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| Surname | | | | | Other names | | | | | | | | | | | | | | |
| Pearson BTEC Level 3 Nationals, Extended Certificate, Foundation Diploma, Diploma, Extended Diploma | | | | | | | | | | Centre Number | | | | | Learner Registration Number | | | | |
| | | | | | | | | | | | | | | | | | | | |
| <h1>Engineering</h1> <h2>Unit 1: Engineering Principles</h2> | | | | | | | | | | | | | | | | | | | |
| Monday 4 June 2018 – Afternoon | | | | | | | | | | Paper Reference | | | | | | | | | |
| Time: 2 hours | | | | | | | | | | 31706H | | | | | | | | | |
| 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.
- 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 and show your working.
- Check your answers if you have time at the end.

Turn over ►

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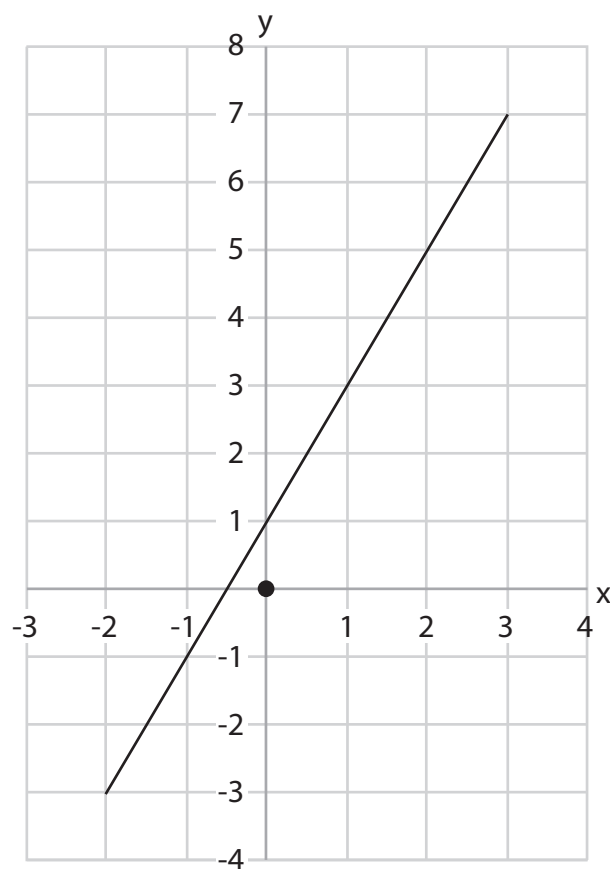

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SECTION A

Applied Mathematics

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

An engineer has plotted a straight line graph based on the results of an investigation.



1 (i) Calculate the gradient of the straight line.

(2)

Answer



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(ii) Find the equation of the straight line.

(2)

Answer

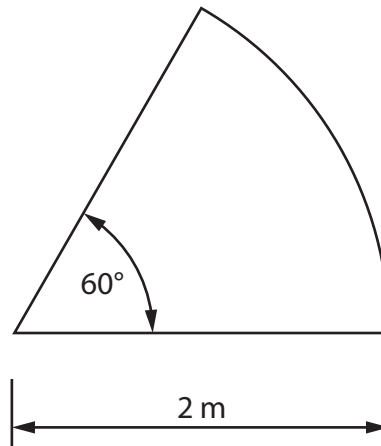
(Total for Question 1 = 4 marks)



P 5 4 0 7 5 A 0 3 2 0

The diagram represents a base of a steel storage tank.

The base is shaped as a sector of a circle.



2 (i) Convert 60° into radians.

(2)

Answer

(ii) Calculate the area of the base (sector of a circle).

(2)

Answer

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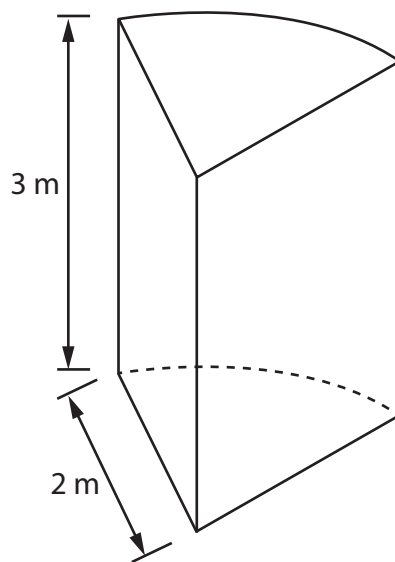
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(iii) Calculate the volume of the steel storage tank.

