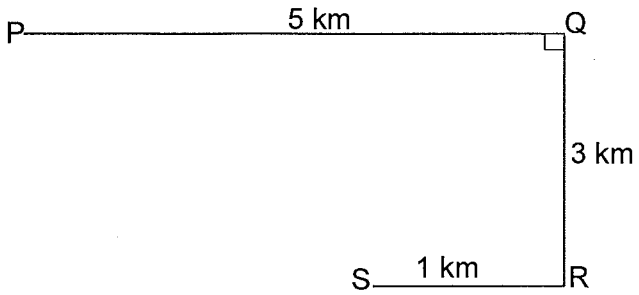
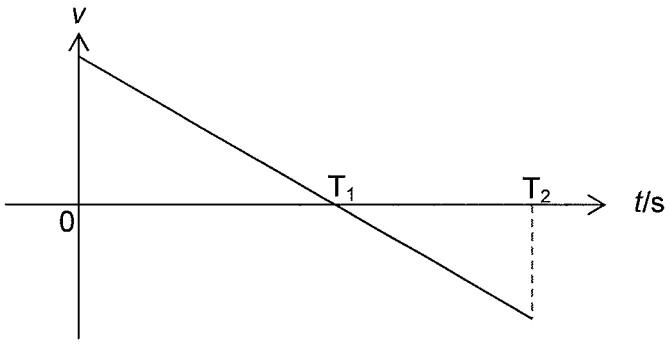
1 The diagram shows the path travelled by a car from P to S.



What is the displacement of the car?

A 5.0 km **B** 6.8 km **C** 8.2 km **D** 9.0 km

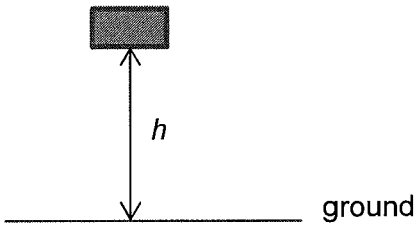
2 The velocity-time graph shown represents the motion of an object from $t = 0$ to $t = T_2$ s



Which of the following describes the motion of the object?

	From 0 to T_1	From T_1 to T_2
A	increasing acceleration	decreasing acceleration
B	uniform acceleration	decreasing acceleration
C	uniform deceleration	uniform deceleration
D	uniform deceleration	uniform acceleration

3 A brick, initially at rest, falls from a height of h and took 2.0 s to reach the ground.



The acceleration of free fall, $g = 10\ m/s^2$.

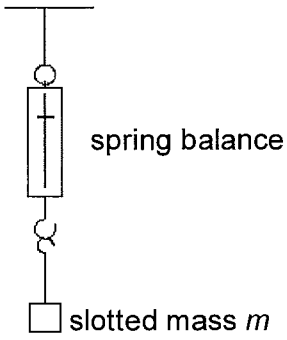
What is the height h of the brick?

A 10 m
B 20 m
C 30 m
D 40 m

4 Which statement about the net force acting on an object is correct?

A A net force is needed to keep an object moving with uniform velocity.
B A net force is needed to keep an object moving with increasing velocity.
C A net force is needed to keep an object moving with constant speed in a straight line
D Net force is zero if the object is slowing down.

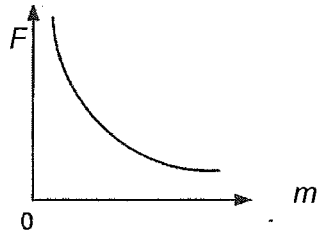
5 Different slotted masses *m* were hung on the end of a spring balance.



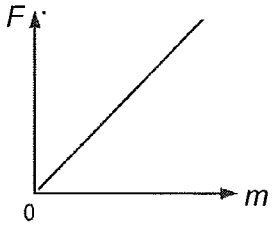
The gravitational force *F* acting on each of the mass was measured using the balance.

Which graph shows the relationship between the gravitational force, *F* and the mass *m*?

