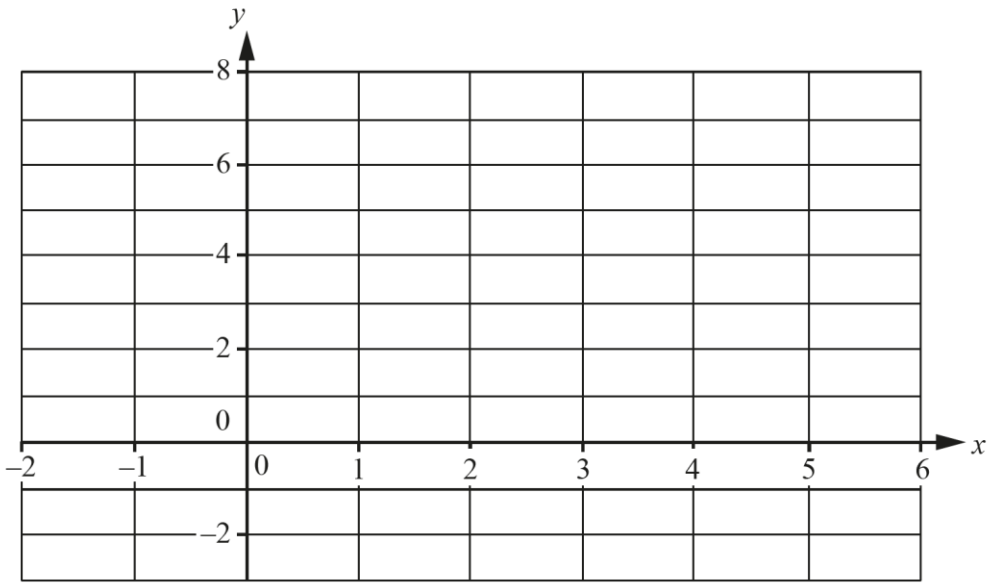
Exemplar 1



This candidate has used $b = 6$ rather than -6, resulting in the incorrect answer. In addition, the formula for the quadratic equation is not written correctly, although this candidate understands that the formula is a single fraction.

Question 2 (a) (ii)

(ii) On the grid below, sketch the curve $y = x^2 - 6x + 7$. Indicate the answers to **part (a)(i)** on your sketch with circles.



[2]

Most candidates seemed to lack the confidence to sketch the quadratic, preferring instead to plot the curve. Those with the incorrect roots from part (a) (i) would have found this difficult. There were a number who plotted the curve and identified the roots correctly on the graph even though their answer to part (a) (i) was incorrect, but seemingly did not realise that there might have been something wrong.

Question 2 (b) (i)

(b) In this question you must show your working.

Two points, A and B, on a coordinate system have coordinates $(-1, 3)$ and $(5, -3)$.

(i) Determine the midpoint of AB.

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..... **[2]**

The question requires working to be shown so a number of candidates did not score as no working was shown.

Question 2 (b) (ii)

(ii) Determine the equation of the line AB.

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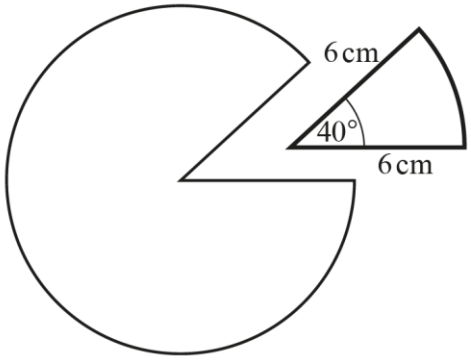
..... **[2]**

The requirement to show working applies to this part as well. Nearly all candidates started with the premise that the equation was $y = mx + c$ and so had first to find the gradient. This was often calculated to be 1 rather than -1.

Question 3 (a) (i)

3

(a) A component in a machine has the shape of a sector of a circle, as shown in the diagram. The circle has a radius of 6 cm. The angle of the sector at the centre of the circle is 40°.



Not to scale

Calculate

(i) the area of the sector,

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..... **[2]**

A few candidates confused radians with degrees, but for most candidates this was done correctly.

Question 3 (a) (ii)

(ii) the total perimeter of the sector.

