Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson BTEC Level 3 Nationals Extended Certificate, Foundation Diploma, Diploma, Extended Diploma

Centre Number | | | | | | |

Learner Registration Number | | | | | | | | |

Wednesday 5 June 2019

Afternoon (Time: 2 hours) | Paper Reference **31706H**

Engineering

Unit 1: Engineering Principles

You must have:
Information booklet of formulae and constants
Ruler, protractor, pencil and 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 learner registration 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 80.
- You may need to recall a few formulae and constants that are not provided in the Information Booklet of Formulae and Constants and you may be rewarded for doing so.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- You may use a non-programmable calculator that does not have the facility for symbolic algebraic manipulation or allow the storage and retrieval of mathematical formulae.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question, show all your working and always answer to an appropriate degree of accuracy.

Turn over ▶

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Pearson

SECTION A

Applied Mathematics

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

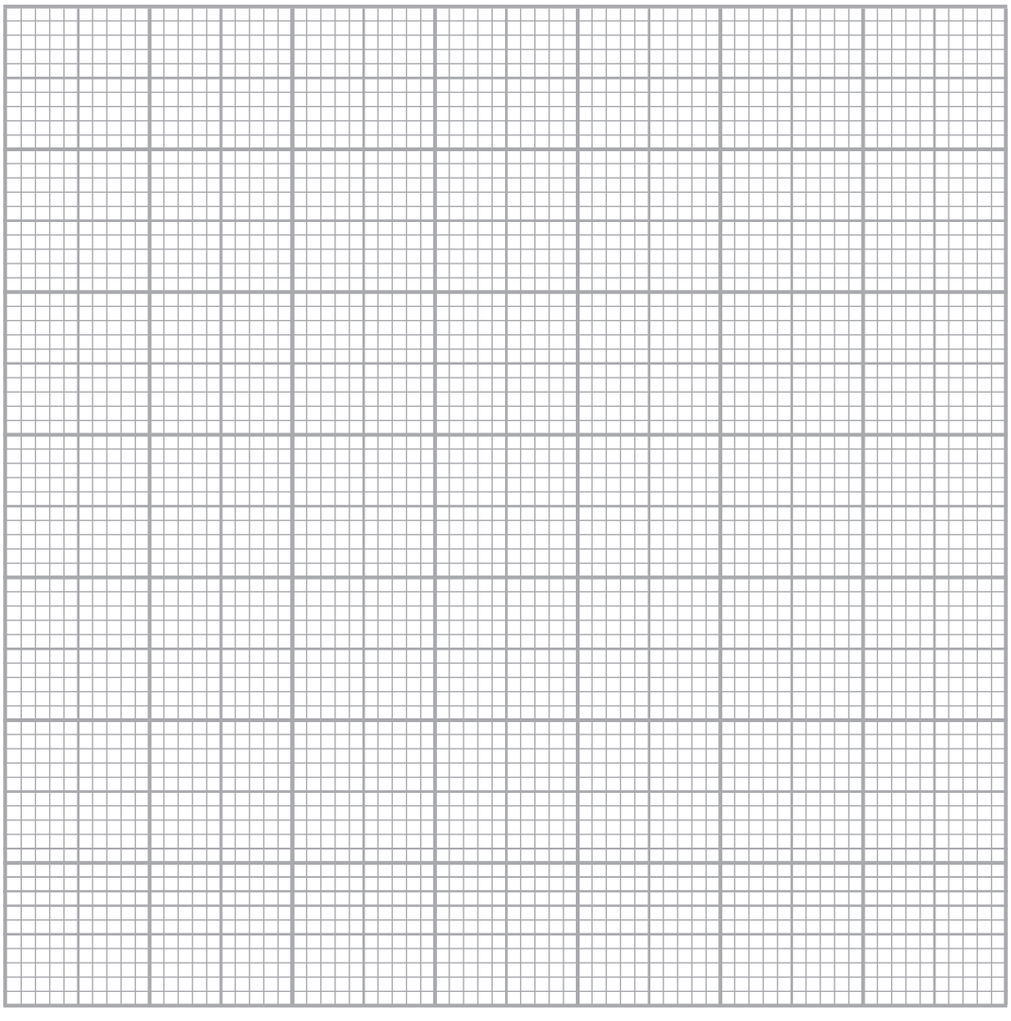
Engineers use the sine function when plotting AC waveforms.