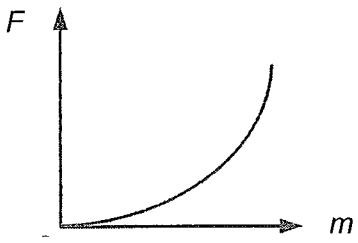
A



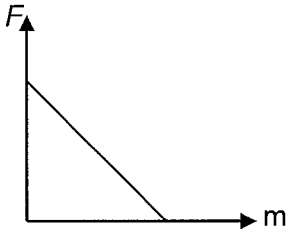
B



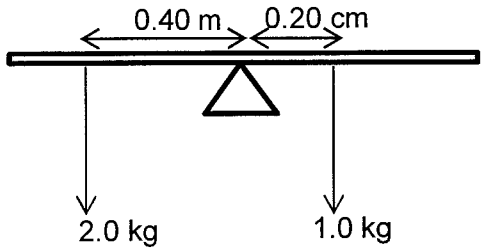
C



D



6 The diagram shows a uniform beam pivoted at the centre.



Two loads 2.0 kg and 1.0 kg are suspended as shown.

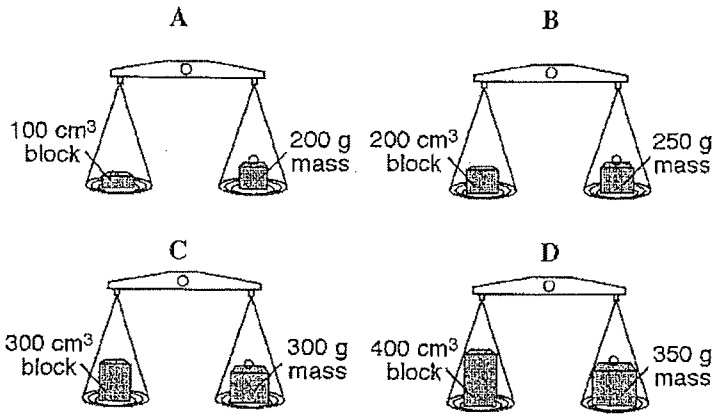
In order to balance the beam, a third load is added to the right of the pivot.

What is the mass of the load and how far from the pivot must it be attached?

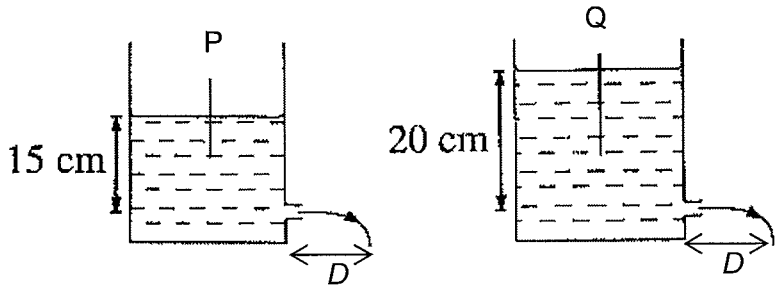
	Load/kg	Distance from pivot /m
A	1	0.40
B	2	0.10
C	2	0.30
D	3	0.10

7 Four blocks, each made from a different material, are placed on scales and balanced as shown in the diagrams.

In which diagram does the block have the greatest density?



8 The diagram shows two identical containers containing liquid P and liquid Q.



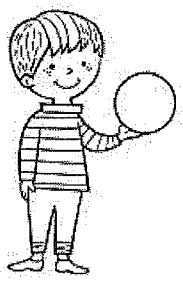
Water spurts out the same horizontal distance *D* when the depth of liquid P is 15 cm and the depth of liquid Q is 20 cm,

The density of liquid P is 2.00 g/cm^3.

What is the density of liquid Q in g/cm^3 ?