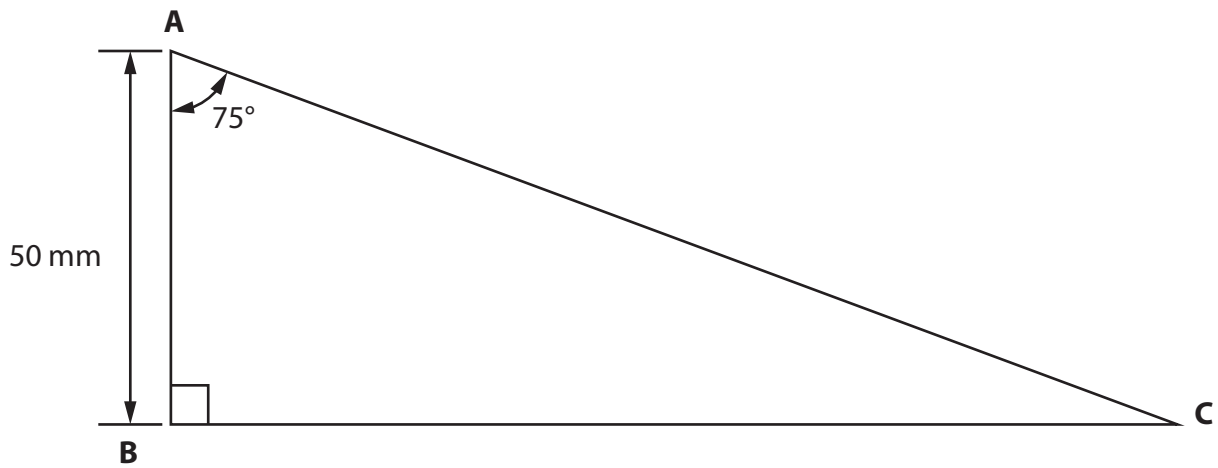
(2)

Answer

(Total for Question 2 = 6 marks)



A drill drift is machined from a flat piece of steel.



3 Calculate the length of side AC.

(4)

Answer

(Total for Question 3 = 4 marks)

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The diagram represents four coplanar tension forces acting on a joint in a structure.

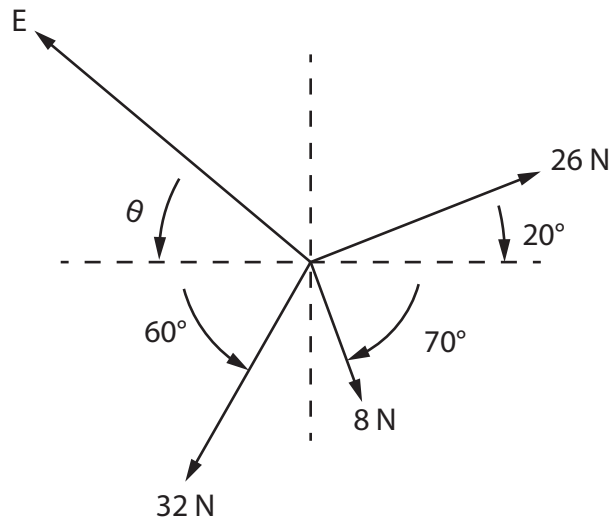


Diagram not to scale

- 4 Calculate the **horizontal** component of the equilibrant force **E**.

Answer

(Total for Question 4 = 4 marks)



The rate of discharge of a capacitor can be represented by the expression:

$$e^{2x} = 6$$

5 Solve the equation to find the value of x .

Show evidence of the laws of logarithms in your answer.

Answer

(Total for Question 5 = 3 marks)

TOTAL FOR SECTION A = 21 MARKS

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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 ☒.

6 Identify the unit of measure for mechanical energy.

(1)

- A joule
- B kilogram
- C newton
- D watt

(Total for Question 6 = 1 marks)

7 Identify the term that describes the ratio of output force to input effort.

(1)

- A load transfer
- B mechanical advantage
- C power rating
- D sinusoidal waveform

(Total for Question 7 = 1 marks)

