

SECTION A

SECTION A: Applied Mathematics

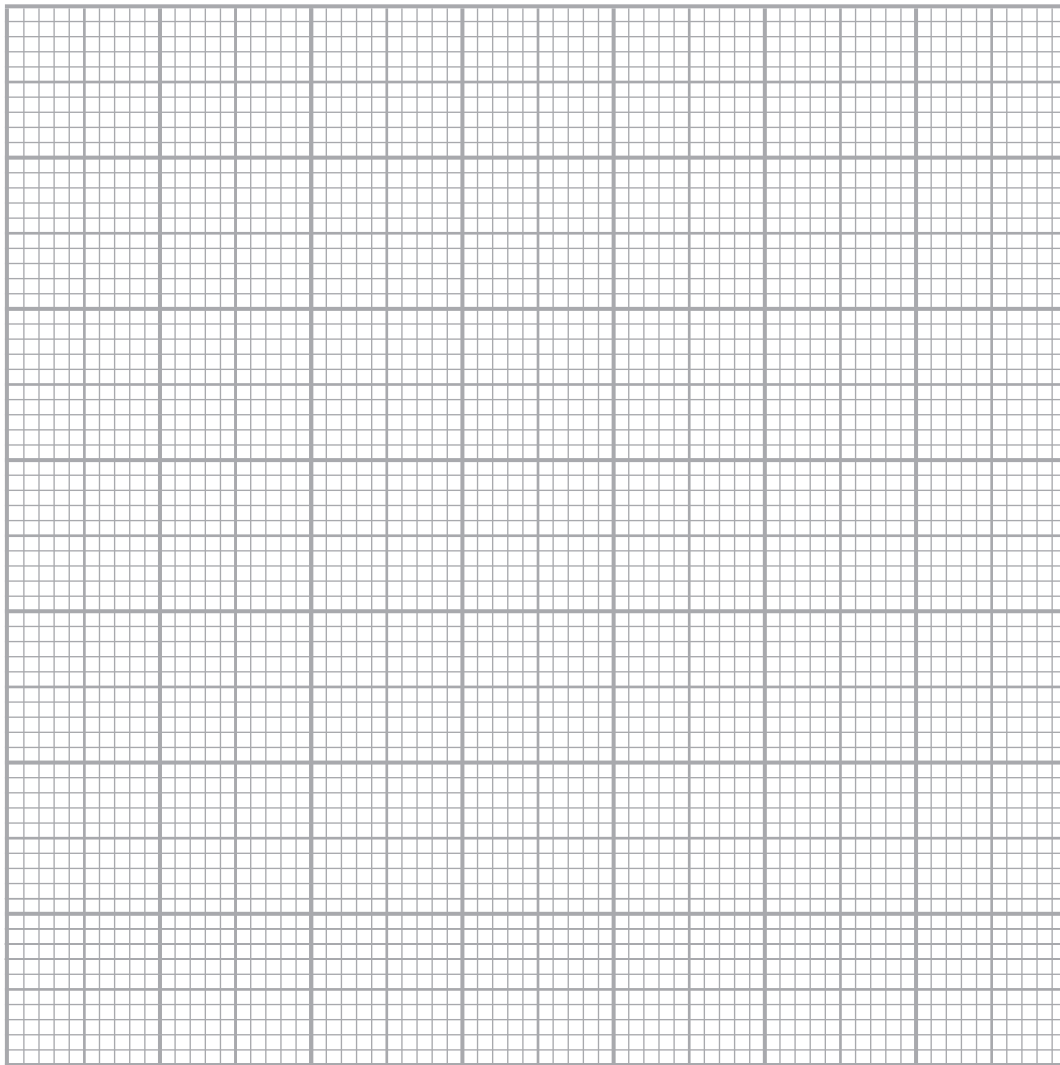
Answer ALL questions. Write your answers in the spaces provided.

The total time spent machining components is represented by the equation of a straight line:

$$\text{Total time (in minutes)} = 3n + 5$$

where n is the number of components.

- 1 Draw a straight line graph to represent the time spent machining up to 5 components.
You should include labels and axis values on your graph.



(Total for Question 1 = 4 marks)

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The image shows a steel wedge in the shape of a triangle.