A 0.67 **B** 1.30 **C** 1.50 **D** 2.70

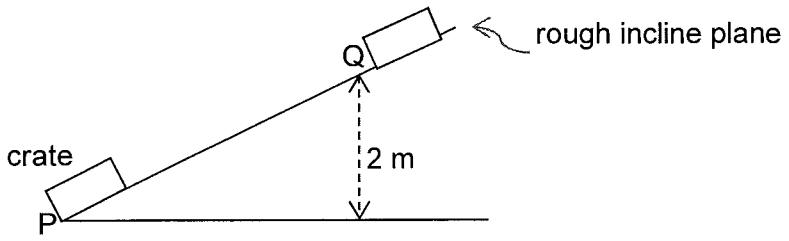
9 Mark holds a bowling ball in a fixed position.



Which statement regarding the work done on the ball is correct?

A The work done depends on the weight of the ball.
B The work done depends on mass of the ball.
C The work done is zero.
D The work done depends on the way he holds the ball.

10 A crate of mass 25 kg is pushed up a rough inclined plane.



The total work done on the crate from P to Q is 1500 J.

The gravitational field strength, g = 10 N/kg.

How much work is done against friction?

A 250 J
B 500 J
C 1000 J
D 2000 J

11 Sam of mass 75kg runs up to the top of a building in 5 minutes.
There are 260 steps, each 0.18 m high.

The gravitational field strength, g = 10 N/kg.

What is Sam's mechanical power?

A 11.7 W
B 65.0 W
C 117 W
D 7020 W

12 Two marbles, A and B are dropped to the ground from the roof of the school.

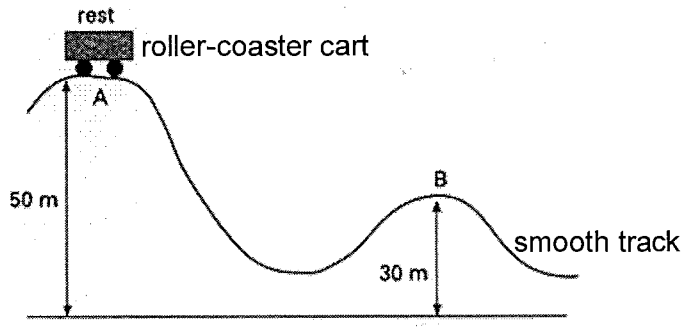
The mass of marble A is 2 times the mass of marble B.

Air resistance can be neglected.

What is the kinetic energy of marble A just before hitting the ground?

A the same kinetic energy as marble B.
B 2 times the kinetic energy of B.
C ½ the kinetic energy of B.
D 4 times the kinetic energy of B.

13 The diagram shows a roller-coaster cart starting from rest at point A and moving down a smooth track to past point B.



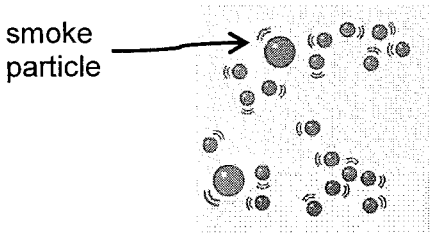
The gravitational field strength, g = 10 N/kg.

What is its speed at point B?

A 10 m/s
B 20 m/s
C 20 m/s
D 40 m/s

14 Illuminated smoke particles, suspended in air, are viewed with a microscope.

They are seen to move randomly.



What does the motion of smoke particles tell us about the molecular movement of air molecules?

A Air molecules are in continuous motion.
B Air molecules moves in clusters.
C Air molecules move just as fast as smoke particles
D Air molecules have the same amount of average kinetic energy at different temperature.

15 Which of the following about internal energy is correct?

A The temperature of a body is a measure of the total internal energy of the body.

