OCR
Oxford Cambridge and RSA

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

Unit 1: Mathematics for engineering

Monday 14 May 2018 – Afternoon

C301/1806

Duration: 1 hour 30 minutes

C301/1806

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	D	D	M	M	Y	Y	Y	Y

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.

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Question No	**Mark**
1	/10
2	/9
3	/13
4	/10
5	/11
6	/7
Total	**/60**

Answer **all** the questions.

1 **(a)** Collect like terms and factorise the expression $3x + y - x + 5y$.

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

(b) Write as a single fraction.

$$\frac{2x-1}{2} + \frac{1-x}{5}$$

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

(c) Solve the following equation.

$$\frac{x-3}{2} - \frac{1}{3} = 1 - x$$

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

(d) A formula for the velocity of a car, v, is given by $v = at^2$.

Rearrange this formula so that t is the subject.

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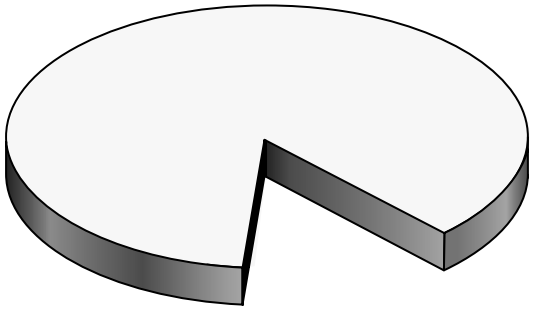
..... **[2]**

2 **(a)** Write down the exact value of $2\sin 60°$.

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

(b) A cylindrical metal plate of radius 10 cm and height 1.5 cm has a sector with angle 60º cut from it.



Calculate the volume of the metal plate remaining.

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

(c) An engineer needs to calculate the height of a tower, as represented by the line BT in Fig.1.

He walks away from the foot of the tower, B, on horizontal ground to a point A. From A he measures the angle of elevation to the top of the tower, T, to be 20º.

He then walks 30 metres directly towards the tower to a point C where he measures the angle of elevation to the top of the tower to be 30º as shown in Fig. 1.

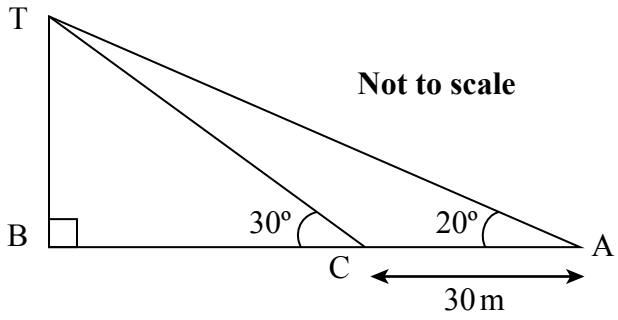

Fig. 1

(i) Using the sine rule in triangle ACT, calculate the length CT.

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

(ii) Hence find the height of the tower BT.

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

3 **(a)** You are given the equation $\log_{10} x + \log_{10}(6 - x) = \log_{10} 5$.

By first expressing the left hand side as a single logarithm, solve the equation.

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

(b) Abbie bought 4 sockets and 5 plugs. The cost was £18.50.
Renu bought 6 sockets and 2 plugs. The cost was £22.80.

Let s pence be the cost of a socket and p pence the cost of a plug.

(i) Write down two simultaneous equations in s and p.

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

(ii) Hence find the cost of a socket and a plug.

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

(c) Solve the equation $x^2 + 3x - 6 = 0$, giving the roots correct to 3 decimal places.
Show all your working.