8 State **one** of the conditions that must be met for a body to be in static equilibrium.

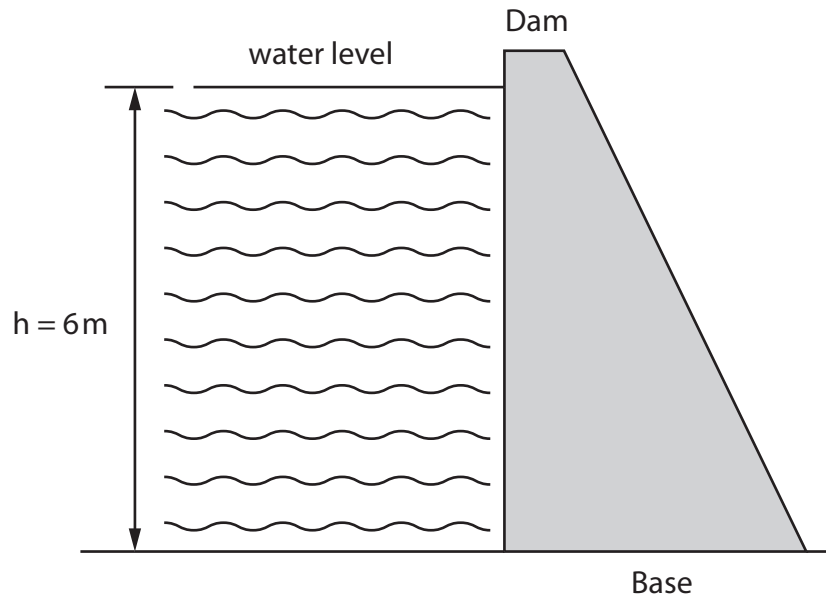
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(Total for Question 8 = 1 marks)



A dam is 8 m wide.



9 (i) Calculate the area of the water against the dam wall.

(2)

Answer

(ii) Calculate the hydrostatic thrust on the dam wall.

Assume the density of water is 1000 kg/m^3 .

(3)

Answer

(Total for Question 9 = 5 marks)



A steel cable has a diameter of 0.02 m and withstands a tensile force of 3 kN.

10 (i) Calculate the cross-sectional area of the circular cable.

(2)

Answer

(ii) Calculate the direct stress in the cable.

Give your answer in an appropriate unit.

(3)

Answer

(Total for Question 10 = 5 marks)



A solid spherical component has a diameter of 0.06 m and a mass of 0.35 kg.
The component is made from an unknown material.

11 (i) Calculate the volume of the spherical component.

(3)

Answer

(ii) Calculate the density of the unknown material.

(2)

Answer

(Total for Question 11 = 5 marks)

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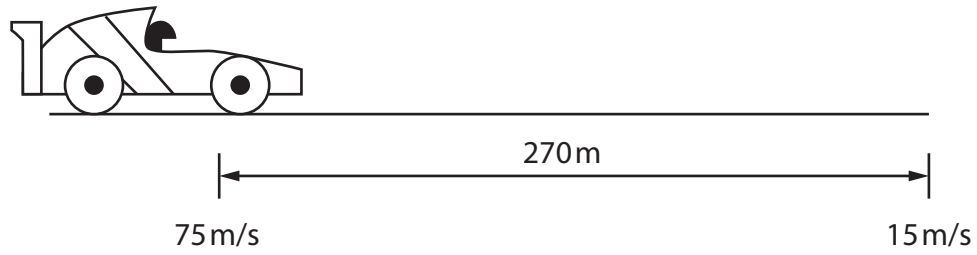
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A racing car decelerates uniformly from 75 m/s to 15 m/s in a distance of 270 m.



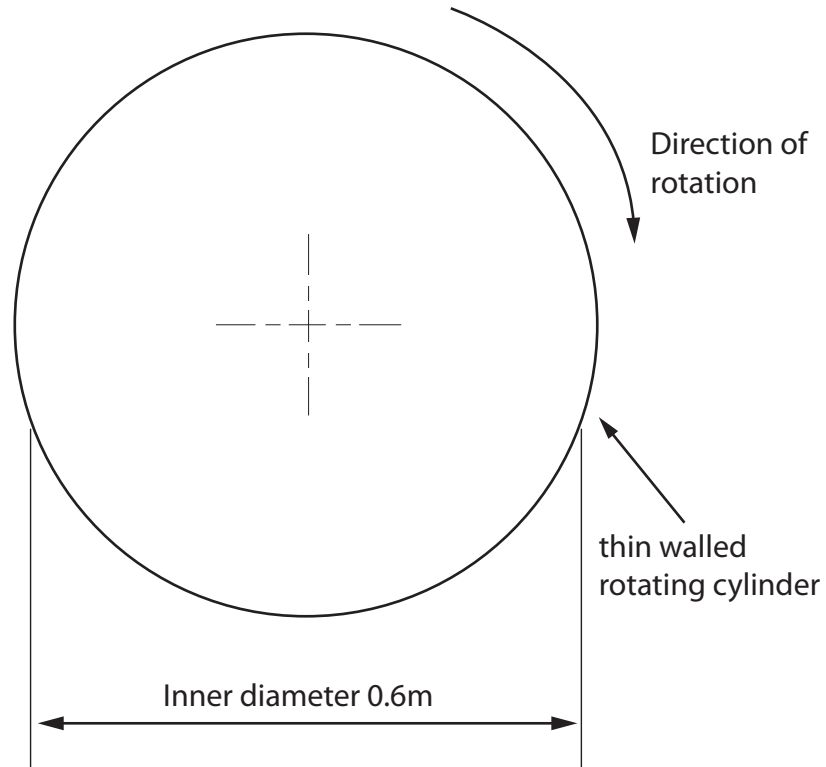
12 Calculate the rate of deceleration of the racing car.

