OCR
Oxford Cambridge and RSA

Level 3 Cambridge Technical in Engineering
05822/05823/05824/05825/05873

Unit 1: Mathematics for engineering

Monday 9 January 2017 – Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- the formula booklet for Level 3 Cambridge Technical in Engineering (inserted)
- a ruler (cm/mm)
- a scientific calculator

First Name		Last Name	
Centre Number		Candidate Number	
Date of Birth			

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number, candidate number and date of birth.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- An answer may receive no marks unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- This document consists of **12** pages.

FOR EXAMINER USE ONLY	
Question No	**Mark**
1	/9
2	/9
3	/10
4	/10
5	/12
6	/10
Total	**/60**

Answer **all** questions.

1 **(a)** Solve the equation $2x+3=7$.

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

(b) **(i)** Multiply out and simplify $(x+2)(x-3)$.

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

(ii) Factorise $x^2+2x-15$.

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

(c) You are given $f(x)=x^3-3x^2+4x-1$.

(i) Find the value of f(1).

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

(ii) Explain whether your result of part **(i)** shows that $x = 1$ is a root of the equation $f(x) = 0$.

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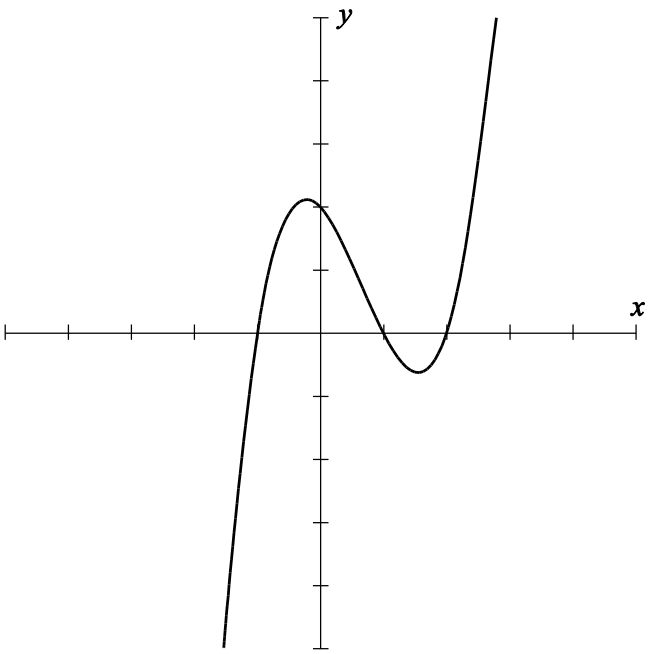
..... **[2]**

2 **(a)** The graph of $y = f(x)$ is sketched on the axes below.

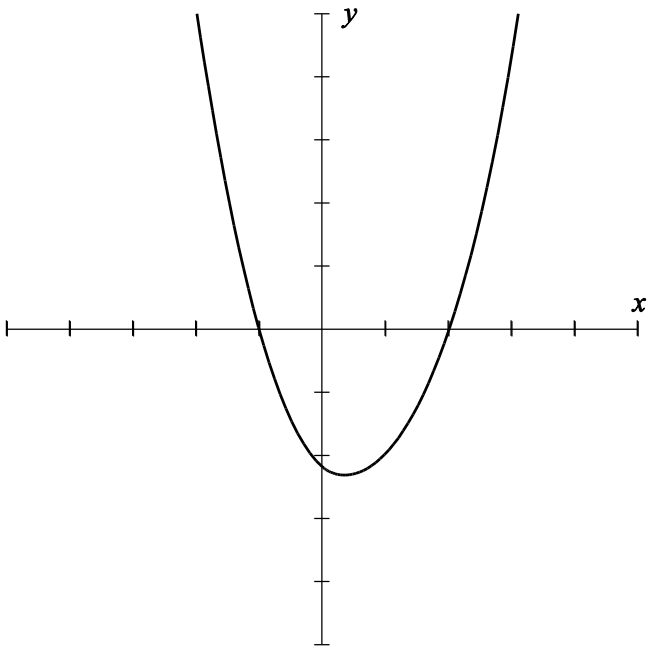


On the same axes sketch the following graphs. Each graph should be labelled clearly.