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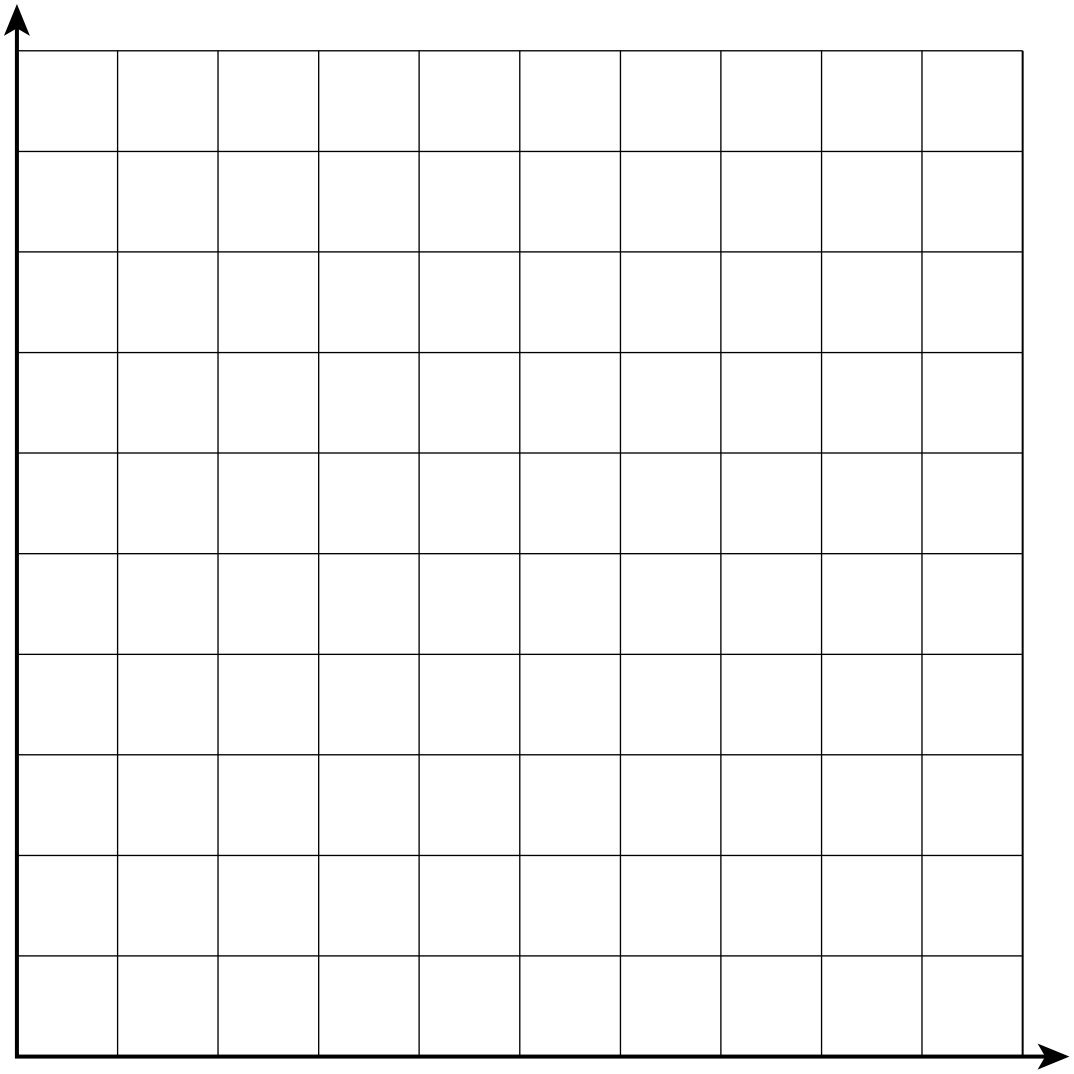
..... **[3]**

4 **(a)** Components are produced on a machine in a factory. The length of each component needs to be in the range 45 mm to 55 mm.
In one period of a day all components produced are measured.
Their lengths, l mm, are summarised in the table below.

Length, l mm	$44.5 < l \leqslant 45.5$	$45.5 < l \leqslant 46.5$	$46.5 < l \leqslant 47.5$	$47.5 < l \leqslant 49.5$
Frequency	5	8	9	8

(i) On the grid below draw a histogram to display the data. Label the axes clearly.



[4]

(ii) Find an estimate for the mean length of these components.

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

The manager decides that all lengths are in the lower part of the acceptable range and so adjusts the machine so that every component will be exactly 2 mm longer.

(iii) State, if any, what effect this would have on the value of the standard deviation (SD).

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

(b) Aaron has a fair 8-sided die with faces numbered 1, 2, 3, 4, 5, 6, 7, 8. When he rolls it, it lands on one face, the number of which he notes.

He rolls it twice. Find the probability that the die lands on the face numbered 2 both times.