1 Draw the waveform to represent the function:

$y = \sin\theta$

where θ is an angle between 0° to 360°.

You should include labels and axis values on your graph.



(Total for Question 1 = 4 marks)

The diagram shows the cross section of an extrusion with a uniform thickness of 4 mm.

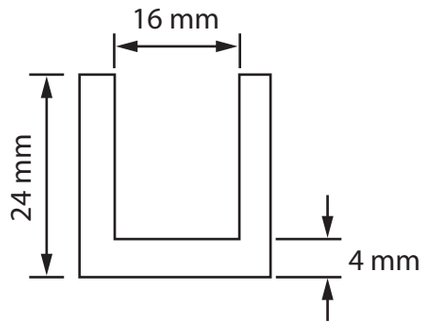


Diagram not to scale

2 Calculate the area of the extrusion.

Answer:

.....

(Total for Question 2 = 3 marks)

The length of time an alarm sounds is represented by the formula:

$l = (n^2)^3$

Where l is the length of time (in milliseconds) and n is the number of activations.

3 (a) Simplify the formula using **one** law of indices.

(2)

Answer:

(b) Calculate the value of l when n = 4.

(1)

Answer:

(Total for Question 3 = 3 marks)

The diagram shows a triangular ledge on a building.

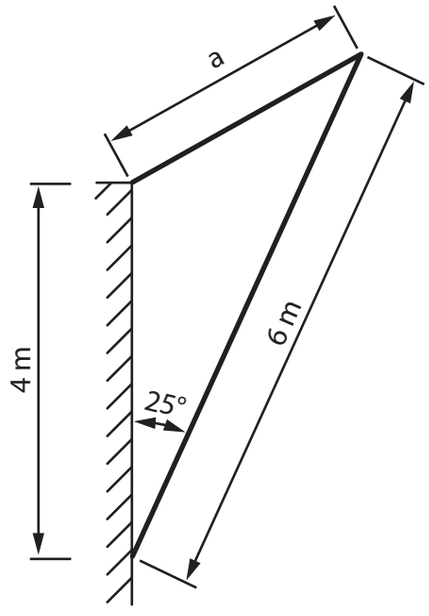


Diagram not to scale

4 Calculate the length of side a.

Answer:

.....

(Total for Question 4 = 4 marks)

A rocket follows a path represented by the equation:

$h = -4t^2 + 24t$

Where t = time in seconds and h = height above ground.

5 Find **by factorisation** the **two** times when the rocket is at a height of 32 m.

Time 1: .....

Time 2: .....

(Total for Question 5 = 6 marks)

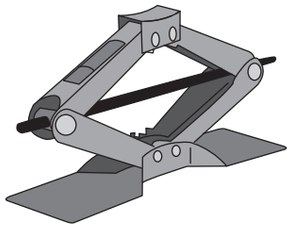
TOTAL FOR SECTION A = 20 MARKS

SECTION B

Mechanical Principles

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The image shows a scissor jack.



6 Identify the output motion from a scissor jack.

- ☒ **A** Linear
- ☒ **B** Oscillating
- ☒ **C** Irregular
- ☒ **D** Rotary

(Total for Question 6 = 1 mark)

7 Identify the unit of measure for angular velocity.

- ☒ **A** Cycles per second
- ☒ **B** Kilograms per second
- ☒ **C** Metres per second
- ☒ **D** Radians per second

(Total for Question 7 = 1 mark)

A beam supporting three loads is in static equilibrium.

