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

Monday 14 January 2019

Morning (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

- Try to answer every question, show all your working and always answer to an appropriate degree of accuracy.
- Check your answers if you have time at the end.

Turn over ▶

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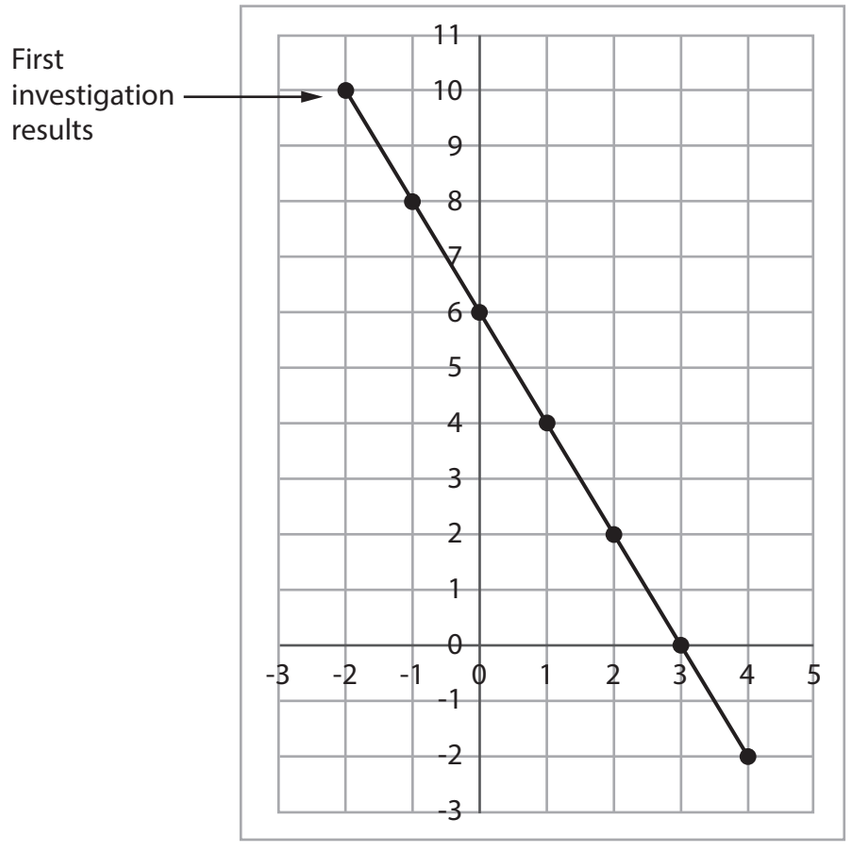
Pearson

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.



The results of a second investigation are represented by the expression:

$y = 3x + 1$

1 (a) Draw a straight line onto the graph paper to show the results of the **second** investigation.

(3)

(b) Find the coordinates of the intercept for the lines plotted for the first and second investigations.

(2)

Answer

.....

(Total for Question 1 = 5 marks)

A milling machine cutter completes 1750 revolutions in 3 minutes 30 seconds.

2 Calculate how many revolutions are completed in 1 minute.

Answer

.....

(Total for Question 2 = 2 marks)

A communications tower has a cable attached as shown.