Answer

(Total for Question 12 = 4 marks)



A rotating cylinder has a mass of 10 kg. The inner diameter of the thin walled cylinder is 0.6 m.



13 Calculate the rotational kinetic energy of the cylinder when it rotates at 60 revolutions per minute (RPM).

(8)

Answer

(Total for Question 13 = 8 marks)

TOTAL FOR SECTION B = 30 MARKS



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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 ☒.

14 Identify the unit of frequency for an alternating current supply.

(1)

- A Farad
- B Henry
- C Hertz
- D Tesla

(Total for Question 14 = 1 marks)

15 Identify the component that allows current to flow in one direction in a circuit.

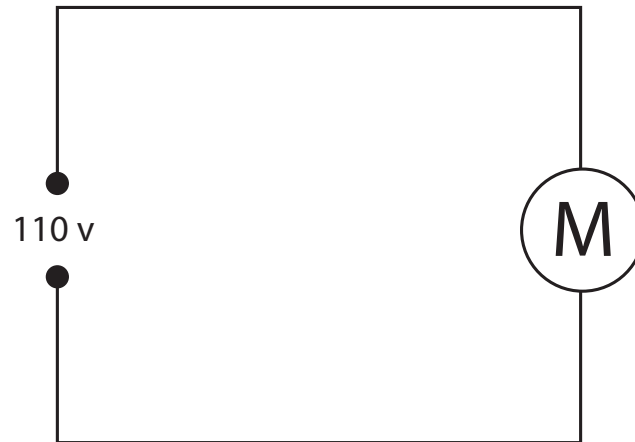
(1)

- A capacitor
- B diode
- C fuse
- D resistor

(Total for Question 15 = 1 marks)



An electric motor is connected to a 110 V power supply and has a power rating of 2 kW.
The DC motor is operating at full power.



16 Calculate the current drawn by the motor.
Give your answer in an appropriate unit.

(5)

Answer

(Total for Question 16 = 5 marks)



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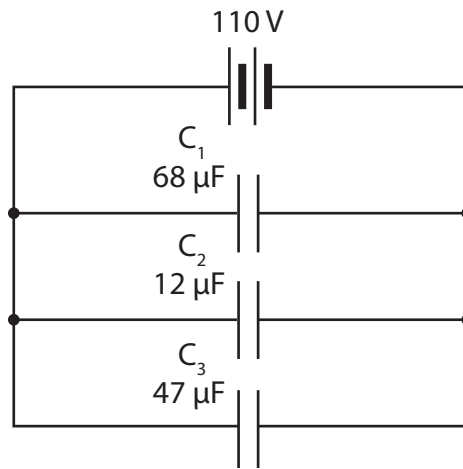
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A network of capacitors has been constructed for testing.



17 Calculate the total charge stored in the circuit.

(4)

(Total for Question 17 = 4 marks)



18 Explain the term conventional current flow in a DC electronic circuit.

(2)

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(Total for Question 18 = 2 marks)

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The RMS voltage of a single-phase AC supply is 100 volts.

19 (i) Calculate the peak voltage of the supply.

(3)

Answer

(ii) Calculate the average value of the supply.

(2)

Answer

(iii) Calculate the form factor for the supply.

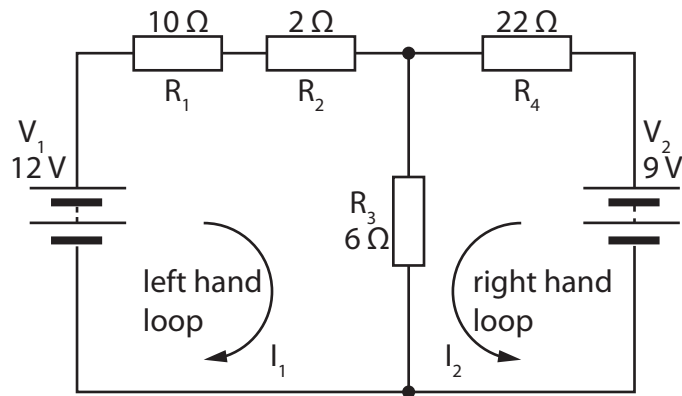
(2)

Answer

(Total for Question 19 = 7 marks)



The diagram shows a network of resistors that is connected to two DC power supplies.



20 Calculate the current flowing through resistor R_3 .

Answer

(Total for Question 20 = 9 marks)

TOTAL FOR SECTION C = 29 MARKS
TOTAL FOR PAPER = 80 MARKS

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