Write your name here

Surname	Other names

Pearson Edexcel Principal Learning

Centre Number	Candidate Number

Engineering

Level 3
Unit 8: Mathematial Techniques and Application for Engineers

Wednesday 4 June 2014 – Afternoon
Time: 1 hour 15 minutes

Paper Reference
EG308/01

You must have:
Calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Laws of indices

$$a^m \times a^n = a^{m+n}$$

$$\frac{a^m}{a^n} = a^{m-n}$$

$$\left(a^m\right)^n = a^{mn}$$

Laws of logarithms

$$\log a + \log b = \log ab$$

$$\log a - \log b = \log \frac{a}{b}$$

$$\log a^n = n \log a$$

Quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Mensuration

	Volume	Surface area
Cylinder	$\pi r^2 h$	$2\pi rh + 2\pi r^2$
Sphere	$\frac{4}{3}\pi r^3$	$4\pi r^2$
Cone	$\frac{1}{3}\pi r^2 h$	$\pi r \times$ slant height

Circular measure and trigonometry

$$s = r\theta$$

$$A = \frac{1}{2} r^2 \theta$$

$$\tan A = \frac{\sin A}{\cos A}$$

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

Cosine rule $$a^2 = b^2 + c^2 - 2bc \cos A$$

Calculus

Differentiation

y	$\frac{dy}{dx}$
x^n	nx^{n-1}
$a \sin kx$	$ka \cos kx$
$a \cos kx$	$-ka \sin kx$
ae^{kx}	kae^{kx}

Integration

y	$\int y\,dx$	
x^n	$\frac{x^{n+1}}{n+1}$	$(n \neq -1)$
$a \sin kx$	$-\frac{a}{k} \cos kx$	
$a \cos kx$	$\frac{a}{k} \sin kx$	
ae^{kx}	$\frac{a}{k} e^{kx}$	

Answer ALL questions. Write your answers in the spaces provided.

You must write down all stages in your working.

1 (a) Given that $v = \frac{4}{3}\pi r^3$

(i) make r the subject of the formula,

(3)

(ii) determine the value of r when $v = 2144$

(1)

(b) Given that $4 \log x + \log 4 = 3 \log 4$, use the laws of logarithms to determine the value of x.

(3)

(c) The current, I amps, in a circuit after a period of time, t seconds, is given by

$$I = 10\left(1 - e^{-40t}\right)$$

Use the laws of logarithms to find the value of t when the current is 9.5 amps.

(3)

(Total for Question 1 = 10 marks)

2 (a) The graph in Figure 1 shows the resistance, R (ohms), for a sample of wire at different temperatures, t (°C).

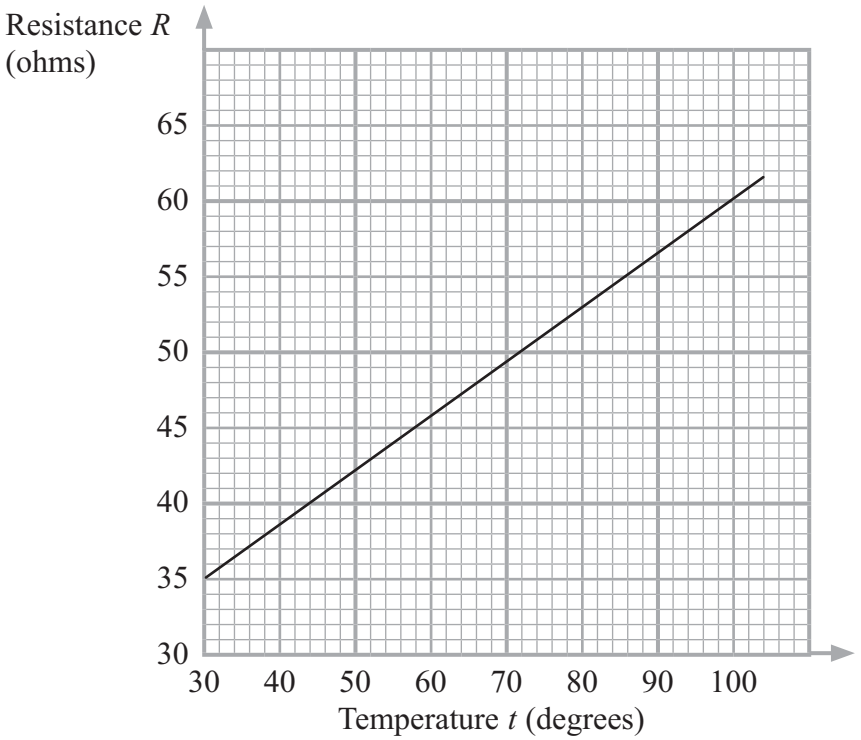

Figure 1

(i) Determine the equation of the line.