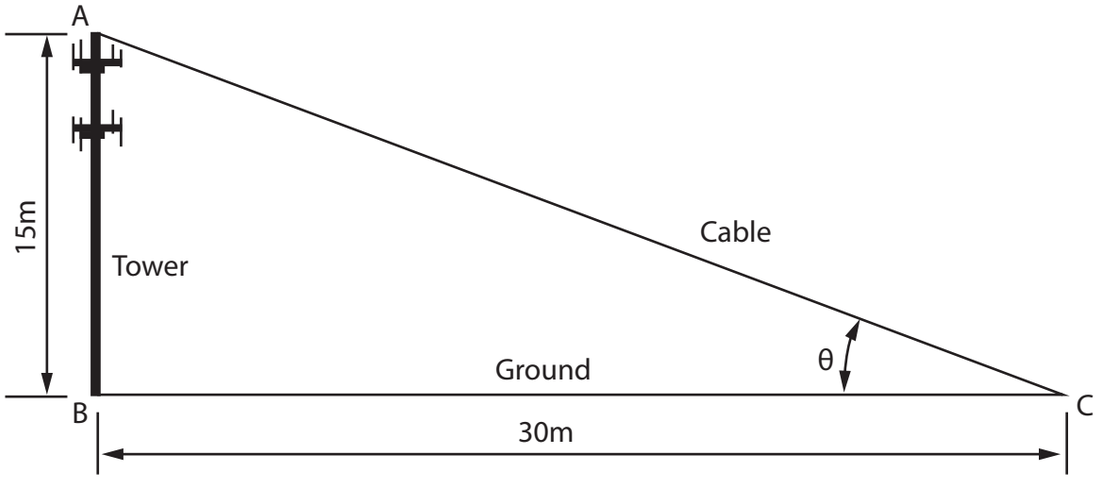


Diagram not to scale

3 Calculate the angle θ.

Answer

.....

(Total for Question 3 = 3 marks)

The diagram represents a cone that covers a satellite receiver.

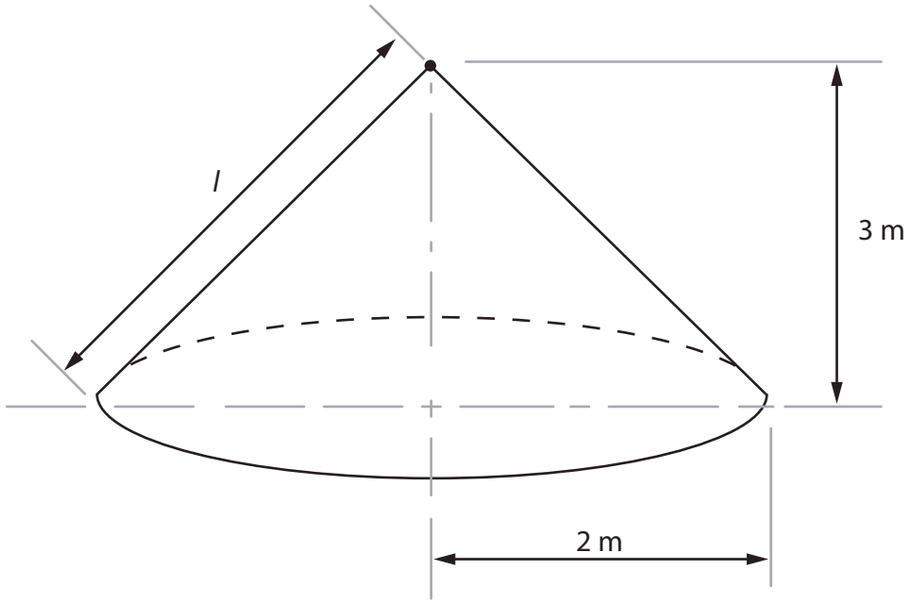


Diagram not to scale

4 (a) Calculate the length of the slope *l*.

(3)

Answer

.....

(b) Calculate the surface area of the cone.

(2)

Answer

.....

(Total for Question 4 = 5 marks)

The results of a test on an electronic circuit are represented by the expression:

$32x^2 - 24x + 4 = 0$

Where x represents the times when two LEDs light up on a display.

5 Calculate, using the quadratic formula, the **two** values of x when the LEDs light up.

Answer

.....

(Total for Question 5 = 5 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 ☒.

6 Identify the name of the unit of measure for hydrostatic pressure.

- ☒ **A** joule
- ☒ **B** lumen
- ☒ **C** henry
- ☒ **D** pascal

(Total for Question 6 = 1 mark)

7 Identify the name of the turning moment that causes rotation about an axis.

- ☒ **A** displacement
- ☒ **B** inertia
- ☒ **C** torque
- ☒ **D** velocity

(Total for Question 7 = 1 mark)

8 State **one** factor that affects stress in a cable supporting an object.

.....

