Write your name here

Surname	Other names

Edexcel
Principal Learning

Centre Number | | | | | |

Candidate Number | | | | |

Engineering

Level 3
Unit 8: Mathematical Techniques and Applications for Engineers

Friday 7 June 2013 – 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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5/6/5/6

P 4 2 0 3 1 A 0 1 1 6

PEARSON

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 $A = \dfrac{\pi r^2 \theta}{360}$

(i) Make r the subject of the expression.

(3)

(ii) Find the value of r, when $A = 588.75$ and $\theta = 75$

(1)

(b) Using the laws of logarithms, determine the value of x from the equation.

$3 \log 4 - \log 8 = x \log 2$

(3)

(c) The current, i in amps, in a circuit can be determined by the expression

$$i = 10\, e^{\frac{-t}{\tau}}$$

Given $\tau = 15$ calculate the time t at which the current is 7.25 amps.

(3)

(Total for Question 1 = 10 marks)

2 (a) Table 1 shows data recorded from a compressor test.

Pressure (bar)	Time (seconds)
2.75	34
3.1	48
3.5	66
3.75	76
4.1	92
5.1	134

Table 1

(i) Use the data in table 1 to plot a pressure-time graph on Figure 1.

(1)

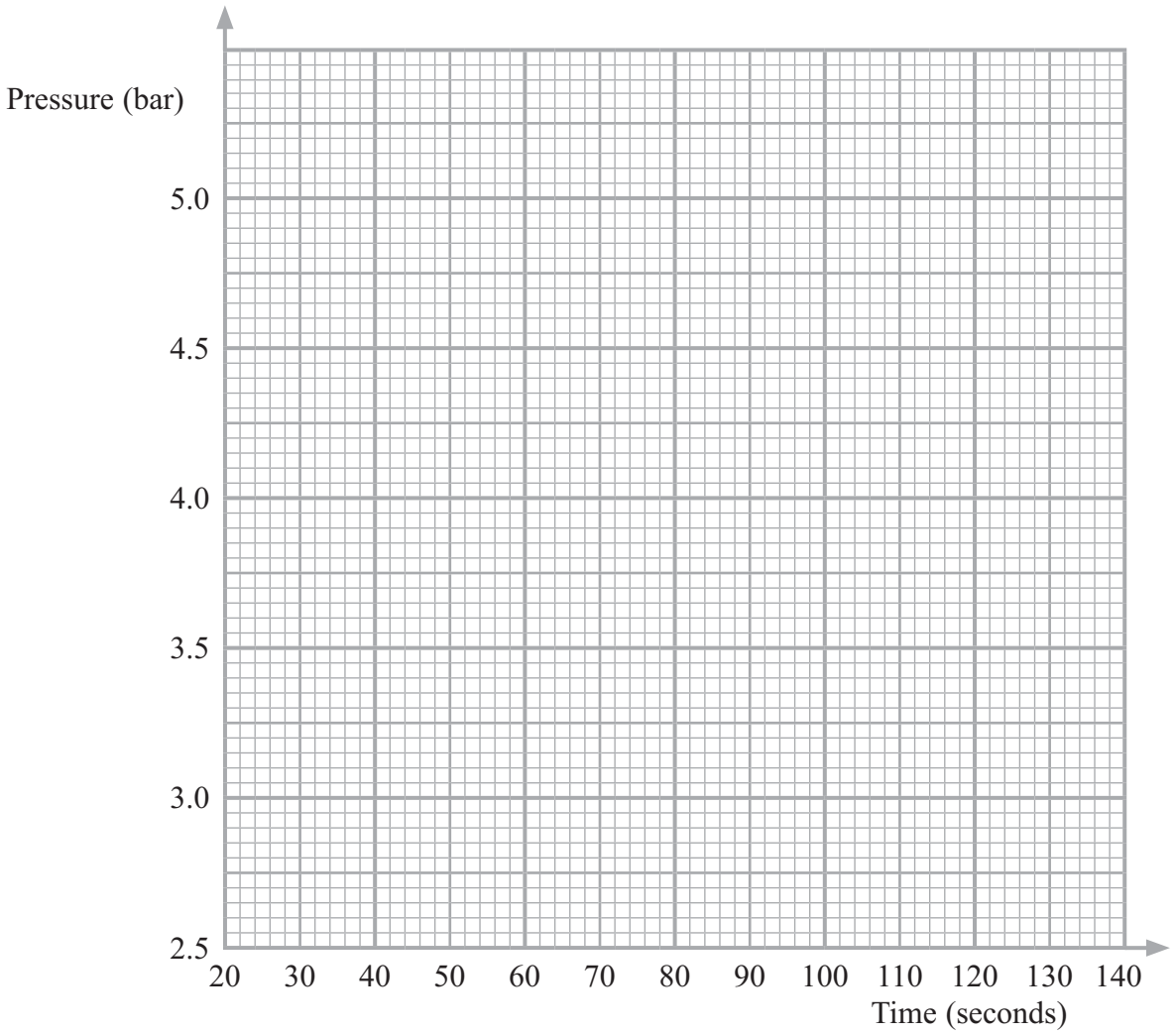

Figure 1

(ii) Determine the equation of the straight line.

(3)

(b) The distance covered by a vehicle can be determined from the relationship:

$3t^2 + 3.5t = 110$

Where t = the time in seconds.

Determine the value of t.

(3)

(c) (i) Solve the following equation by factorisation.

$x^2 - x - 2 = 0$

(2)

(ii) Substitute one of the values from (c) (i) to confirm your answer.

(1)

(Total for Question 2 = 10 marks)

3 (a) A crate 1200 mm long is raised at one end by a jack through an angle of 12° as shown in Figure 2.

Calculate the vertical height, *h*, of the jack.

(3)

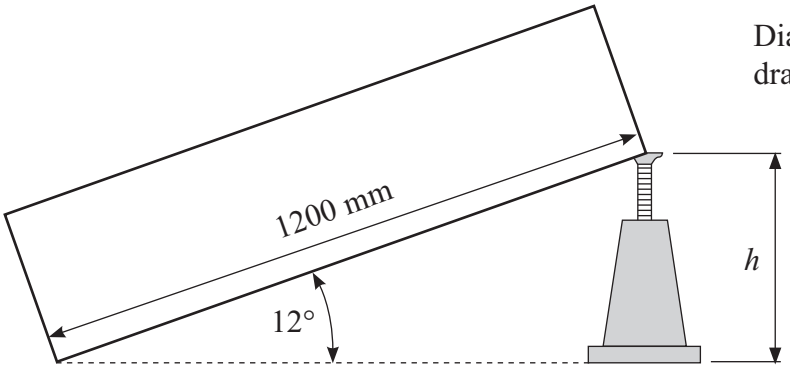

Diagram **NOT** drawn to scale

Figure 2

Space for working

Answer: .....

(b) Calculate the length *x* of the crane jib shown in Figure 3.

(4)

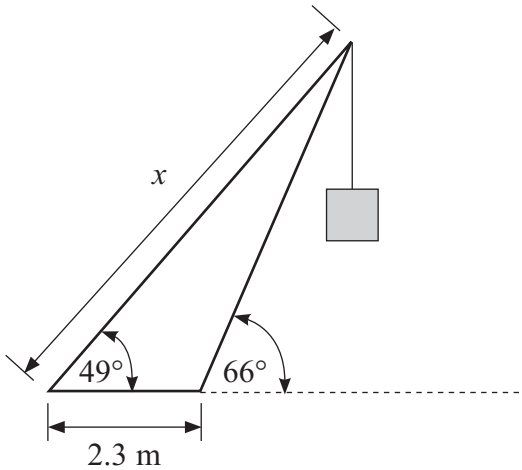

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Figure 3

Space for working

Answer: .....

(c) Figure 4 shows a sine wave between 0° and 360° where $y = 4\sin\theta + b$.

