OCR
Oxford Cambridge and RSA

# Wednesday 8 January 2025 – Afternoon

## Level 3 Cambridge Technical in Engineering

**05822/05823/05824/05825/05873** Unit 1: Mathematics for engineering

**Time allowed: 1 hour 30 minutes**
**C301/2501**

*C301--2501*

**You must have:**
- the Formula Booklet for Level 3 Cambridge Technical in Engineering (inside this document)
- a ruler (cm/mm)
- a scientific calculator

*05822-01*

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

Date of birth | D | D | M | M | Y | Y | Y | Y |

**INSTRUCTIONS**
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Give your final answers to a degree of accuracy that is appropriate to the context.

**INFORMATION**
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **16** pages.

**ADVICE**
- Read each question carefully before you start your answer.

**1**

**(a)** Multiply out $2(5x-4y)$.

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**(b)** Multiply out, simplifying each term, $(x+2y)^3$.

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**(c)** Factorise $x^2-8x+15$.

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**(d)** Solve the equation $2(x-2)-3=5$.

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

**(e)** Find the remainder when $x^3+2x^2-5x+4$ is divided by $x-2$.

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

**2**

**(a)** In a shop, all screwdrivers cost the same and all paintbrushes cost the same.

Jack buys 3 screwdrivers and 2 paintbrushes for £8.60.

Amaya buys 2 screwdrivers and 3 paintbrushes and pays £9.90.

Let the cost of a screwdriver be £$x$ and the cost of a paintbrush be £$y$.

Form two equations in $x$ and $y$ and solve them to find the cost of:

- a screwdriver
- a paintbrush.

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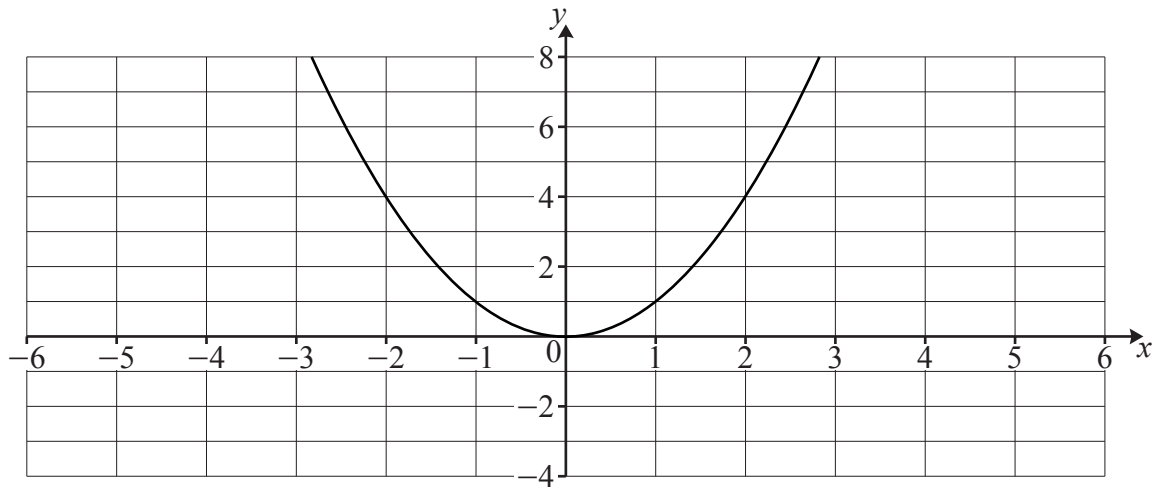
..... **[5]**

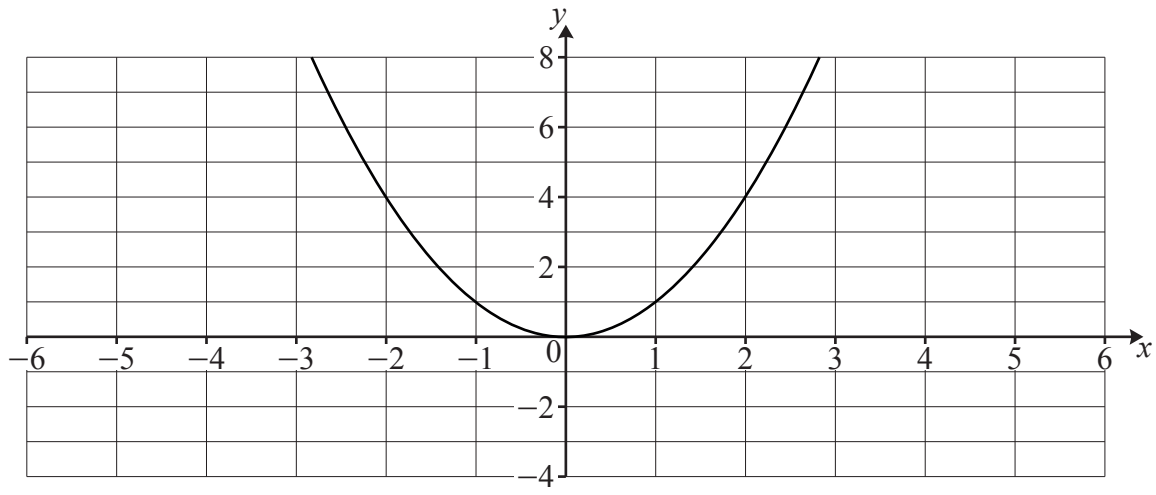
**(b)** Part of the curve with equation $y = x^2$ is shown on the two diagrams below.