.....

(Total for Question 8 = 1 mark)

A pipe tapers from an area of 0.5 m^2 to 0.3 m^2.

Assume that the pipe runs full and contains an incompressible fluid.

The inlet flow velocity is 15 m/s.

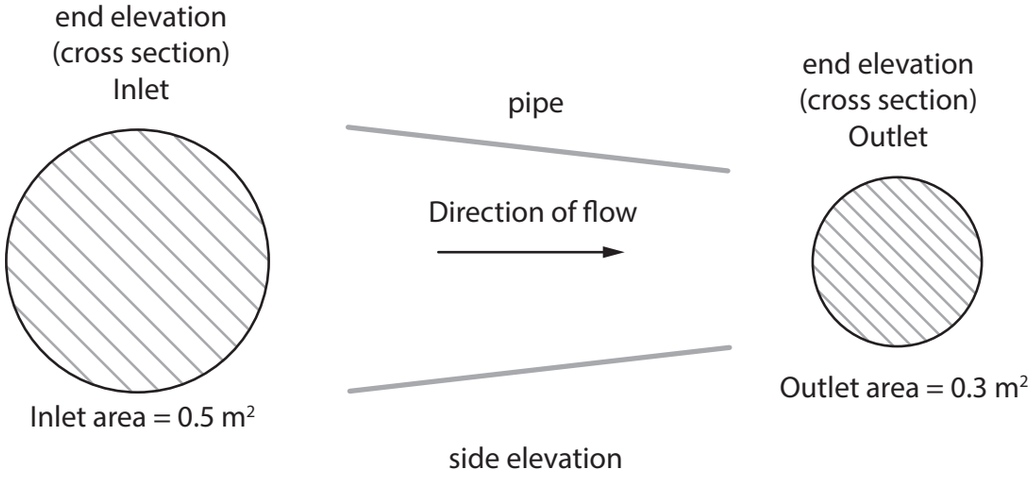


Diagram not to scale

9 Calculate the outlet flow velocity.

Answer

.....

(Total for Question 9 = 3 marks)

A steel cable of uniform diameter has a length of 5 m.

The cable extends by 3 mm when a load is applied.

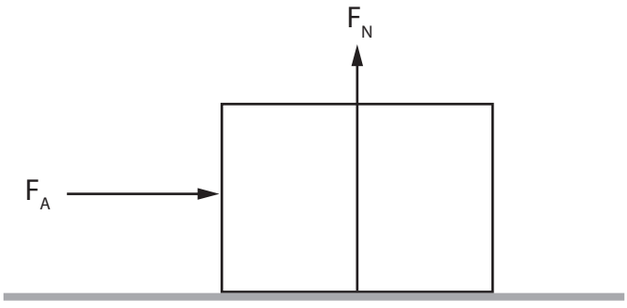
10 Calculate the direct strain in the cable.

Answer

.....

(Total for Question 10 = 3 marks)

A 50 kg packing crate is being pushed along a horizontal surface.



11 (a) Calculate the normal reaction force F_N.

Give your answer in an appropriate unit.

(4)

Answer

(b) Calculate the force (F_A) needed to overcome the effects of friction.

Assume the coefficient of friction $\mu = 0.3$.

(2)

Answer

(Total for Question 11 = 6 marks)

A railway engine travels on a level track at a constant velocity of 4 m/s.
Ignore the effects of friction and wind resistance.