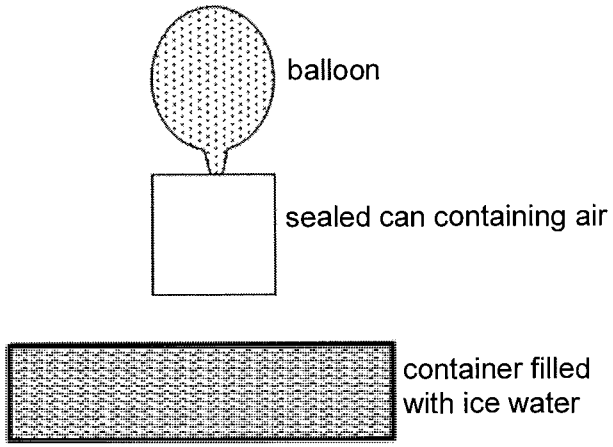
B The internal energy is a measure of the total kinetic and potential energy of the molecules in the body.

C Two bodies at the same temperature always have the same amount of internal energy.

D The internal energy of a body will increase if the temperature decreases.

16 Air was pumped into a balloon. The balloon is then connected to a sealed can.

The can is then placed in a container of ice water as shown in the diagram.



What will happen to the balloon when placed inside the container of ice water?

A The balloon will increase in size because the pressure inside the balloon decreases.

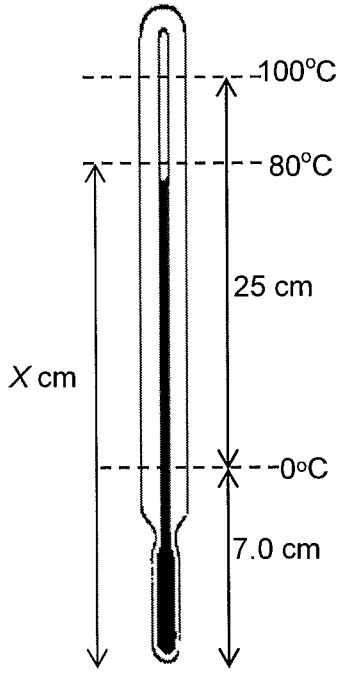
B The balloon will increase in size because the pressure outside the balloon decreases.

C The balloon will decrease in size because the pressure inside the balloon decreases.

D The balloon will decrease in size because the pressure outside the balloon increases.

17 When a thermometer was placed in pure melting ice the mercury thread has a length of 7.0 cm measured from the end of the thermometer bulb,as shown in the diagram.

When placed in steam from water boiling at 100°C the mercury thread increases by a length of 25.0 cm.

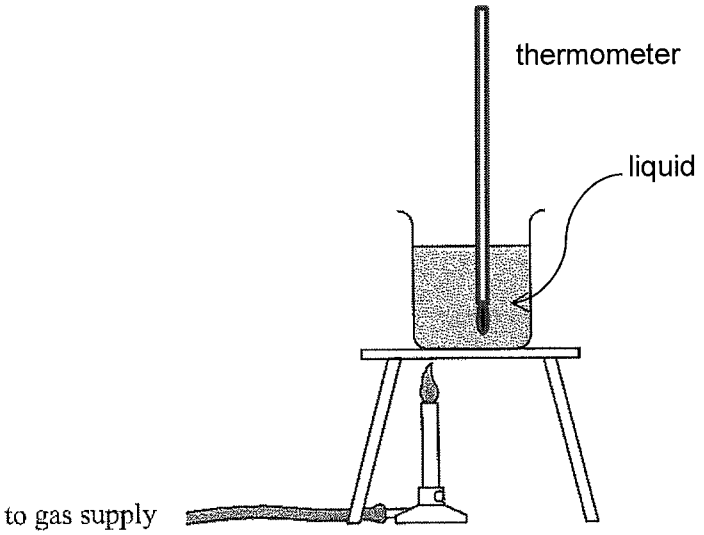


What is the length of the thread X in cm if the thermometer measures 80°C ?

A 20
B 21
C 27
D 28

18 The experimental setup shown is used to determine the specific heat capacities of four different liquids W, X, Y, and Z.

The bunsen burner is switched on for the same period of time for each substance of the same mass.



Neglecting energy loss to the surroundings, which of the following substances has the largest specific heat capacity?