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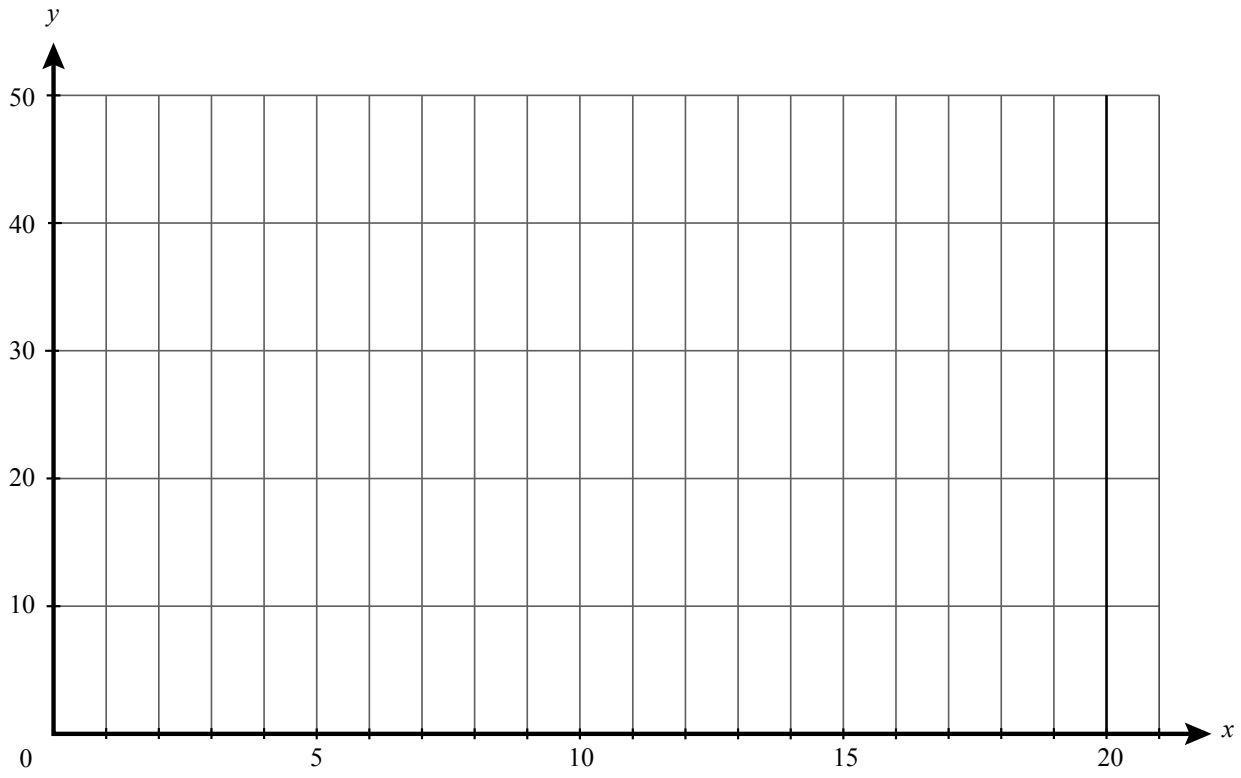
..... **[2]**

5 **(a)** **(i)** On the grid below is drawn the line $x = 20$.

On the same grid sketch the curve $y = 30 + 2x - \frac{1}{10}x^2$ for $0 \leqslant x \leqslant 20$.



[3]

(ii) The shape enclosed by the curve and the lines $x = 0$, $y = 0$ and $x = 20$ is a plan view of a swimming pool which is full of water. The units are metres.

Find by integration the surface area of the water in the pool.

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

(b) You are given that $y = 2\sin x + \cos 2x$.

(i) Find an expression for $\frac{dy}{dx}$.

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

(ii) Verify that there is a turning point at $x = \frac{\pi}{6}$ and determine whether it is a maximum or a minimum point.
You must show all your working.

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

Turn over for the next question

6 The centre of a circle, C, has coordinates (2, 3).
The point A with coordinates (5, 5) lies on the circumference of the circle.
The point B has coordinates (0, 6).

(i) By considering the lengths of CA and CB, show that B lies on the circle.

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(ii) Find the coordinates of the point D where DA is a diameter of the circle.

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

(iii) Write down the equation of the circle in the form $(x - a)^2 + (y - b)^2 = r^2$
where a, b and r are to be determined.

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

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