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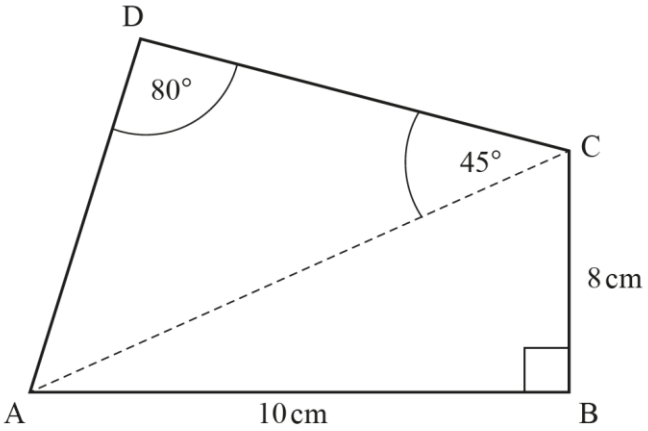
..... **[3]**

Finding the arc length caused the same problem for some as in part (i). Most candidates recognised that they had to add two radii to the arc length to achieve the correct answer.

Question 3 (b) (i)

(b) A piece of wood ABCD is in the shape of a quadrilateral, as shown in the diagram.
The angle at B is 90° and the sides AB and BC are 10 cm and 8 cm respectively.



Not to scale

(i) Calculate the length of the diagonal, AC.

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..... **[2]**

Finding AC by Pythagoras caused very few problems, although a few subtracted the squares of adjacent sides rather than adding.

Question 3 (b) (ii)

(ii) The angle ACD is 45° and the angle ADC is 80°.

Using the sine rule, calculate the length of AD.

..... [3]

A few candidates ignored the instruction and treated the triangle as being right-angled. Most candidates however, were able to apply the sin rule correctly.

Exemplar 2

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$\frac{a}{\sin 45} = \frac{12.8}{\sin 80°}$

$\frac{a}{\sin 45} = 12.997$

$a = 12.997 \times \sin(45)$

$a = 9.2$

check $\frac{9.2}{\sin 45} = 12.997$

AD = 9.2 cm

[3]

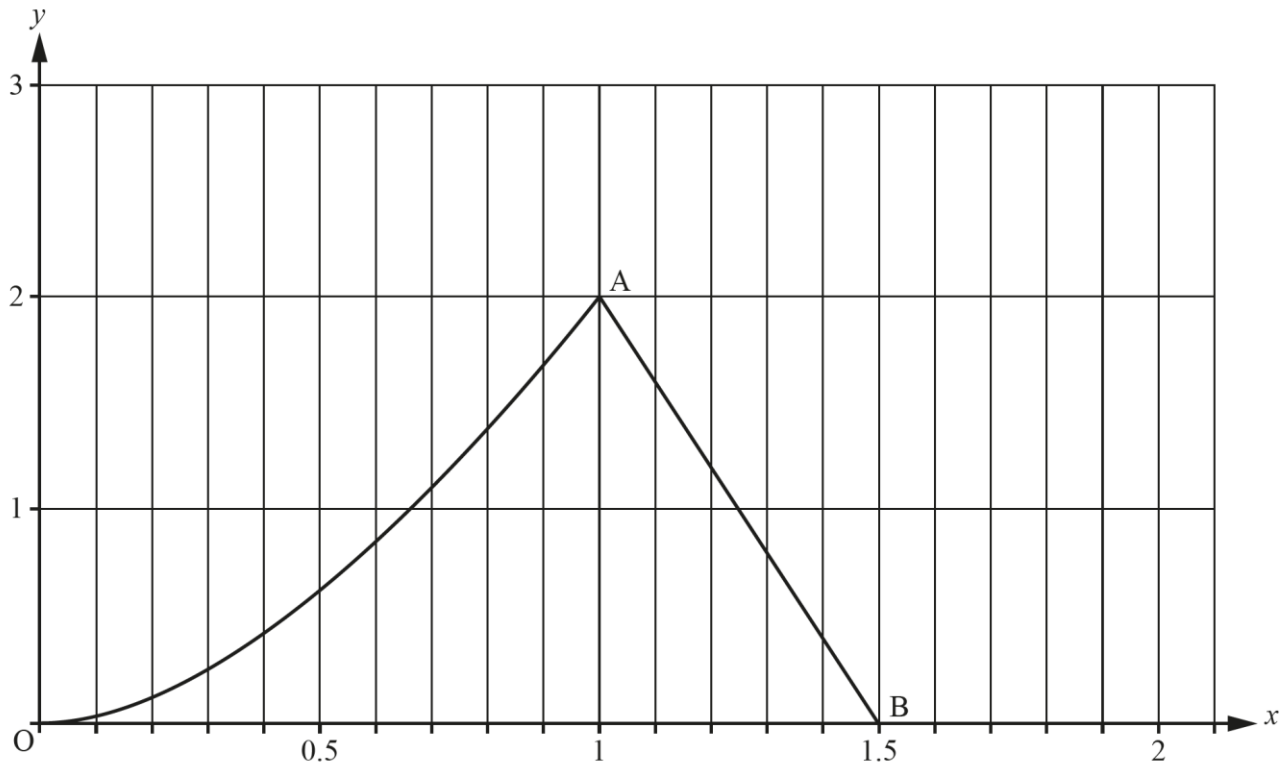
This candidate has obtained the correct answer but has taken an extra step to do it. Candidates are encouraged to complete the calculation in one step, i.e. to rearrange the equation to give AD = *their value for AC from part (b) (i)* × sin45/sin80..