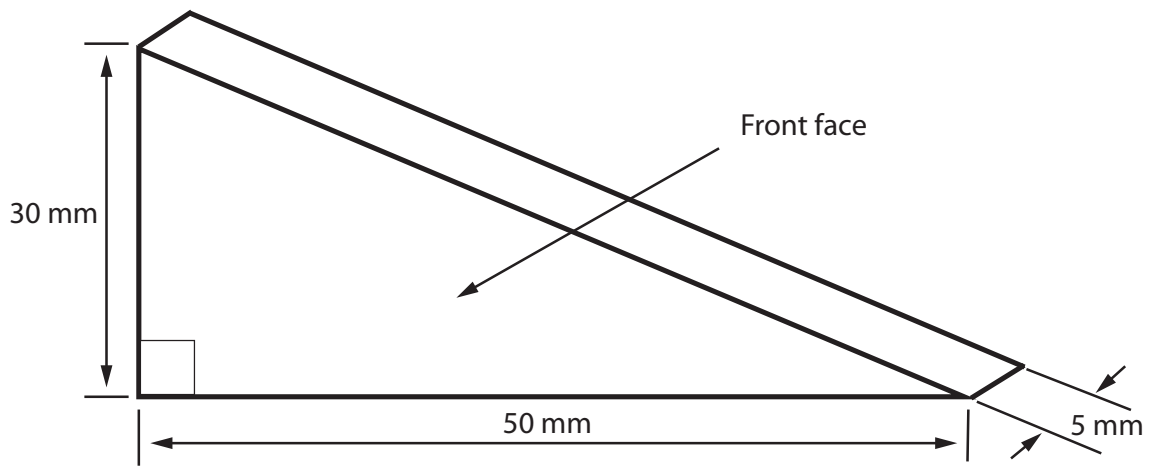


Diagram not to scale

- 2 (i) Calculate the area of the front face of the wedge.

(2)

Answer

- (ii) Calculate the volume of the wedge.

(2)

Answer

(Total for Question 2 = 4 marks)



Two lines have been drawn by a CNC plotter. The lines are represented by the following simultaneous equations:

$$4y = 3x - 9$$

$$y = x - 11$$

- 3 Find the co-ordinate (x, y) where the lines cross.

Answer

(Total for Question 3 = 4 marks)

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The diagram shows a metal circle of steel where a sector has been marked out so it can be cut.

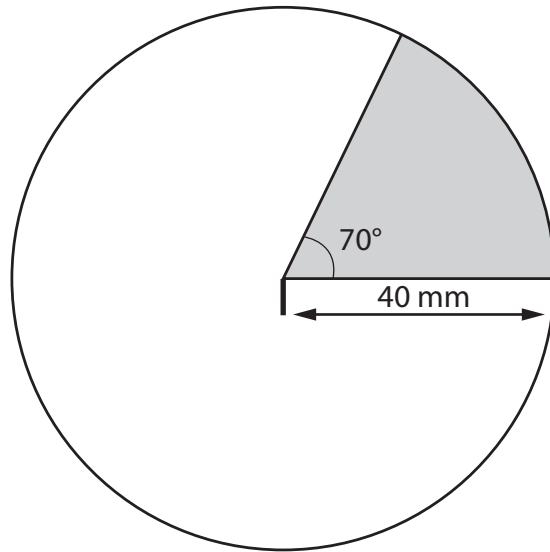


Diagram not to scale

- 4 (i) Convert 70° into radians.

(2)

Answer

- (ii) Calculate the arc length of the shaded sector.

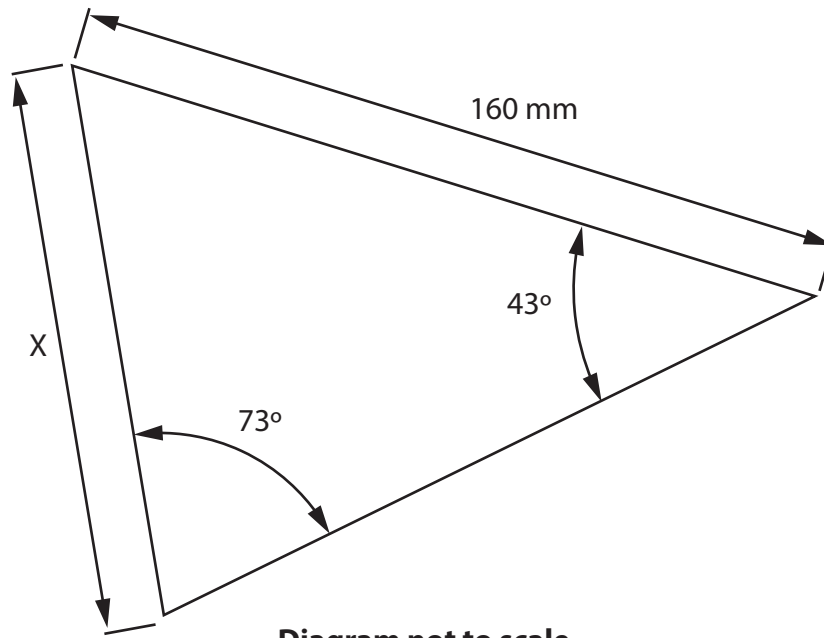
(2)