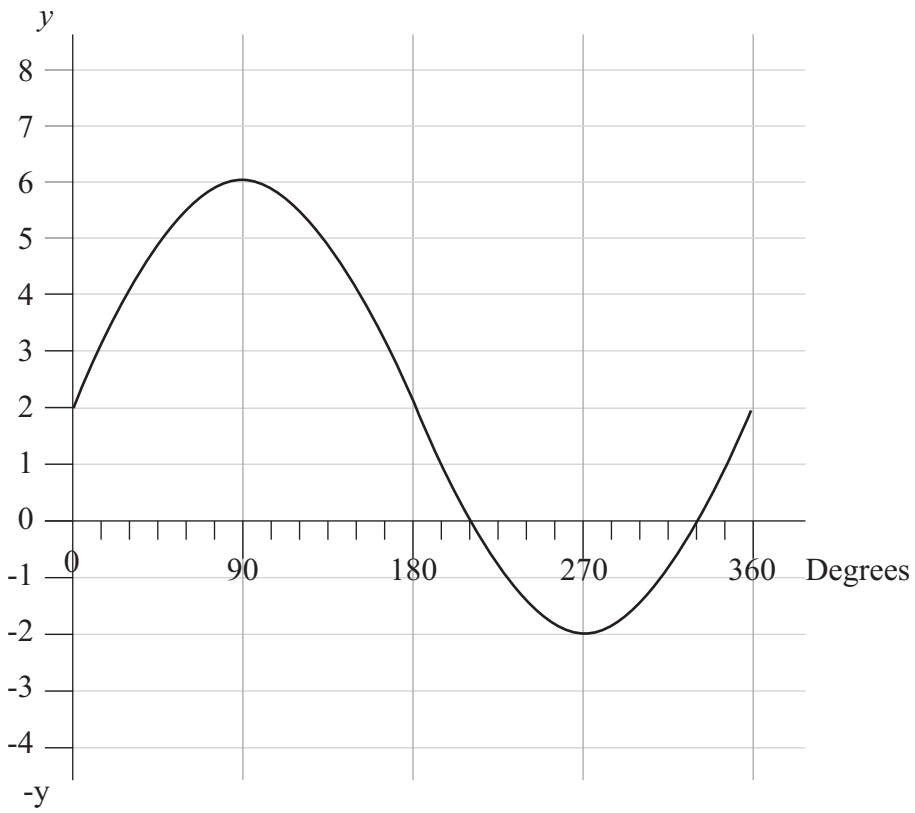

Figure 4

(i) Determine the value of b.

(1)

(ii) Calculate the value of y when $\theta = 120°$.

(2)

(Total for Question 3 = 10 marks)

4 (a) Figure 5 shows a cylinder of diameter 40 mm and 130 mm in length, which is closed at both ends. Determine the total surface area of the cylinder.

(3)

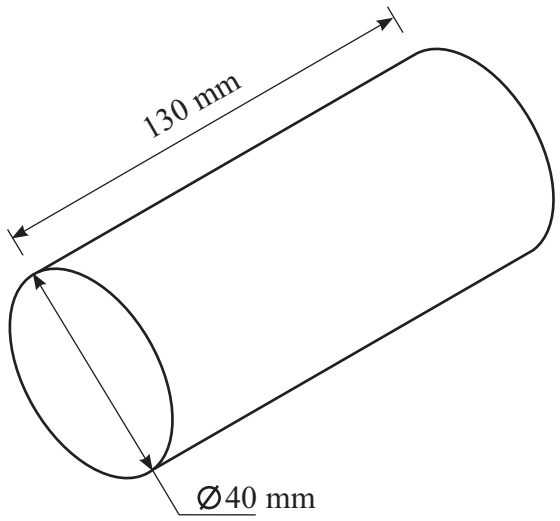

Diagram **NOT** drawn to scale

Figure 5

Space for working

Answer: .....

(b) A cam rotates through $\frac{3\pi}{4}$ radians.

Determine the angle rotated in degrees.

(2)

(c) A flywheel rotates at 2600 rev/min. Calculate the angular velocity of the flywheel in radians/second.

(2)

(Total for Question 4 = 7 marks)

5 Engineering components were tested under extreme conditions to determine the time to failure. Table 2 shows the result of the tests.

(a) Complete Table 2 to show cumulative frequency values for the components.

(1)

Time to failure (hours)	Frequency	Cumulative Frequency
121-130	22	
131-140	26	
141-150	31	
151-160	23	
161-170	17	
171-180	9	
181-190	3	
191-200	2	

Table 2

(b) Use the values from Table 2 to draw a cumulative frequency graph on Figure 6.