Question 4 (a)

4 The diagram shows the cross section of a flood bank OAB on a coordinate system.
O is the origin and A is the point $(1, 2)$ on the curve with equation $y = 3x^2 - x^3$.

The line AB meets the x-axis at B with coordinates (1.5, 0).

The units are metres.



(a) Using calculus, determine the gradient of the curve at the point A.

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..... **[3]**

Calculus continues to be a topic which candidates find difficult to grasp. Many did not answer the question while others integrated the function rather than differentiate. For those that did differentiate correctly a few assumed that, as in most questions, there was a need to find when the gradient function was equal to zero to find a stationary point. In this question all that was needed was to find the value of the gradient function when $x = 1$.

Question 4 (b)

(b) Using calculus, calculate the cross-sectional area, OAB, of the flood bank.
Give the units of your answer.

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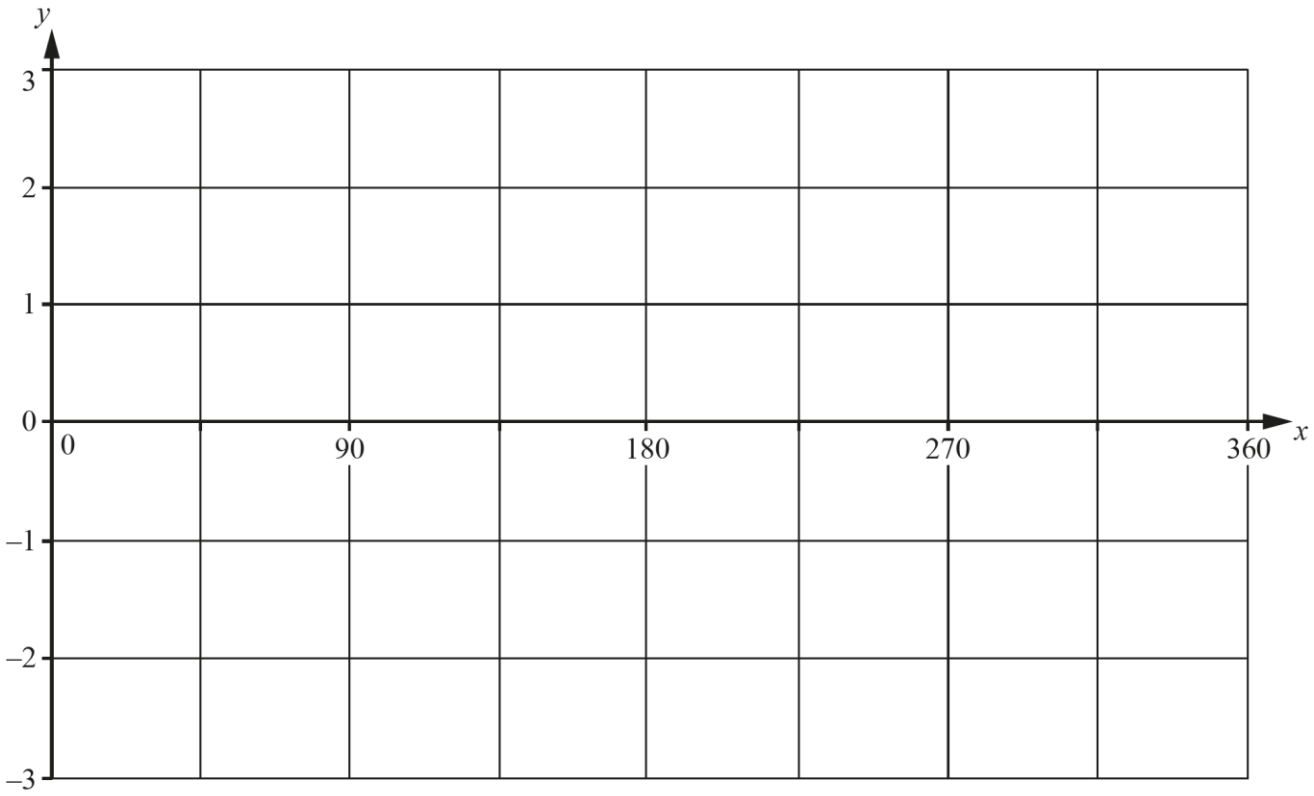
..... **[6]**