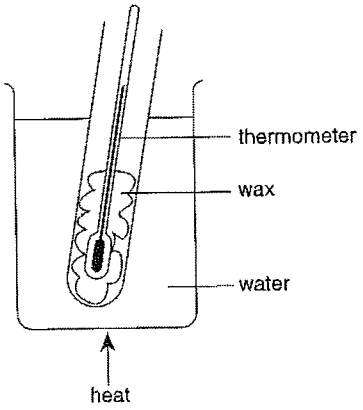
	Liquid	Rise in temperature /°C
A	W	8
B	X	7
C	Y	6
D	Z	5

19 A piece of iron feels colder than a piece of wood when touched.

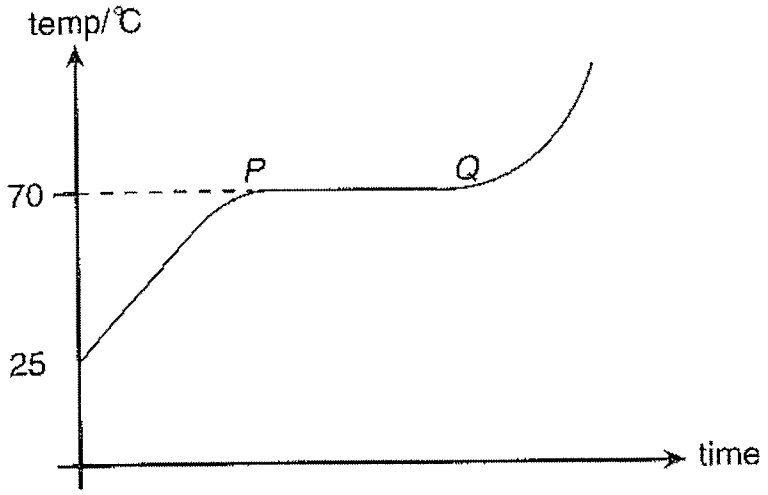
Which of the following statements explains why?

A Iron is a better thermal conductor than wood.
B Iron surface is smoother than wood.
C The temperature of the piece of iron is lower than the wood.
D Wood is a better thermal conductor than iron.

20 A piece of solid wax in a test-tube is heated in a water bath.



A graph of temperature-time graph is plotted.



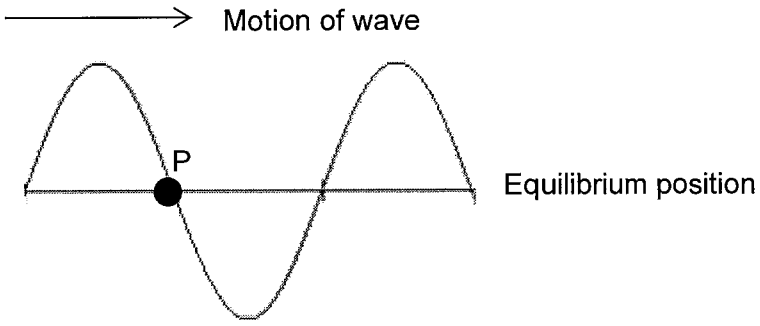
Which of the following statements is correct?

A The boiling point of wax is 70°C.
B Only liquid wax is present between P and Q.
C No thermal energy is absorbed by the wax between in the horizontal section PQ.
D There is an increase in internal energy of the wax in the horizontal section PQ.

21 Which of the following statements about wave motion is **incorrect**?

A Longitudinal waves are characterized by rarefactions and compressions.
B Longitudinal waves can be represented by displacement-distance graphs.
C Transverse wave transmit energy by transferring matter.
D Transverse waves are characterized by crests and troughs.