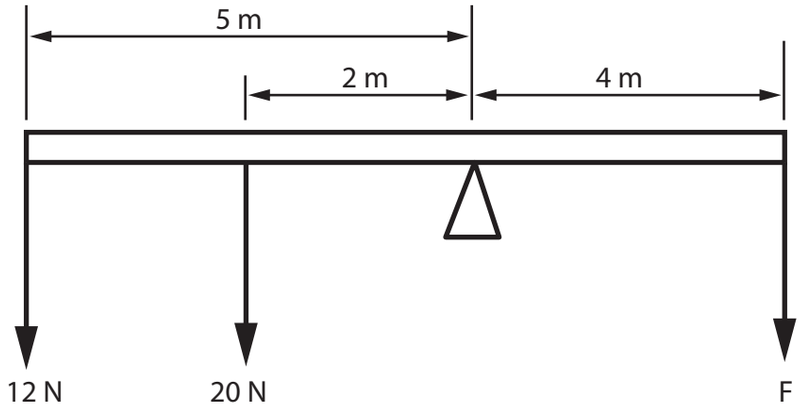


Diagram not to scale

8 Calculate the force F needed to keep the beam in static equilibrium.

Answer:

.....

(Total for Question 8 = 5 marks)

A 500 kg car on a theme park ride is shown below.

As the car passes point A, the total energy in the system is 154 000 J.

Total energy = potential energy + kinetic energy.

Assume the car is rolling freely, the track is frictionless and there is no wind resistance.

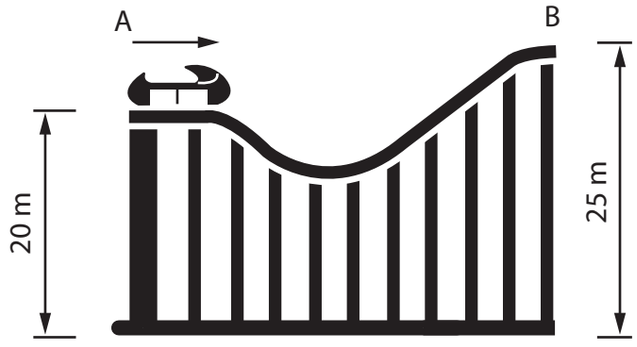


Diagram not to scale

9 (i) Calculate the potential energy of the car at point B on the ride.

(2)

Answer:

.....

(ii) Calculate the velocity of the car as it passes point B on the ride.

Give your answer in an appropriate unit.

(4)

Answer:

.....

(Total for Question 9 = 6 marks)

10 State **one** factor affecting the flow rate of a liquid in a section of a gradually tapering pipe.

Assume that the pipe is rigid and the fluid is incompressible.

.....

.....

(Total for Question 10 = 1 mark)

A punch will be used to produce a hole through a sheet of aluminium.

The diameter of the hole is 0.2 m and the thickness of the aluminium sheet is 0.004 m.

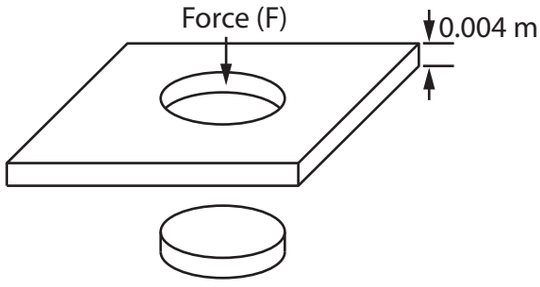


Diagram not to scale

The ultimate shear stress of the aluminium sheet is 50 MPa.

11 Calculate the force (F) needed to punch the hole through the aluminium sheet.

Answer:

.....

(Total for Question 11 = 7 marks)

A solid cylinder is fully submerged in a tank of water and is in static equilibrium.

Assume the cylinder is made from an unknown material.

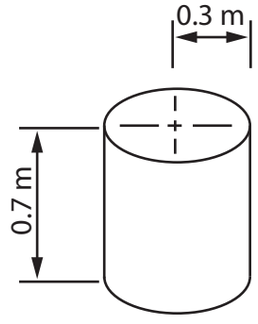


Diagram not to scale

The weight of water displaced by the cylinder is 22 N.

12 Calculate the density of the solid cylinder using Archimedes' principle.

Answer:

.....