(3)

(ii) Use the equation in (i) to determine the resistance of the wire when $t = 12.5$

(1)

(b) The quantity of water, Q litres, in a tank is determined by

$Q = 1.5t^2 + 4t$

where t is the time in seconds.

Determine the value of t when $Q = 55$

(4)

(c) The volume of a composite body can be found using

$\frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$

Fully factorise $\frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$

(2)

(Total for Question 2 = 10 marks)

3 (a) Figure 2 shows a crane jib lifting a box. The jib is inclined at an angle of 37° to the horizontal.

Determine the value of *a*.

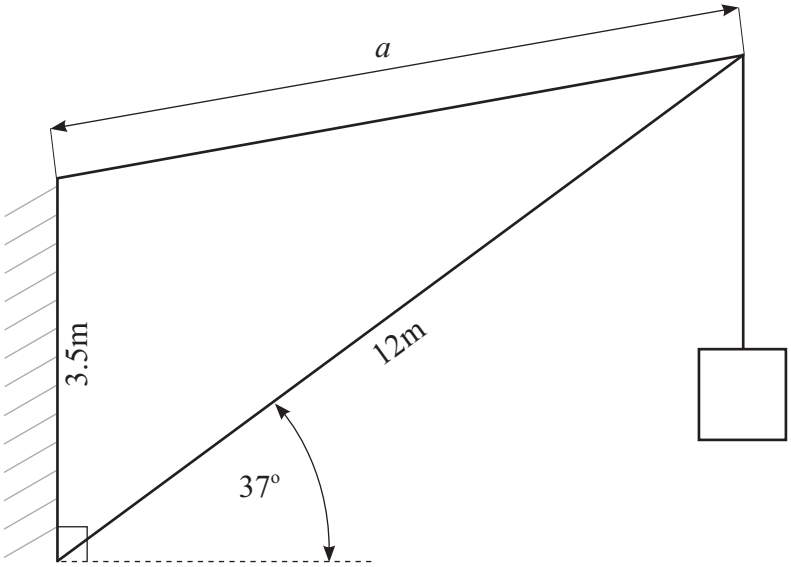

Diagram **NOT** drawn to scale

Figure 2

(4)

(b) A small mass is rotating as shown in Figure 3. Determine the height, h, of the mass above the datum if the radius is 360 mm.

(3)

Diagram **NOT** drawn to scale

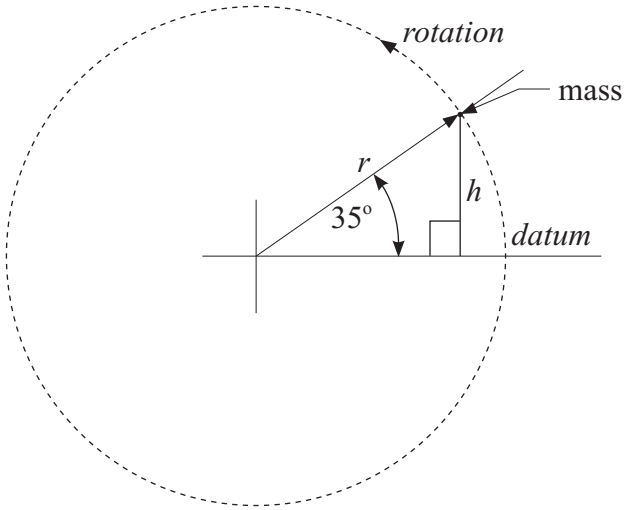

Figure 3

(c) A flywheel is rotating at 40 revolutions per minute. Convert this value to an angular velocity in radians per second.

(2)

(Total for Question 3 = 9 marks)

4 (a) Figure 4 shows a drawing for a component made from a 20 mm diameter bar, with a conical point as shown.

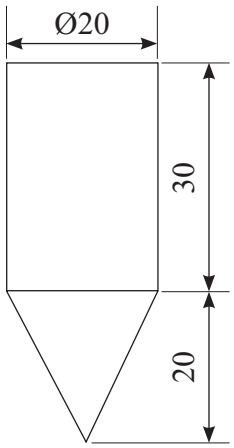

Diagram **NOT** drawn to scale
All dimensions are in mm

Figure 4

Calculate the volume of the component.