(2)

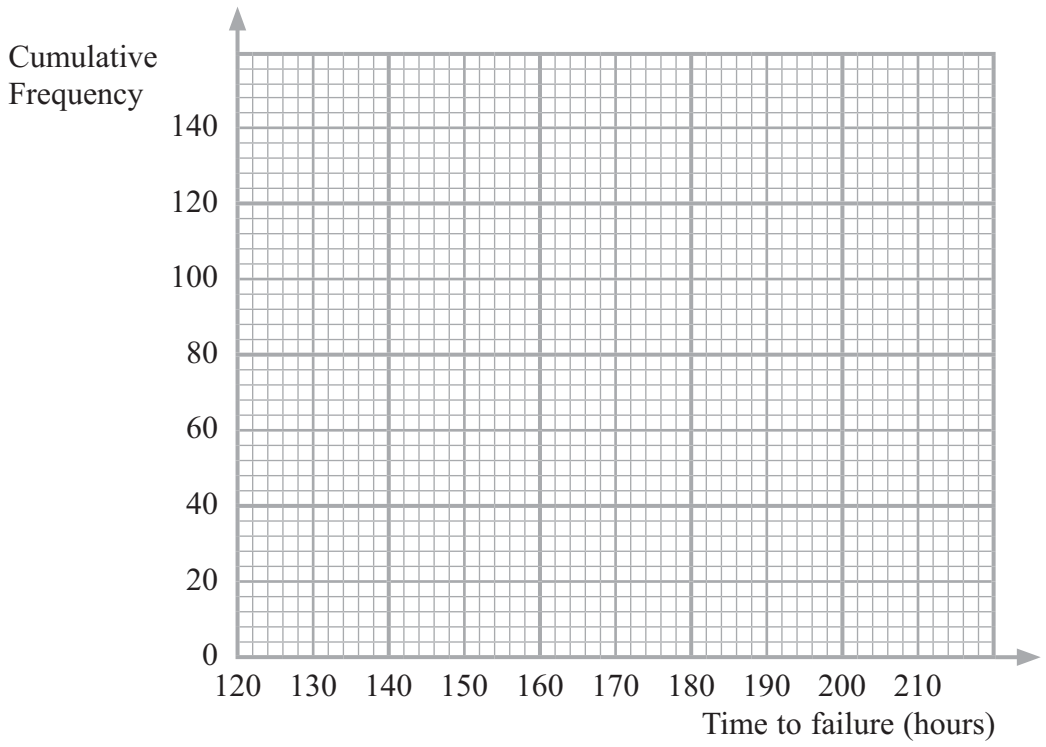

Figure 6

(c) Determine the median from the graph.

(2)

(d) Determine the mean value for the data.

(3)

(e) Give **two** benefits of the use of statistical data such as Mean Time To Failure (MTTF) to engineering.

(2)

(Total for Question 5 = 10 marks)

6 (a) Differentiate the following expression

$y = 2.4\sin\theta - 3\cos\theta$

(2)

(b) Figure 7 shows the velocity of an object decreasing over a time period. Sketch a tangent at $t = 1.25$ s and use it to determine the rate of change of velocity at this point.

(3)

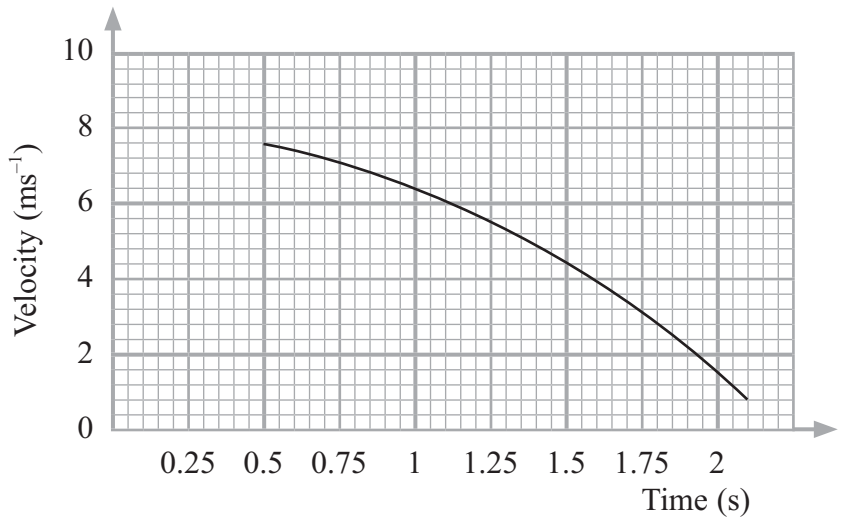

Figure 7

(c) The velocity v (ms^{-1}) at time t (seconds) of an object can be determined by the expression

$v = 2t^3 + 4t^2 + 3t - 2$

Differentiate the expression and find the acceleration of the object when $t = 3$ seconds.

(4)

(d) Integrate the expression $v = 2t^3 + 4t^2 + 3t - 2$ to find the distance, s, travelled by the object between $t = 4$ and $t = 6$

(4)

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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