Answer

(Total for Question 4 = 4 marks)



The diagram shows a stamped angled plate.



5 Calculate the length of dimension X.

Answer

(Total for Question 5 = 4 marks)

TOTAL FOR SECTION A = 20 MARKS



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SECTION B

Mechanical Principles

Use appropriate units in your answers.

6 Identify the unit of measure for mechanical power. (1)

- A** metres
- B** newtons
- C** ohms
- D** watts

(Total for Question 6 = 1 mark)

7 Identify the term that describes the ratio of tensile stress to tensile strain. (1)

- A** Young's modulus
- B** Rigidity modulus
- C** Resilience
- D** Ductility

(Total for Question 7 = 1 mark)

8 State **one** method that can produce a mechanical advantage. (1)

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(Total for Question 8 = 1 mark)



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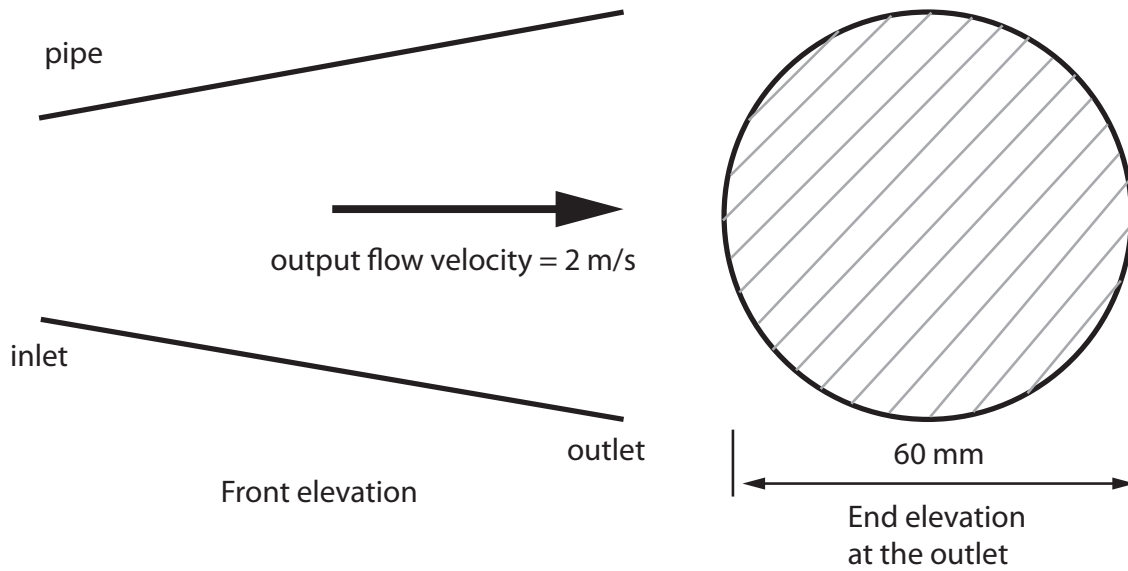
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A mechanical engineering technician is investigating flow rates through a tapering pipe. The pipe contains an incompressible fluid of density (ρ) 1000 kg/m^3 and runs full.



9 (i) Calculate the cross sectional area of the outlet.

(2)

Answer

(ii) Calculate the mass flow rate of the fluid (mass flow rate = ρAv).