(i) $y = f(x) + 2$, **[2]**

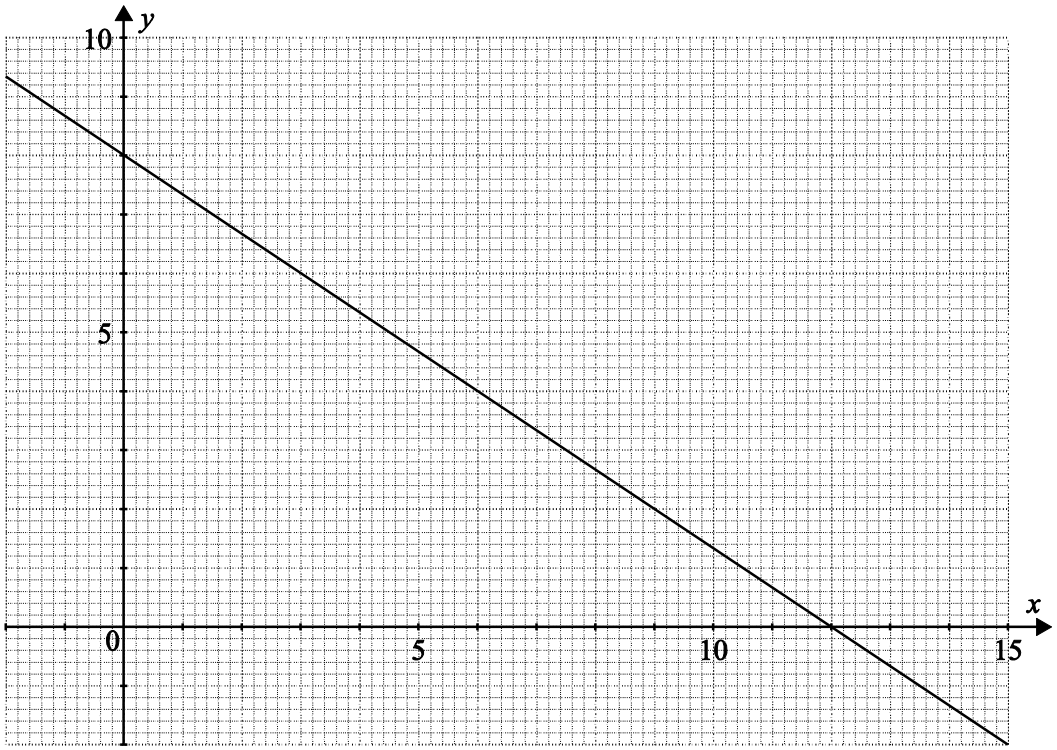
(ii) $y = f(x + 2)$. **[2]**

(b) The graph of $y = g(x)$ is sketched on the axes below.



On the same axes sketch the graph of $y = 2g(x)$. **[2]**

(c) The graph of the equation $2x + 3y = 24$ is shown on the grid below.



(i) On the same grid plot the line $y = 2x$. **[2]**

(ii) Hence write down the solution to the following simultaneous equations.

$$2x + 3y = 24$$
$$y = 2x$$

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

3 **(a)** Toolmart sell assorted screwdrivers and spanners in two "economy bags". Bag A contains 6 spanners and 8 screwdrivers and costs £10. Bag B contains 9 spanners and 6 screwdrivers and costs £10.20.
Let x be the cost of one spanner and y the cost of one screwdriver.

(i) Write down two simultaneous equations in x and y from the given information.

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

(ii) Solve these equations simultaneously to find the cost of a spanner and the cost of a screwdriver.

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

(b) The speed, v m s^{-1}, of a car which moves with constant acceleration, a m s^{-2}, is given by $v^2 = u^2 + 2as$ where s m is the distance travelled and u m s^{-1} is the initial speed.
A car moves from rest with constant acceleration 2 m s^{-2}.

Find the speed of the car after it has moved 100 m.

