



Oxford Cambridge and RSA

Monday 9 January 2023 – Afternoon

Level 3 Cambridge Technical in Engineering

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

Time allowed: 1 hour 30 minutes

C301/2301



You must have:

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



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

Centre number

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Candidate number

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First name(s)

Last name

Date of birth

D	D	M	M	Y	Y	Y	Y
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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 **12** pages.

ADVICE

- Read each question carefully before you start your answer.

Answer **all** the questions.

- 1 (a) Factorise $6x - 4$.

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..... [1]

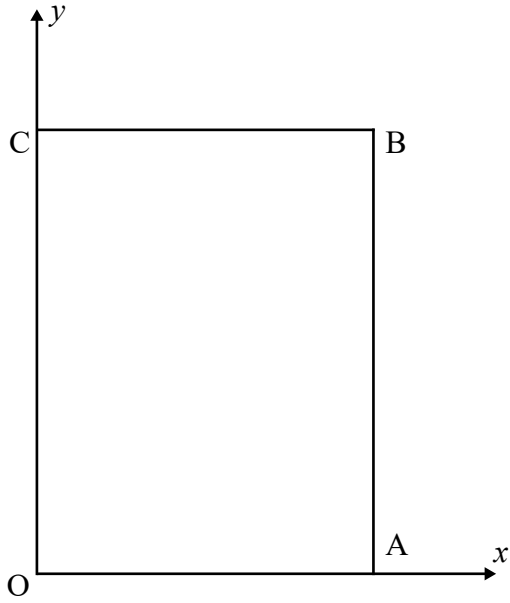
- (b) Multiply out $(2x + y)^3$. Your final answer should be in simplified form.

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- (c) Determine the quotient and the remainder when $x^3 - 5x^2 + 6x - 3$ is divided by $x - 2$.

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..... [3]

- 2 On a rectangular plate OABC a coordinate system is placed. O is the origin (0,0). A and C have coordinates (7,0) and (0,8) as shown in the diagram.



- (i) Find the coordinates of M, the midpoint of OB.

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 [2]

- (ii) Find the equation of the line AC.

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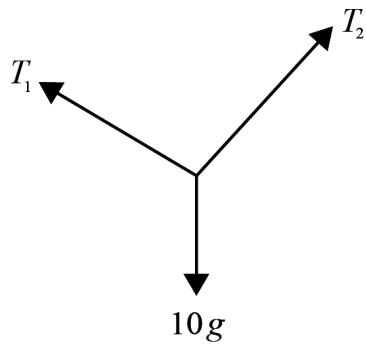
 [3]

- (iii) Confirm that point M lies on the line AC.

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 [1]

- 3 (a) A weight of 10 g N is suspended by two ropes as shown in the diagram. The tensions in the ropes are T_1 and T_2 respectively.



In this situation you are given that the forces obey the following equations.

$$9T_1 = 5T_2$$

$$5T_1 + 9T_2 = 1000$$

Find the values of T_1 and T_2 .

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..... [4]

- (b) Solve the equation $x^2 + 3x - 28 = 0$.

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(c) You are given that $f(x) = 2x^2 - 16x + 15$.

(i) Write $f(x)$ in the form $f(x) = 2(x+a)^2 + b$.

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

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- 4 (a) Write the following as a single logarithm.

$$\log x^2 + \log 2 - \log x$$

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..... [2]

- (b) When a capacitor is charged through a resistor in an electrical circuit the voltage, V , at time t seconds, is given by the formula $V = V_s(1 - e^{-\frac{t}{RC}})$. C is the capacitance, R is the resistance and V_s is the applied voltage.

In a circuit there is a resistor of 5000Ω and a fully discharged capacitor of 0.0008 F .
A voltage of 12 V is applied to the circuit.

Calculate the time in seconds when the voltage across the capacitor has reached 11 V .

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- 5 (a) A wheel is rotating at 10 revolutions per minute.

Express this in radians per second.

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- (b) A piece of wood, ABC, is triangular in shape. $AB = 8$ cm, $BC = 3$ cm and $CA = 7$ cm.

- (i) Calculate the angle ABC.

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- (ii) Calculate the area of the wood. Give the units of your answer.

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6 The management of a company that assembles components analysed the work completed by each employee.

(a) They recorded the number of components assembled by each employee in one particular hour.

The data are as follows.

12 14 18 11 13 13 11 17 16 13
 18 17 12 15 16 17 12 11 17 14

(i) On the table below complete a tally of these data.

Number of components	Tally	Total
11		

[2]

(ii) Write down the mode of these data.