22 A transverse wave is travelling to the right as shown.

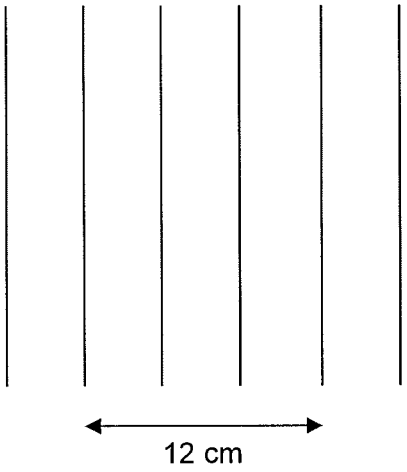


What is the direction of motion of P at this instant?

A momentarily at rest.
B moving downwards.
C moving to the right.
D moving upwards.

23 A ripple tank filled with water is used to study waves.

The diagram shows some wavefronts when viewed from the top.



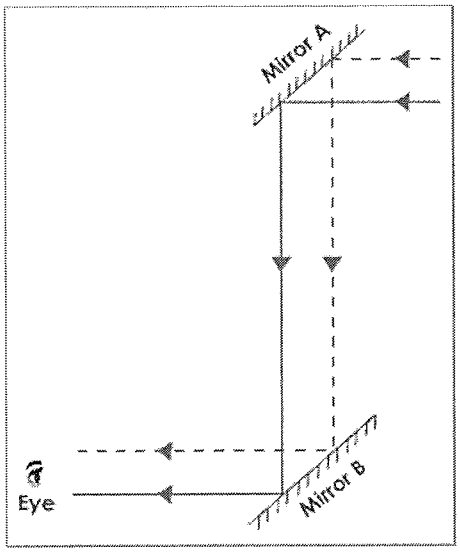
The frequency of the water waves is 20 Hz.

What is the wave speed in m/s?

A 0.20
B 0.40
C 0.80
D 1.20

24 A boy sees an object is through a periscope.

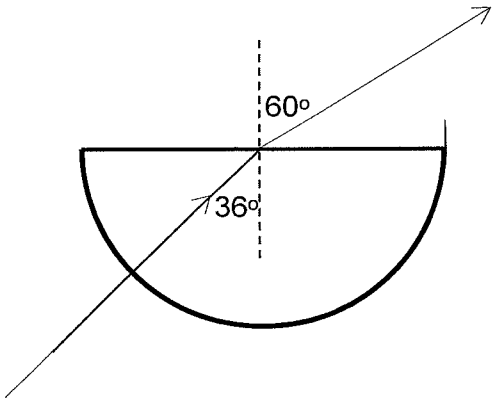
The periscope is made from 2 mirrors as shown in the diagram.



Which of the following statements is correct?

A The image is magnified.
B The image is laterally inverted.
C The image is virtual.
D The image is inverted.

25 A ray of light travelling in air enters a semi-circular glass block.



A student measures the angle of incidence 36° and the corresponding angle of refraction as 60°.

What is the refractive index of the glass block?

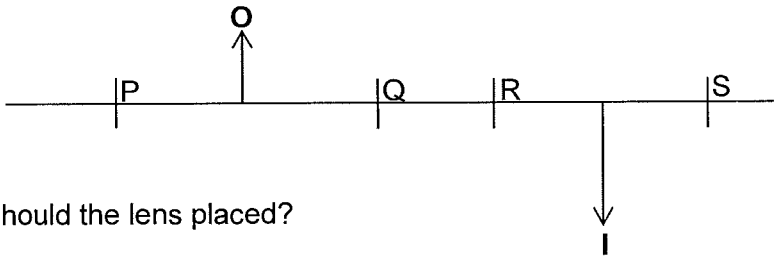
A 0.60
B 0.69
C 1.47
D 1.67

26 An object is placed at a distance between one focal length and two focal lengths from the centre of a converging lens.

Where is the image formed?

A on the opposite side of the object and formed more than two focal length from the lens.
B on the opposite side of the object and formed very close to the lens.
C on the same side as the object and formed more than two focal lengths from the lens.
D on the same side as the object and formed very close to the lens.

27 In the diagram **I** is the image of an object **O** formed by the lens.



Where should the lens placed?