Those that integrated in part (i) generally differentiated in this part. A significant minority of candidates did not understand the question fully and so did not realise that the area was in two parts – the area under the curve from $x = 0$ and $x = 1$ and the triangle under the straight line part.

Many lost the last mark by not including the units as required.

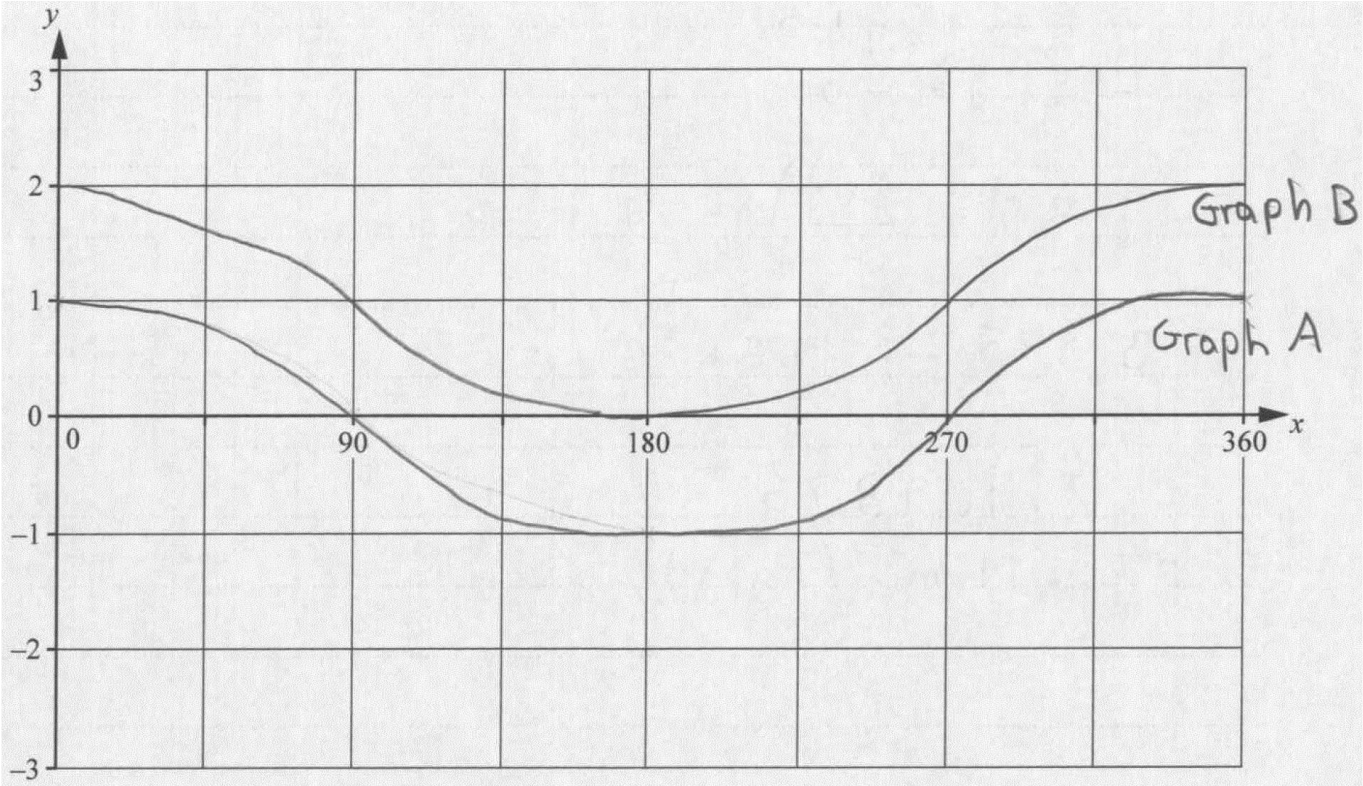
Question 5 (a) (i)

5
(a)
(i) On the grid below sketch the graph of $y = \cos x$ for $0° \leqslant x \leqslant 360°$.
Label your graph A. **[2]**



As in Question 2 (a) (ii), most candidates chose to plot the curve rather than sketch. Whether they plotted or sketched they often did not identify stationary points at either end.