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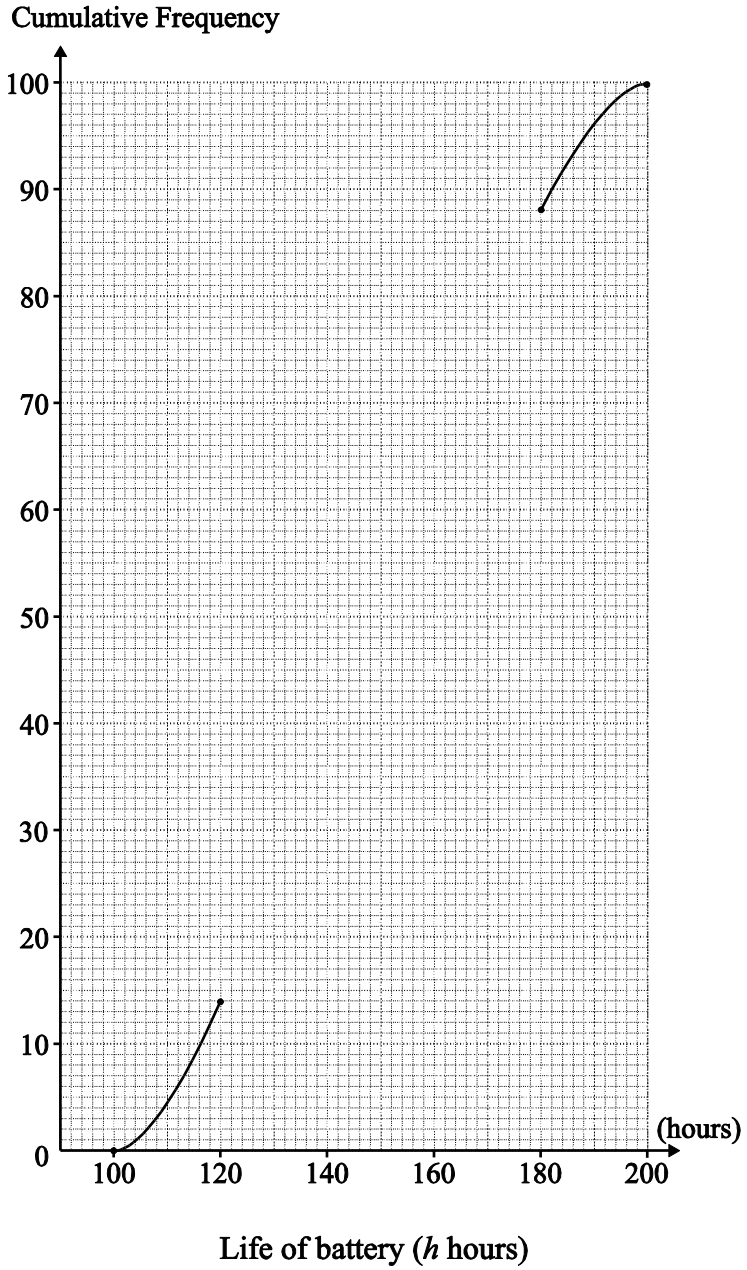
..... **[3]**

4 The life of a sample of batteries is tested. The results are given in the frequency table below.

Life of battery (h hours)	Frequency	Cumulative frequency
$h \leq 100$	0	0
$100 < h \leq 120$	14	
$120 < h \leq 140$	26	
$140 < h \leq 160$	30	
$160 < h \leq 180$	18	
$180 < h \leq 200$	12	100

(i) Fill in the cumulative frequency column in the table above. **[2]**

(ii) Complete the cumulative frequency graph below. **[2]**



(iii) From your graph find

(*A*) the median value,

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

(*B*) the interquartile range,

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

(*C*) the percentage of batteries that last less than 175 hours.

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

5 **(a)** Find the integral $\int \cos 3x \, dx$.

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

(b) A ball is thrown vertically upwards from ground level. Its height, h m, is given by the formula

$$h = 20t - 5t^2$$

where time t is in seconds.

(i) Find, by differentiation, a formula for the velocity of the ball.

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

(ii) Find the time when the ball reaches its maximum height.

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

(iii) Find this maximum height.

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

(c) A 1000 μF capacitor is connected in series with a 2 kΩ resistor across a 12 V d.c. supply. At time t seconds, the potential difference, V_c, is given by the formula

$$V_c = V_s\left(1 - e^{-t/RC}\right)$$

where V_s is the voltage supply, R is the resistance of the resistor in ohms and C is the capacitance of the capacitor in Farads.

Find the time taken for the potential difference to reach 10 V.

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

6 **(a)** A triangular lamina ABC has angles A = 30º, B = 60º and C = 90º.
BC = 10 cm.

Find the length of AB.

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

(b) The triangular cross section of a prism has sides 8 cm, 9 cm and 11 cm.

Find the largest angle of the cross section.

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

(c) A sector of a circle has an arc length of 5 cm. The radius of the circle is 10 cm.

Find the angle of the sector in degrees.

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).