

Write your name here

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Other names

Edexcel
Principal Learning

Centre Number

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Candidate Number

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Engineering

Level 3

**Unit 8: Mathematical Techniques and
Applications for Engineers**

Friday 1 June 2012 – 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.

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PEARSON

Laws of indices

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

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

$$(a^m)^n = a^{mn}$$

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	$\frac{1}{3}\pi r^2 h$	$\pi r \times \text{slant height}$



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

$$y \quad \frac{dy}{dx}$$

$$x^n \quad nx^{n-1}$$

$$a \sin kx \quad ka \cos kx$$

$$a \cos kx \quad -ka \sin kx$$

$$ae^{kx} \quad kae^{kx}$$

Integration

$$y \quad \int y dx$$

$$x^n \quad \frac{x^{n+1}}{n+1} \quad (n \neq -1)$$

$$a \sin kx \quad -\frac{a}{k} \cos kx$$

$$a \cos kx \quad \frac{a}{k} \sin kx$$

$$ae^{kx} \quad \frac{a}{k} e^{kx}$$



Answer ALL questions. Write your answers in the spaces provided.
You must write down all stages in your working.

- 1 (a) Simplify the value of E using the laws of indices when

$$E = \frac{1 \times 10^2}{1 \times 10^{-3}}$$

(2)

(b) Given that $H = \frac{4fv^2}{2gd}$

Make v the subject of the equation.

(3)



(c) Given that $2 \log 3 + \log x = \log 36$, determine the value of x using the laws of logarithms.

(3)

(d) Evaluate the following:

$$0.5197(e^{2.48} - e^{2.08})$$

(2)

(Total for Question 1 = 10 marks)



- 2 (a) Figure 1 shows a plate $80 \text{ mm} \times 40 \text{ mm} \times 5 \text{ mm}$ thickness with a 16 mm diameter hole drilled through in a processing stage.

Determine the volume of the finished plate.

(3)

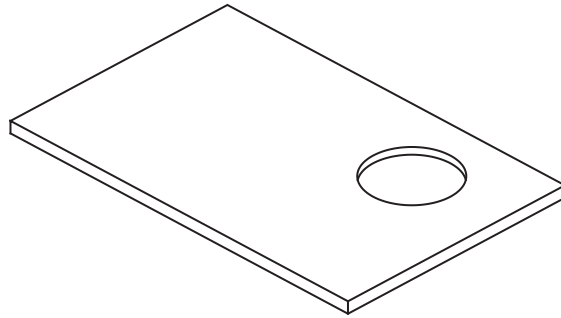


Diagram **NOT**
accurately drawn

Figure 1

Space for working

Answer:

- (b) The area of a drilled hole is 78.54 mm^2 .

What is the diameter of the hole?

(2)



- (c) The velocity of a vehicle is monitored and plotted against time on a graph.
Figure 2 shows the graph.

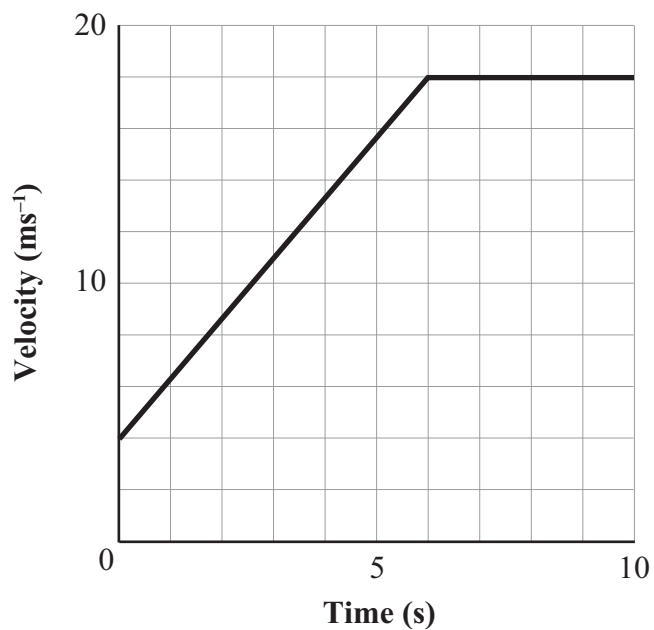


Figure 2

- (i) Determine the equation of the line during acceleration. (3)
- (ii) Calculate the velocity after 2.25 seconds. (2)

(Total for Question 2 = 10 marks)



3 (a) Figure 3 shows a template from a press operation.

Calculate the length a .