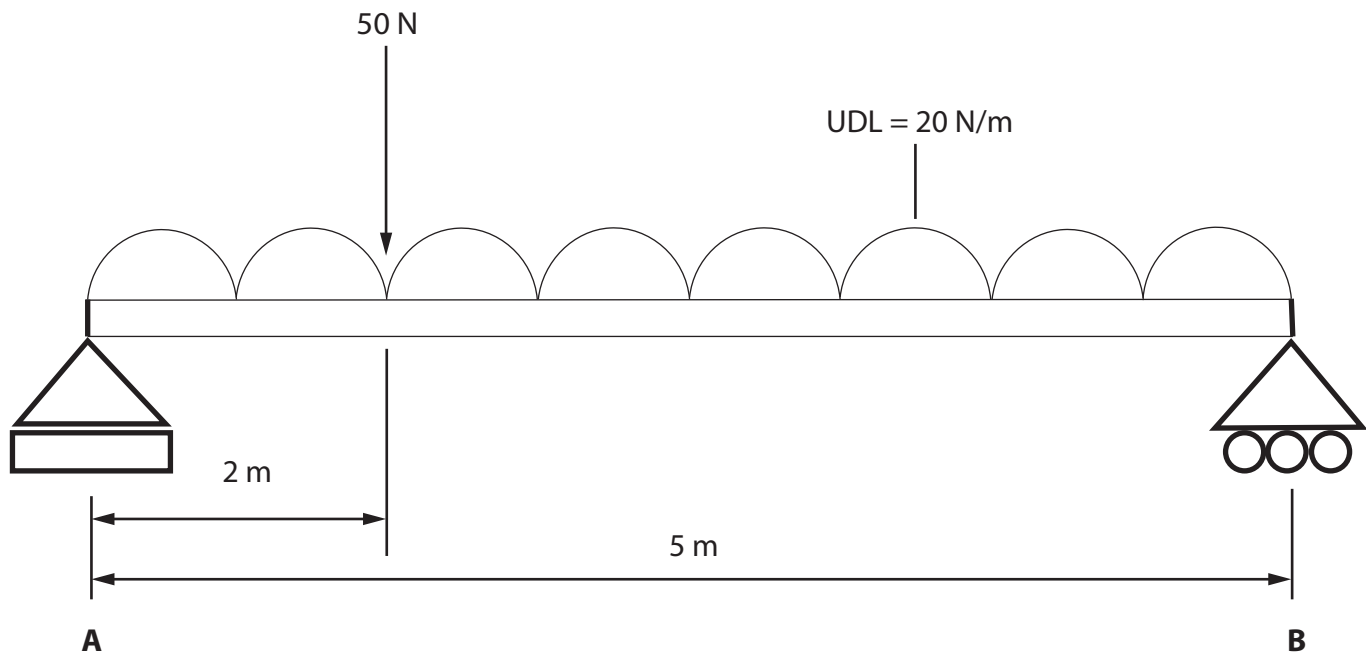
(2)

Answer

(Total for Question 9 = 4 marks)



The diagram shows a simply supported beam in static equilibrium.



10 Calculate the reaction force at point B.

Answer

(Total for Question 10 = 7 marks)



11 Describe the principle of conservation of momentum.

(2)

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(Total for Question 11 = 2 marks)

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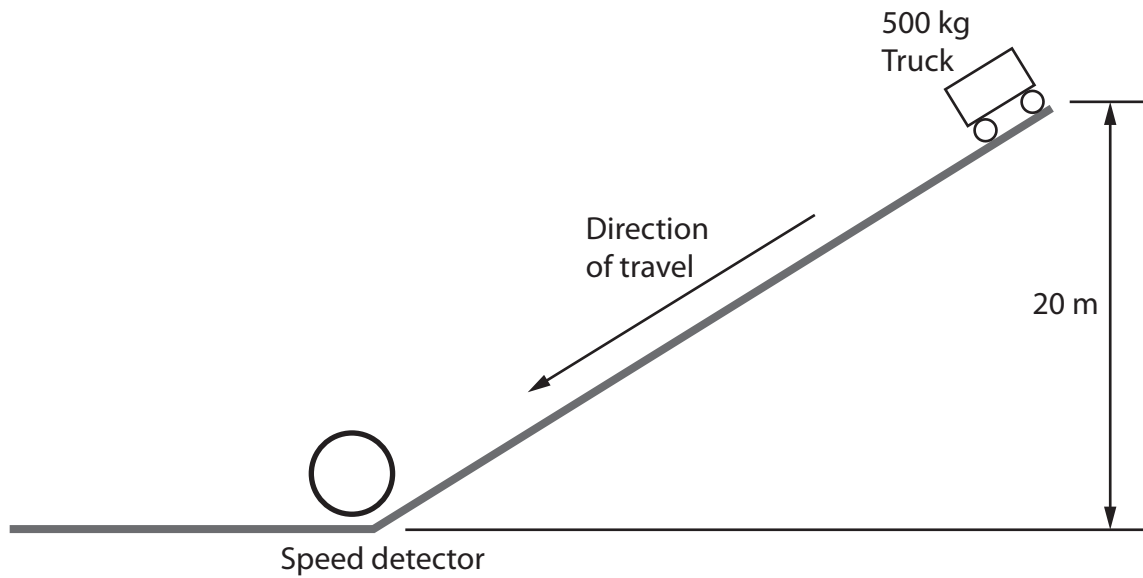
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A truck with a mass of 500 kg travels down a ramp.