(5)

(b) Calculate the surface area of a spherical steel ball of diameter 50 mm.

(2)

(c) Figure 5 shows a sine wave between $\theta = 0^o$ and $\theta = 360^o$ for $y = 2a + b\sin\theta$

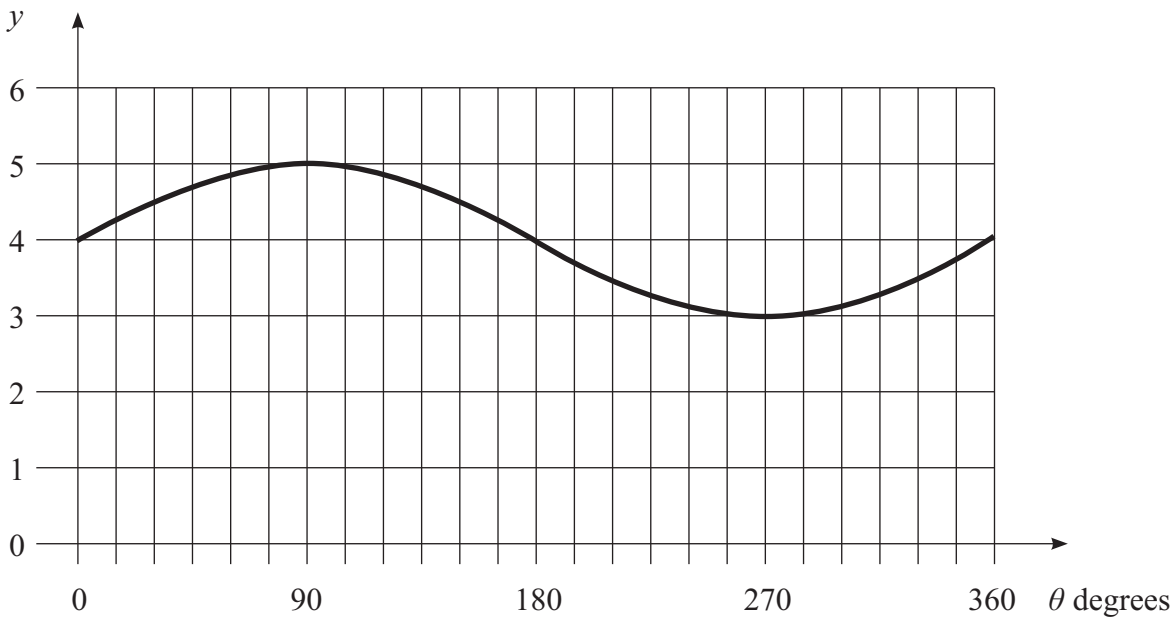

Figure 5

Determine the value of a and the value of b.

(2)

Space for working

a = ...

b = ...

(Total for Question 4 = 9 marks)

5 A stock check showed the following data for steel bars held in a store.

Diameter of bar (mm)	6	8	10	12	16	20	24
Quantity of bars	6	5	6	7	4	3	2

(a) One measure of average is the mode.

(i) State what is meant by the term mode.

(1)

(ii) State the mode for the diameters of the bars.

(1)

(b) Another measure of average is the median.

(i) State what is meant by the term median.

(1)

(ii) Determine the median for the diameters of the bars.

(2)

(c) Calculate the mean diameter of the bars.

(3)

(d) One 12 mm bar is removed from the store. What effect does this have on the mode?

(1)

(Total for Question 5 = 9 marks)

6 Figure 6 shows the velocity of a projectile over a period of time. The velocity, v ms^{-1}, of the projectile at time t seconds is given by $v = 30 + 40t - 3t^2$