(4)

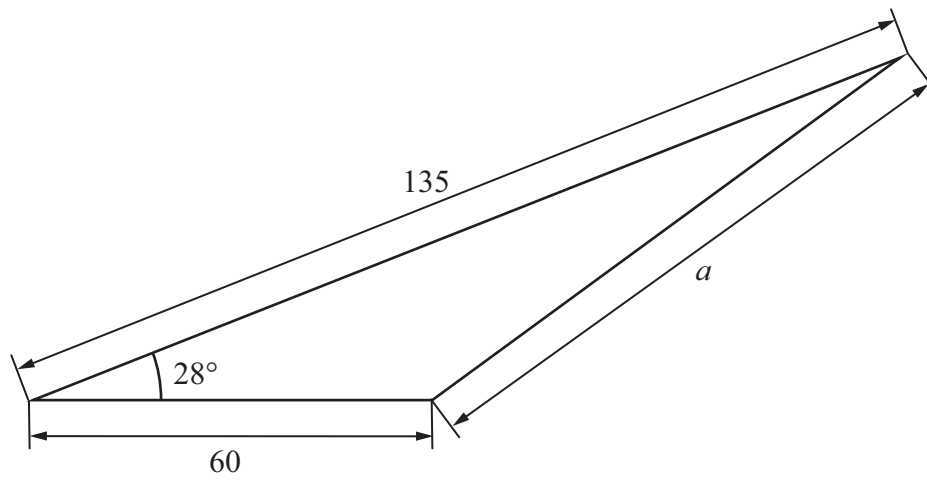


Diagram **NOT** accurately drawn

All dimensions are in millimetres

Figure 3

Space for working

Answer:



(b) The displacement of a body in oscillation follows the equation $y = 0.5 + 0.5 \sin \theta$

(i) Sketch one cycle of the body on Figure 4.

(3)

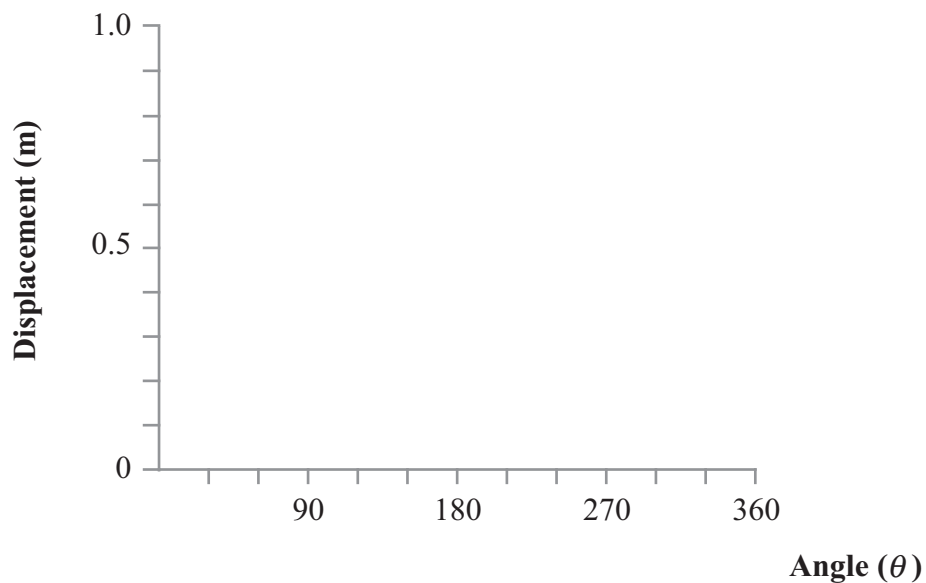


Figure 4

(ii) What is the value of the displacement at $\theta = 270^\circ$?

(1)

(Total for Question 3 = 8 marks)



- 4 (a) The formula $\theta = \omega_1 t + \frac{1}{2} \alpha t^2$ relates to the angle, in radians, turned by a flywheel after a time t .

Determine the value of t when $\theta = 648$, $\omega_1 = 6$ and $\alpha = 8$

(4)

- (b) The flywheel is monitored and reaches a speed of 1256 radians per second.

What is the flywheel speed in revolutions per minute?

(2)

- (c) The cost of employing two engineers and three technicians is £107 per hour.

The cost of employing four engineers and two technicians is £138 per hour.

Determine the individual cost per hour for an engineer and for a technician.

(5)

(Total for Question 4 = 11 marks)



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5 Table 1 shows the current ratings for a range of fuses in a vehicle electric system.

Fuse function	Rating A (amps)
Brake lights	15
Heated windscreen	30
Radio	10
Indicators	15
Front windows	30
Driving lights	20
Windscreen wipers	15
Electric seat	30
Fuel injection	30
Instrument panel	15
Airbag	10
Air conditioning	15
Central locking	20

Table 1

(a) Which value is the mode? (1)

(b) Calculate the mean value.
You must show your working. (3)

(c) Determine the median value.
You must show your working. (2)



(d) If the fuse rating for the driving lights is increased to 30 amps, state the effect on each of the following:

(i) the mode

(1)

(ii) the mean

(1)

(iii) the median.

(1)

(Total for Question 5 = 9 marks)



- 6 (a) A pneumatic piston moves a distance s metres in a time t seconds according to the following relationship:

$$s = 3t^3 - 4t^2 + 5t - 6$$

Using calculus:

- (i) determine the velocity of the piston at $t = 2$ seconds (4)

- (ii) determine the acceleration of the piston at $t = 2$ seconds. (3)

- (b) After a period of time t seconds, the velocity $v \text{ ms}^{-1}$ of a conveyor belt is given by
 $v = 5t - 6$

Use integration to determine the distance travelled by the conveyor belt in the first 5 seconds. (5)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS



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