At the bottom of the ramp, the truck passes through a speed detector.



12 (i) Calculate the potential energy of the truck at the top of the slope.

Give your answer in an appropriate unit.

(3)

Answer

(ii) Calculate the velocity of the truck as it passes through the speed detector.

The effects of friction can be ignored.

(4)

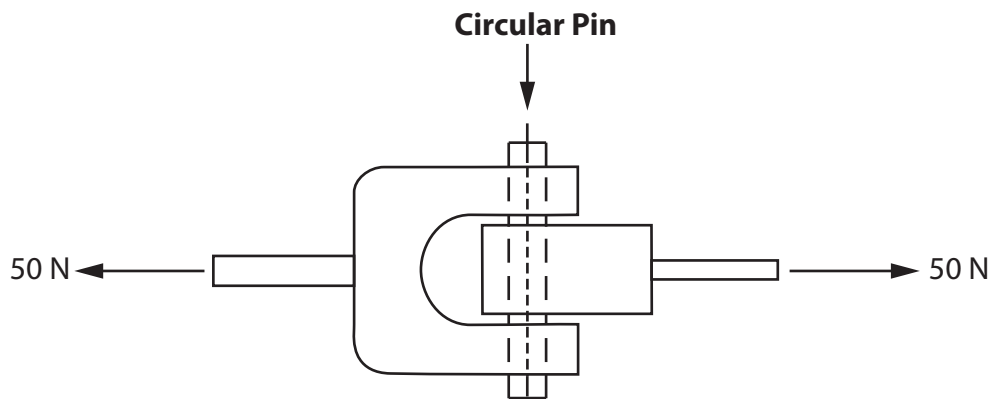
Answer

(Total for Question 12 = 7 marks)



A pin is used as part of a connection between two rods in a framework.

The shear stress of the pin is limited to 50 kPa.



13 Calculate the minimum suitable diameter for the pin.

Answer

(Total for Question 13 = 7 marks)

TOTAL FOR SECTION B = 30 MARKS

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SECTION C

Electrical/Electronic Principles

Use appropriate units in your answers.

14 Identify the useful form of energy produced directly by an electric motor. (1)

- A** chemical energy
- B** potential energy
- C** kinetic energy
- D** light energy

(Total for Question 14 = 1 mark)

15 Identify the unit of measure for magnetic flux. (1)

- A** henry
- B** hertz
- C** tonne
- D** weber

(Total for Question 15 = 1 mark)



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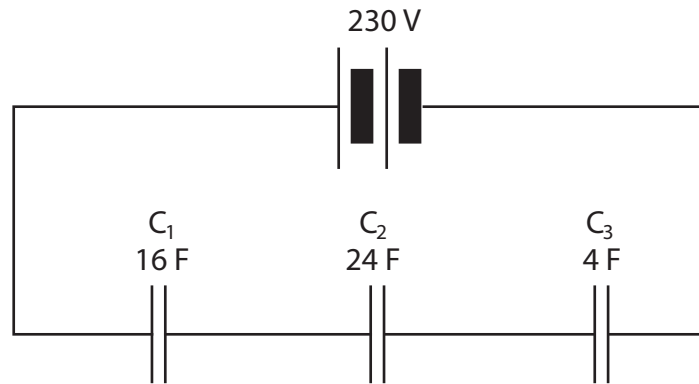
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The circuit diagram shows a DC power supply connected to a number of capacitors in series.



16 (i) Calculate the total capacitance of the circuit.