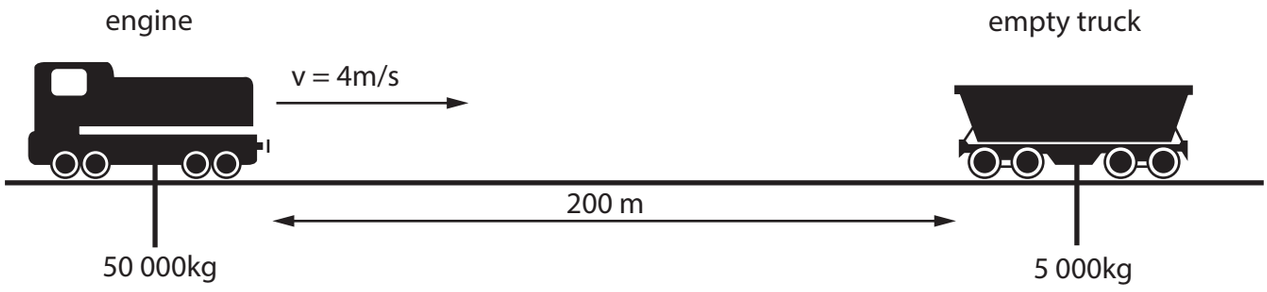


Diagram not to scale

12 (a) Calculate the time taken for the engine to travel 200 m.

(3)

Answer

.....

The engine collides with and couples to the stationary empty truck and continues moving.

(b) Calculate the velocity of the coupled engine and truck just after the collision.

(5)

Answer

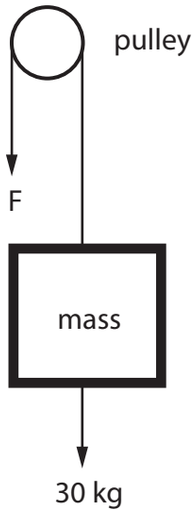
.....

(Total for Question 12 = 8 marks)

A mass of 30 kg is hoisted vertically by a rope running over a pulley.

The mass accelerates with an initial velocity of 2 m/s to a final velocity of 3 m/s when travelling through a distance of 5 m.

Ignore the effects of friction.



13 Calculate the work done in raising the mass.

Answer

.....

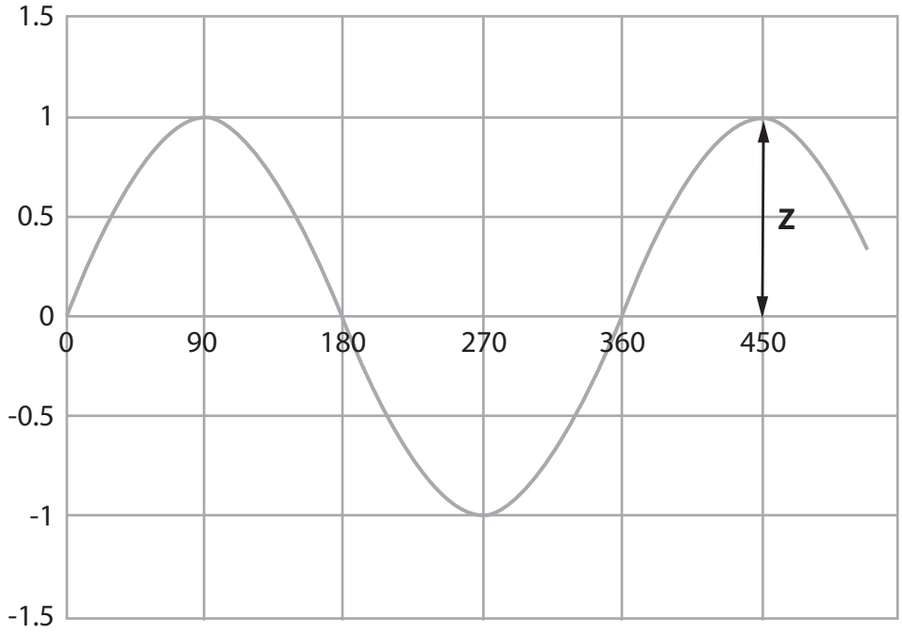
(Total for Question 13 = 8 marks)

TOTAL FOR SECTION B = 31 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 ☒.