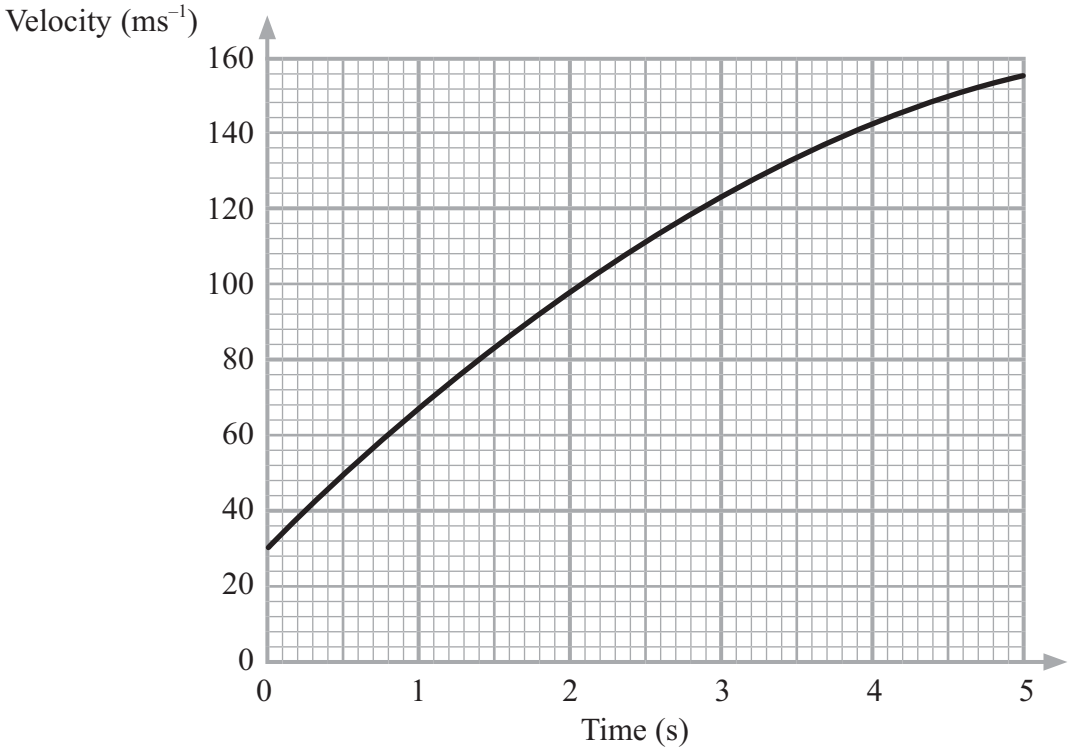

Figure 6

(a) Use differentiation to produce an equation for the acceleration of the projectile and use this to find the acceleration at $t = 3$

(3)

(b) Determine the time at which the maximum velocity occurs.

(3)

(c) Calculate the maximum velocity of the projectile.

(2)

(d) Two observation points at $t = 2$ and $t = 4$ were set up. The shaded area in Figure 7 represents the distance travelled by the projectile between these points. Use integration to find the distance between the two observation points.

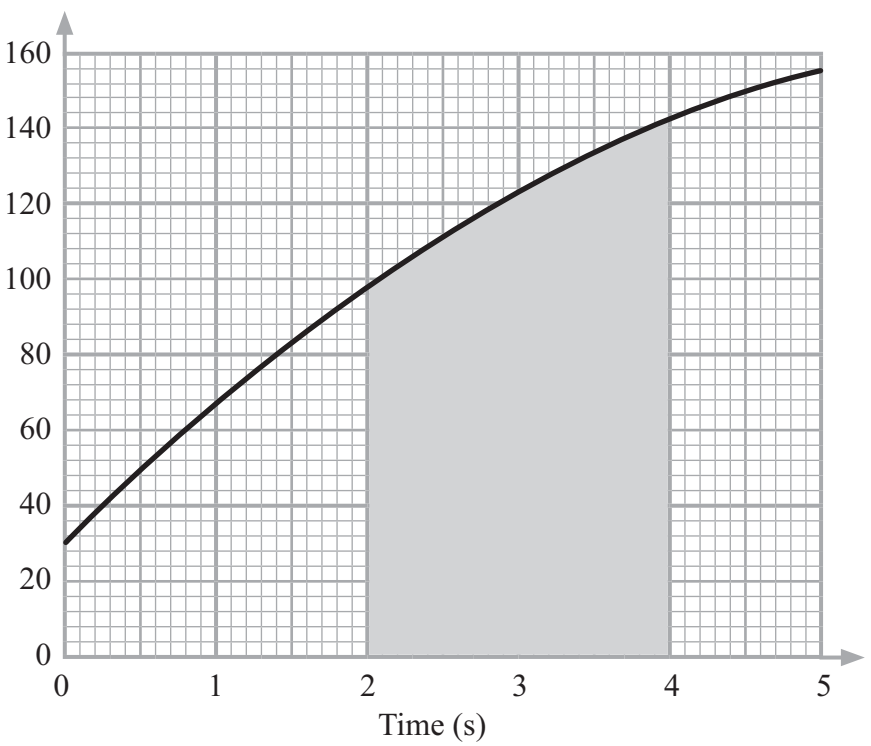

Figure 7

(5)

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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