(3)

Answer

(ii) Calculate the total charge stored on the capacitors.

Give your answer in an appropriate unit.

(3)

Answer

(Total for Question 16 = 6 marks)



An electric motor is supplied with a 230 V supply and has a power rating of 12 kW.

The motor is operating at full power.

17 Calculate the resistance of the motor windings.

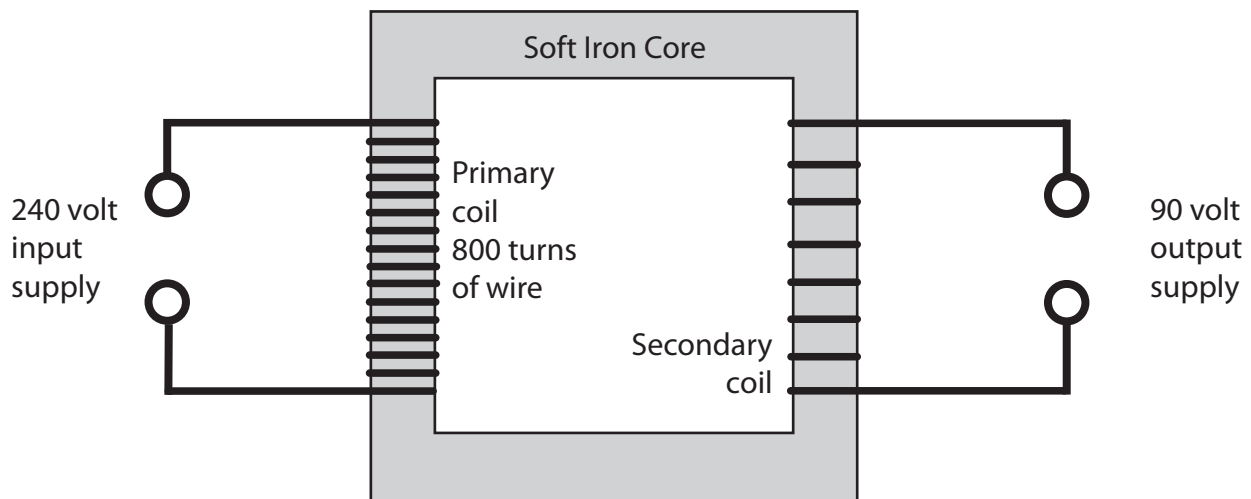
(4)

Answer

(Total for Question 17 = 4 marks)



A technician is designing a transformer.



18 (a) Calculate the number of turns needed in the secondary coil.

(3)

Answer

(b) State **two** methods of reducing power losses from a transformer.

(2)

1

2

(Total for Question 18 = 5 marks)



A winch is powered by a 230 volt electric motor drawing a current of 60 A.

The motor has an efficiency of 58%.

19 (a) Calculate the power output of the motor to the winch.

(4)

Answer

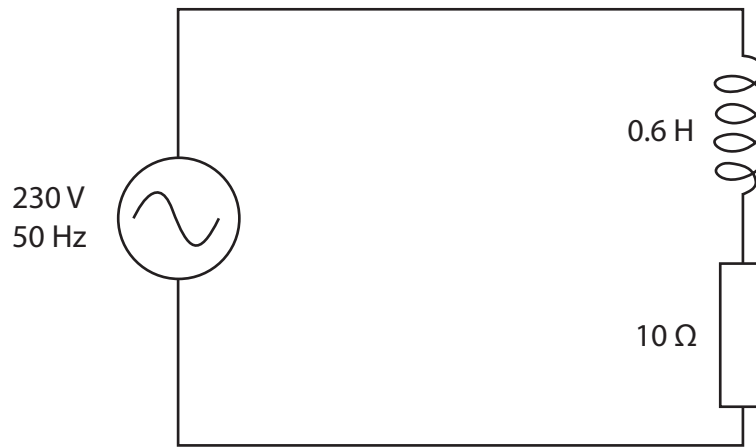
(b) Explain **one** method of improving the efficiency of the electric motor that powers the winch.

(2)

(Total for Question 19 = 6 marks)



A solenoid has an inductance of 0.6 H and an internal resistance of 10 Ω .
The inductor is connected to a 230 V, 50 Hz AC supply.



20 Calculate the current drawn from the supply.

(7)

Answer

(Total for Question 20 = 7 marks)

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

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