**(i)** On the first diagram, sketch the curve with equation $y = (x-2)^2$.




**[2]**

**(ii)** On the second diagram, sketch the curve with equation $y = x^2 - 2$.




**[2]**

**3**

**(a)** Write down the exact value of:

**(i)** $\cos 60°$

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

**(ii)** $\sin x$ where $x = \frac{\pi}{3}$ radians.

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

**(b)** Solve the equation $\tan x = 2$ for $0° < x < 360°$.

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

**(c)** Find the exact value of $\sin x$ when $\cos x = 0.7$ and $x$ is acute.

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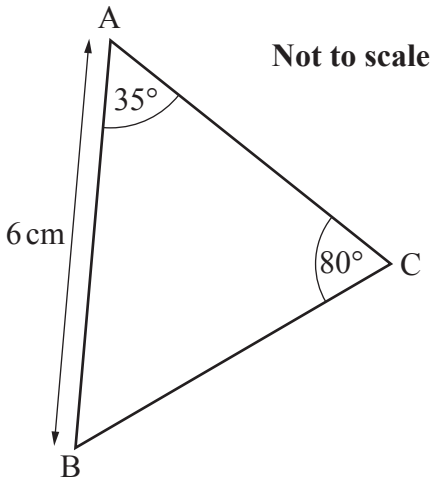
**(d)** In the triangle ABC, AB = 6 cm, angle A = 35° and angle C = 80°.




Calculate the length of the side BC.

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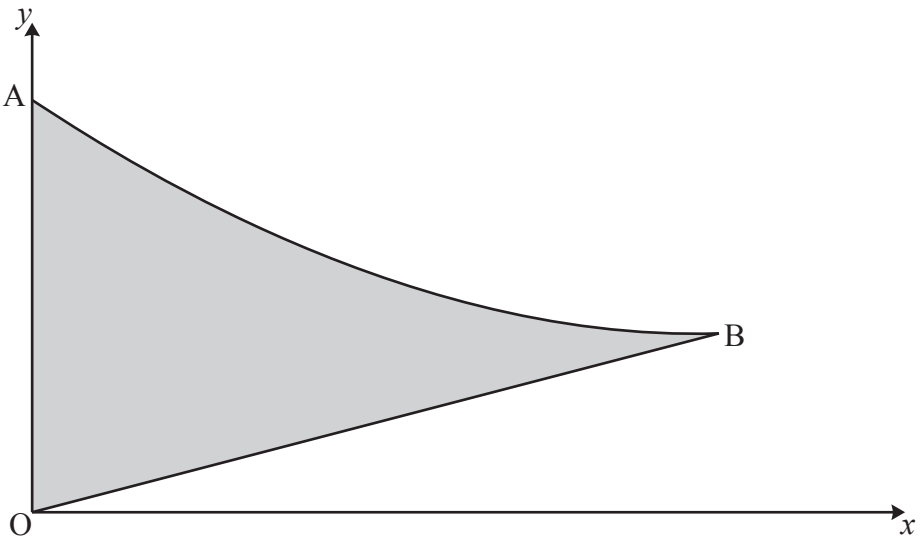
..... **[3]**

**4** The shape of a component of a machine is as shown in the diagram. Units are centimetres.

Aligned to a coordinate system, the curved edge, AB, has equation $y = x^2 - 4x + 7$.

The point A lies on the $y$-axis and the point B is the stationary point of the curve.




**(a)** Write down the coordinates of A.

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**(b)** Using calculus, determine the coordinates of B.

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**(c)** Find the equation of the line OB, where O is the origin.

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**(d)** Determine the area of the shape.