14 Identify the feature of the waveform labelled Z.

- ☒ **A** amplitude
- ☒ **B** form factor
- ☒ **C** frequency
- ☒ **D** time period

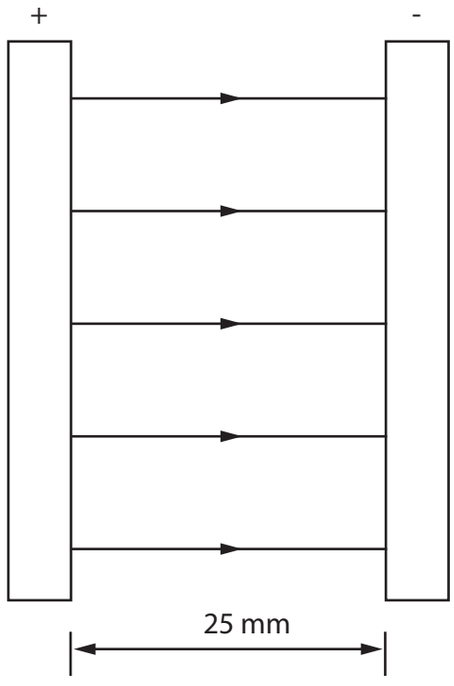
(Total for Question 14 = 1 marks)

15 Identify the term that defines resistance to magnetic flux.

- ☒ **A** hysteresis
- ☒ **B** induction
- ☒ **C** permeability
- ☒ **D** reluctance

(Total for Question 15 = 1 marks)

The potential difference between two parallel plates is 75 kV.



16 Calculate the uniform electric field strength between the two plates.

Give your answer in an appropriate unit.

Answer

.....

(Total for Question 16 = 4 marks)

17 State **one** factor that affects the electrical resistance of a conductor.

.....

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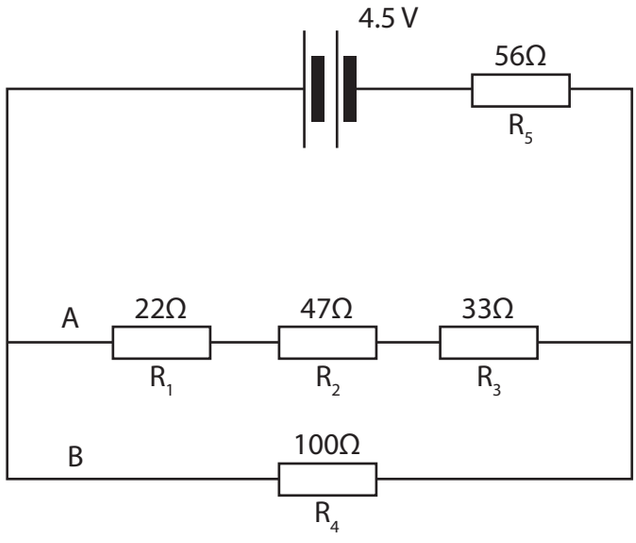
(Total for Question 17 = 1 mark)

A resistor network has been constructed for testing.



18 (a) Calculate the total resistance of branch A of the circuit.

(2)

Answer

.....

(b) Calculate the total resistance of the network.

(4)

Answer

.....

(Total for Question 18 = 6 marks)

19 Explain the effects of full wave rectification on an alternating current supply.

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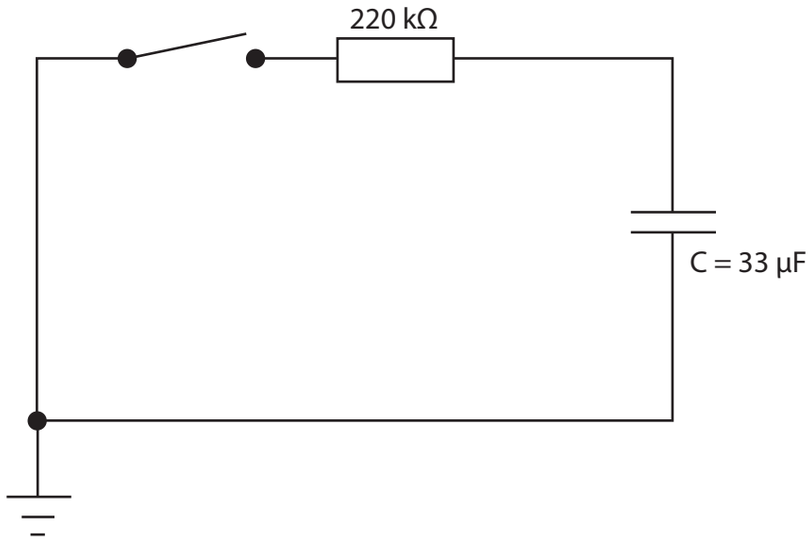
(Total for Question 19 = 2 marks)

A fully charged capacitor is discharged through a resistor when the switch is closed.