Exemplar 3



It looks as though this candidate has sketched the curves rather than plotting. The labels give the equations rather than A and B as required, but this was allowed. The slight error to the right of $y = \cos x$ where it goes above the line $y = 1$ is allowed as it is a sketch. Note that the curve $y = \cos x + 1$ requested in part (ii) is also seen 1 unit above the original.

Question 5 (a) (ii)

(ii) On the same grid sketch the graph of $y = \cos x + 1$ for $0° \leqslant x \leqslant 360°$.
Label your graph B. **[2]**

It was necessary for this curve to be consistently 1 unit above the curve given in part (i). Additionally, some candidates lost a mark for not identifying the two curves.

Question 5 (b) (i)

(b) A shop has two packs of paintbrushes for sale.

Pack A contains 3 large and 4 small paintbrushes and costs £10.20.
Pack B contains 4 large and 2 small paintbrushes and costs £9.60.

(i) By writing the cost of a large paintbrush as £x and a small paintbrush as £y, form two equations in x and y.

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..... **[2]**

The majority of candidates were able to write down the correct equations. It should be noted that no unit symbols should be present as each equation is a comparison of values.

Question 5 (b) (ii)

(ii) Solve the equations to find the cost of a large paintbrush and a small paintbrush.

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..... **[4]**

Some candidates solved their equations by substitution and others by elimination and both methods were equally effective. Many lost a mark at the end by not answering the question. Candidates were asked to give the cost of each paintbrush and so the correct answer should be 'the cost of a paintbrush is….' rather than 'x = …'

Question 6 (a) (i)

6

(a) Two engineers, Jane and Jack, are given the task to make metal discs which are circular with diameter 55 mm.
A sample of 10 discs is taken from each engineer.

The data for Jane's sample are as follows.

54 54 54 55 55 55 55 56 57 57

Calculate

(i) the mean of the sample,

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..... **[2]**

Candidates found no difficulty with this question. The use of calculators is to be encouraged so the answer with no working was perfectly acceptable.

Question 6 (a) (ii)

(ii) the standard deviation of the sample.

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..... **[3]**

As in the previous part, the use of calculators is to be encouraged and the correct answer with no working was accepted. If candidates chose to work it all out numerically it was necessary to see the formula being used and although this is given in the formulae booklet, was not always written down and used correctly.

Some calculators use the divisor n and other the divisor n - 1 and both answers were accepted. The variance given as the answer was treated as a special case.

Question 6 (a) (iii)

(iii) The mean and standard deviation for Jack's sample were 55.2 and 1.66 respectively.

State which of the two engineers have produced more consistent discs, giving your reasoning.

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..... **[1]**

This question was a test of the understanding that standard deviation measured spread and consequently a smaller standard deviation meant a smaller spread. Most candidates were able to write a response that conveyed this fact.

Question 6 (b)

(b) Finley throws two fair dice and notes the numbers showing.

Determine the probability that they both show the same number.

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..... **[2]**

The majority of candidates wrote down the answer to the question 'Determine the probability that they both show the number 1 (or any of the other numbers)', not realising that of the 36 outcomes, 6 of them will show the same number. Some constructed the outcome space, giving each cell with the ones with the same number on the leading diagonal leading to the answer 1/36 × 6 = 1/6.

Question 7 (a)

7 The voltage across a capacitor in a circuit, which includes a battery (which applies a constant voltage) and a resistor, is given by the formula

$$V = 20(1 - e^{-0.05t})$$

where t is the time in seconds from the moment that voltage is applied.

(a) Write down the applied voltage.

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..... **[1]**

Most candidates did not realise that the applied voltage was the maximum value for V, i.e. the value of V in the long term. Many put $t = 0$ or 1.

Question 7 (b)

(b) Calculate the time when $V = 10$.

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..... **[4]**

The use of logs to solve the equation that results from setting $V = 10$ was unsuccessful. This is an important topic in Engineering.

The use of logs

A question which assesses LO3 may use exponential functions and will often involve the solving of the equation $e^{ax} = b$ where a and b are numbers. The solving of such an equation using logarithms will require the use of natural logarithms, giving the solution $ax = \ln b$. The question will usually also require candidates to derive this formula from something more complicated, using skills given in LO1, particularly LO 1.4

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