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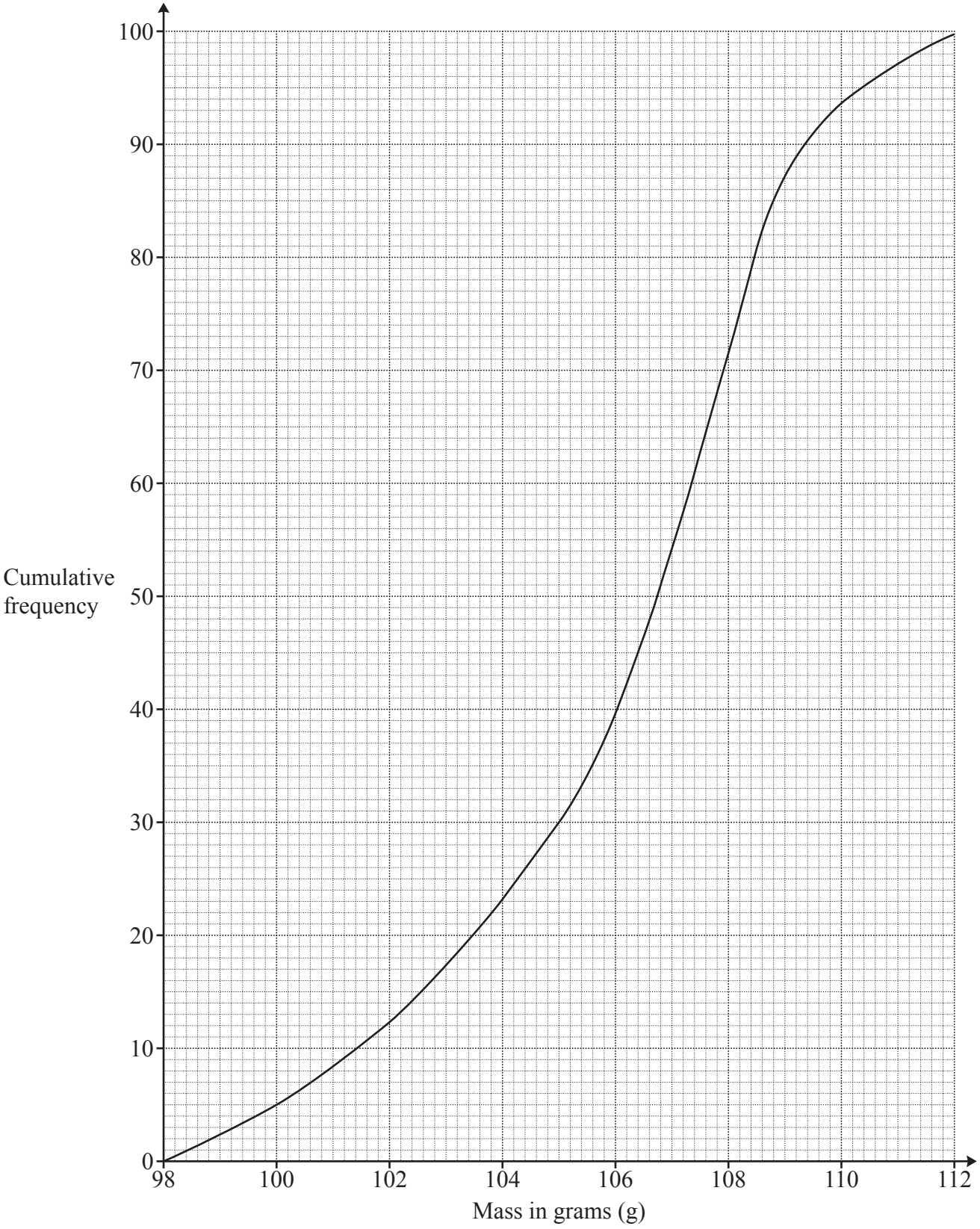
**5** A machine making a particular component is required to produce components with a mass in the range 100 g to 110 g.

A control engineer selects a sample of 100 components at random from a day's production and weighs them. She records their masses to the nearest gram and draws a cumulative frequency graph as shown on the grid.



**(a)** The machine is left to run providing that no more than 12% of the sample is outside the acceptable range.

**(i)** On the basis of this sample, determine whether the machine should be stopped.

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

When she drew the graph, the control engineer made an error and plotted the point (109, 88) instead of (109, 80).

**(ii)** Without doing any further calculation, say whether the median is affected by this error, and justify your answer.

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

**(b)** Dev travels to work by car and on the journey he passes through three sets of traffic lights. Experience indicates that he will be stopped at a light 60% of the time, independent of the other lights.

Find the probability that:

**(i)** he is not stopped at the first light

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

**(ii)** he is stopped at at least one light.

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

**6** A scientist introduces a number of a certain species of animal into an enclosed space and counts the population at the end of each year for a number of years.

He believes that the number of animals, $N$, at the end of year $t$, can be modelled by the equation $N = 100 - 90e^{-0.5t}$.

**(a)** Find the number of animals that were introduced.

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

According to this model, the population size becomes a constant number after many years.

**(b)** State this number.

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

**(c)** Calculate the number of animals there will be after 4 years.

Give your answer to the whole number below.

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**(d)** After how many years will the number exceed 95?

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**END OF QUESTION PAPER**

## EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.