20 (a) Calculate the time constant for the capacitor.

(3)

Answer

When the switch is closed the capacitor begins to discharge. When t = 0, the voltage across the capacitor is 12 v.

(b) Calculate the voltage across the capacitor after 20 seconds.

(3)

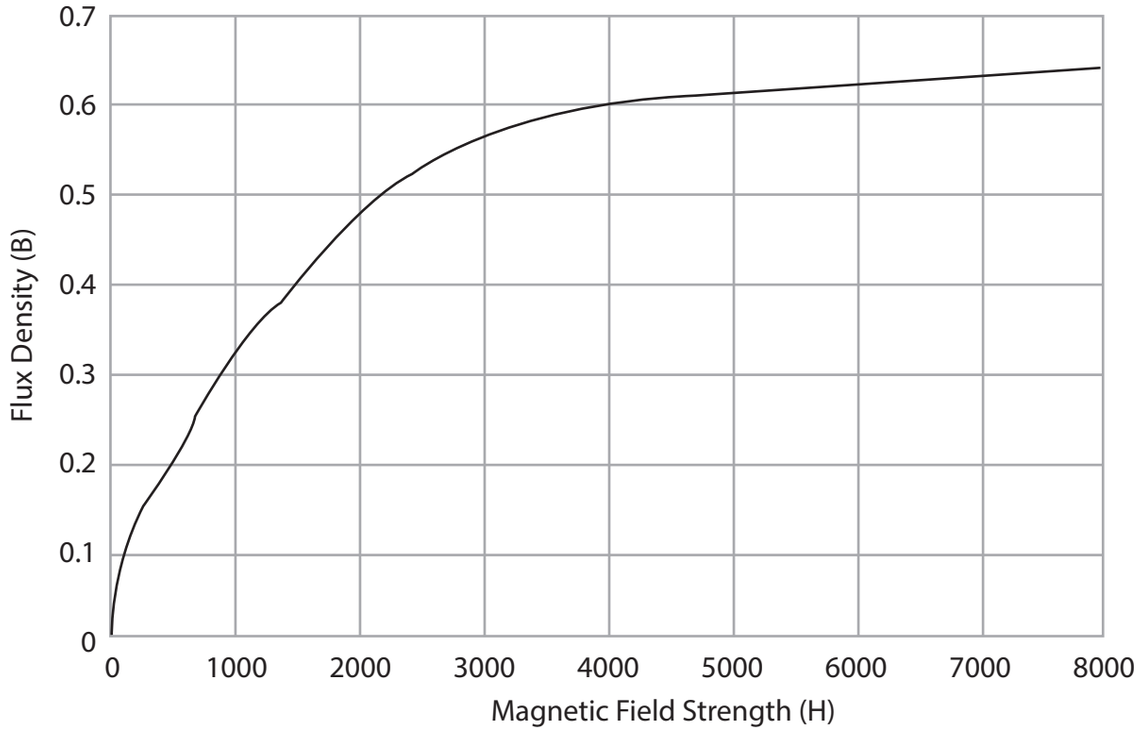
Answer

(Total for Question 20 = 6 marks)

A coil of 300 turns is wound around a steel core.

The coil has a length of 0.9 m and a cross sectional area of 250 x 10^{-6} m^2.

A BH curve has been produced using the results from experiments.



21 Calculate the current required to create a magnetic flux (Φ) of 0.1mWb in the core.

Answer

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(Total for Question 21 = 8 marks)

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

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