(Total for Question 12 = 9 marks)

TOTAL FOR SECTION B = 30 MARKS

SECTION C

Electrical and Electronic Principles

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

13 Identify the component represented by the electronic circuit symbol.

☒ **A** Battery

☒ **B** Transistor

☒ **C** Inductor

☒ **D** Diode

(Total for Question 13 = 1 mark)

14 Identify the unit of measure for rate of charge on a capacitor.

☒ **A** Coulombs per second

☒ **B** Henry per second

☒ **C** Tesla per hour

☒ **D** Watts per hour

(Total for Question 14 = 1 mark)

15 State **one** application of a rectifier circuit.

.....

.....

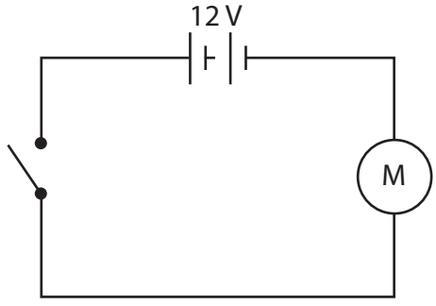
.....

.....

.....

(Total for Question 15 = 1 mark)

A DC electric motor has an output power of 50 W.



The current flowing in the circuit is 5.5 A.

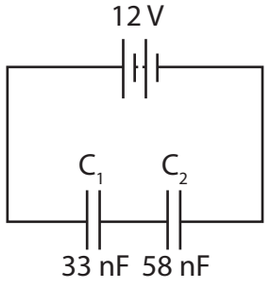
16 Calculate the input power to the electric motor.

Answer:

.....

(Total for Question 16 = 2 marks)

Two capacitors are connected in a series circuit to a 12 volt DC power supply.



17 (a) Calculate the total capacitance in the circuit.

(3)

Answer:

.....

(b) Calculate the total energy stored in the capacitors.

Give your answer in an appropriate unit.

(4)

Answer:

.....

(Total for Question 17 = 7 marks)

A technician carried out an investigation into the temperature coefficient of a conductor. The following measurements were recorded:

Temperature	**Resistance**
T1	12 Ohms
T2	15 Ohms

The difference in temperature between T1 and T2 was 17°C, and the value of R_0 = 12 Ohms.

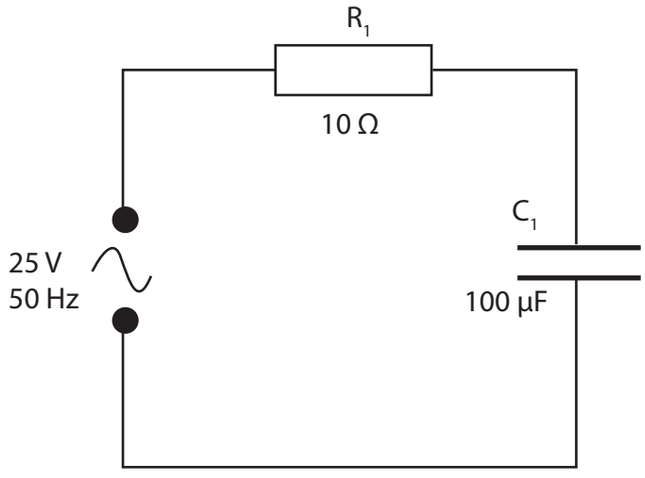
18 Calculate the temperature co-efficient (α) of the conductor.

Answer:

.....

(Total for Question 18 = 4 marks)

The diagram shows an AC circuit that has a resistor and capacitor in series.



19 Calculate the total impedance in the circuit.

Answer:

.....

(Total for Question 19 = 5 marks)

A coil with 200 turns has a current of 3 A flowing through it.

The coil is wrapped around a circular bar with a cross-sectional area of 0.4 m^2 and is 0.25 m in length.

The relative permeability (μ_r)of the circular bar is 150 and the permeability of free space (μ_0) is $4\pi \times 10^{-7}$ H/m.

20 Calculate the magnetic flux (Φ) in the circular bar.

Answer:

.....

(Total for Question 20 = 9 marks)

TOTAL FOR SECTION C = 30 MARKS
TOTAL FOR PAPER = 80 MARKS

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