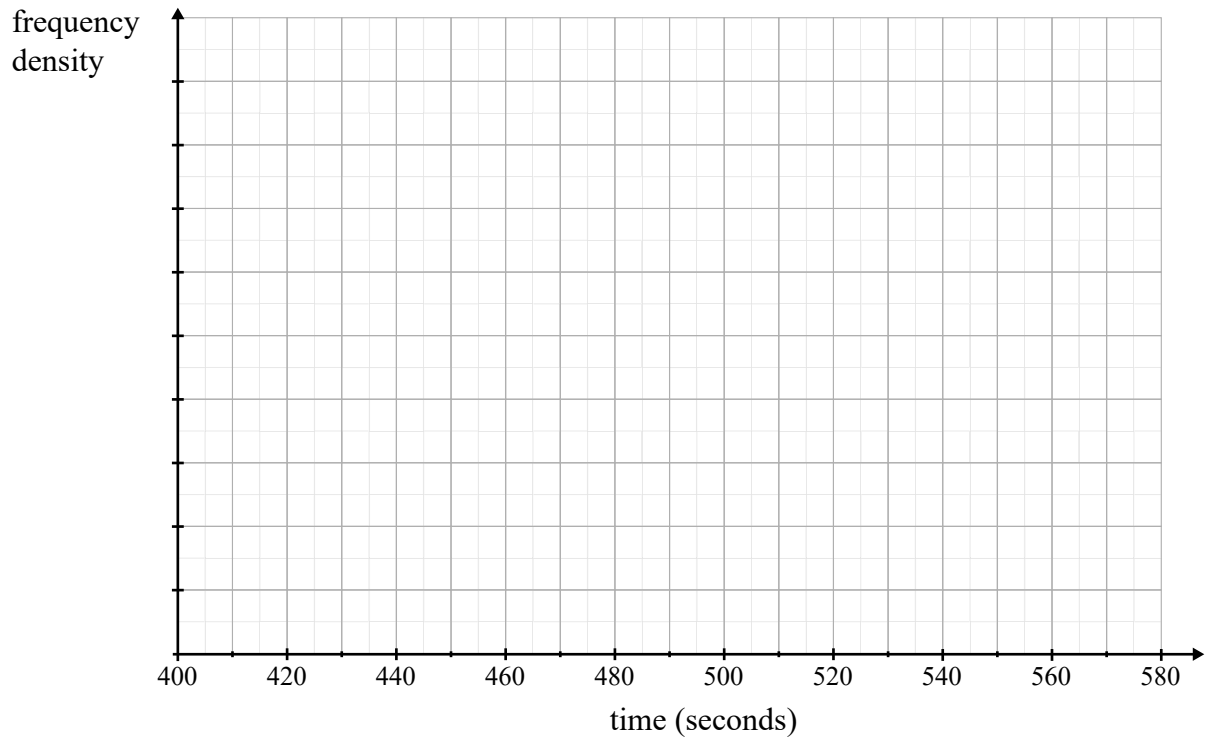
..... [1]

- (b) They recorded the time, t seconds, that each employee took to complete the assembly of two components.

The data are summarised as follows.

Time (t secs)	$440 \leq t < 460$	$460 \leq t < 480$	$480 \leq t < 500$	$500 \leq t < 540$
Frequency	4	8	6	2

- (i) On the grid below, draw a histogram of these data.



[4]

- (ii) On your histogram draw a frequency polygon to display the data.

[2]

7 (a) Find $\int \cos 2x \, dx$.

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 [2]

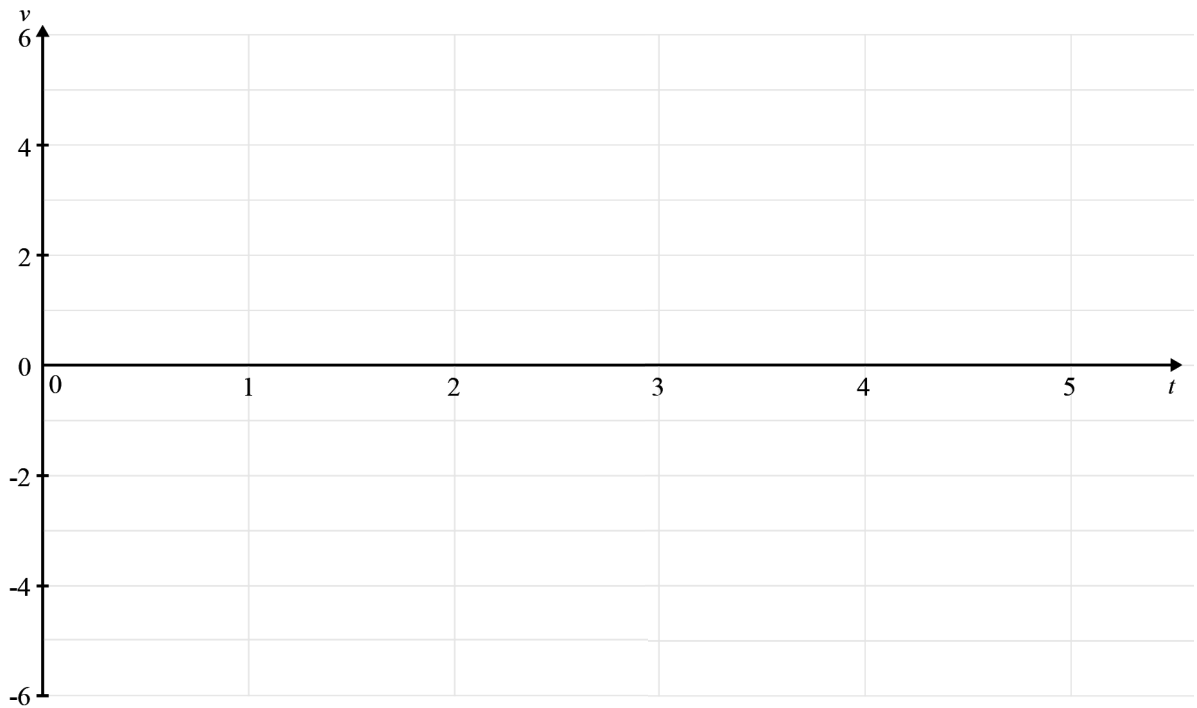
(b) A particle moves on a straight line through a point O such that its velocity, v metres per second, at t seconds is given by the formula $v = 4t - t^2$.

(i) Find the time at which the acceleration is zero.

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 [3]

(ii) On the grid below, sketch the graph of v against t for $0 \leq t \leq 5$.



[2]

(iii) Given that the total distance travelled in the first 4 seconds of motion is given by the area between the curve, t -axis and the line $t = 4$, calculate this distance.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined pages. The question numbers must be clearly shown – for example, 1(c) or 2(i).

A vertical line on the left side is followed by 20 horizontal dotted lines, providing a grid for writing answers.



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