	Position of lens
A	P
B	Q
C	R
D	S

28 Which of the following electromagnetic waves has the longest wavelength?

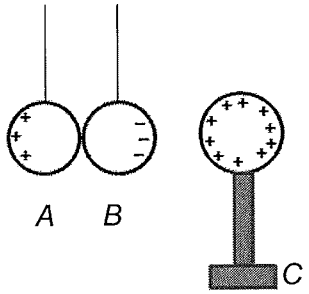
A infra-red radiation
B red light
C ultra-violet radiation
D violet light

29 *A* and *B* are two insulated uncharged metal spheres touching each other and hung on threads.

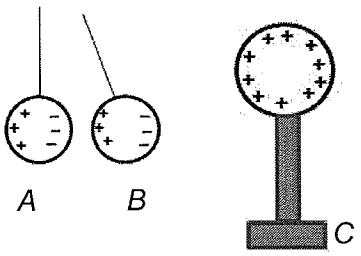
A positively-charged sphere C mounted on a plastic stand is brought near to *B*.

Which of the following diagrams shows the correct distribution of the charges on the spheres?

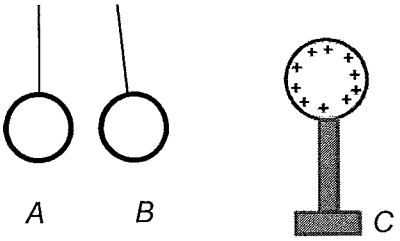
A



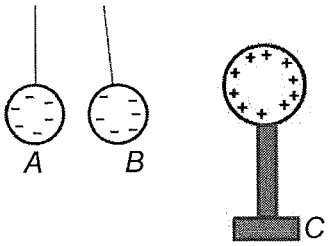
B



C



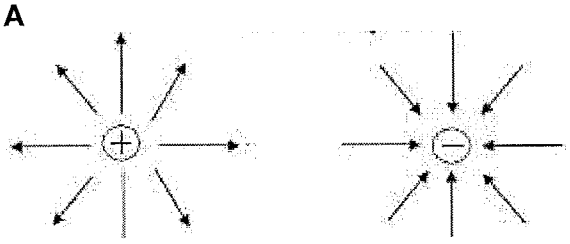
D



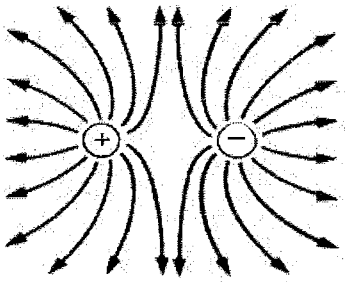
30 Two opposite charged spheres are shown in the diagram.

Which of the following diagrams best represent the resultant electric field between the 2 charged spheres?

A

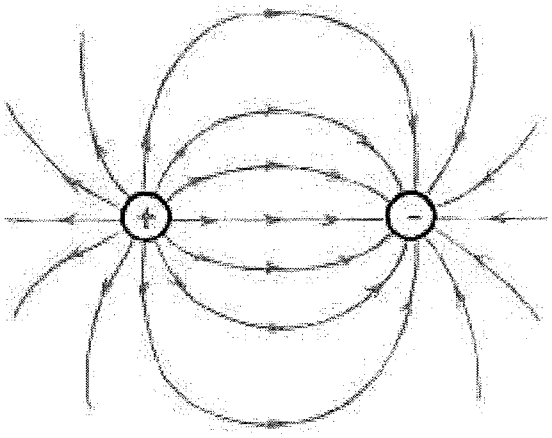


B

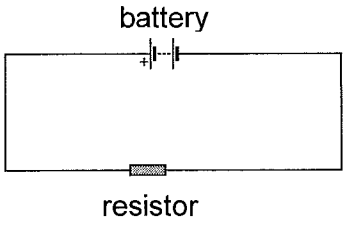


C

D



31 In the circuit 9 J of energy is supplied by a battery when 3 C of charges passes through it.



Which of the following statements is true?

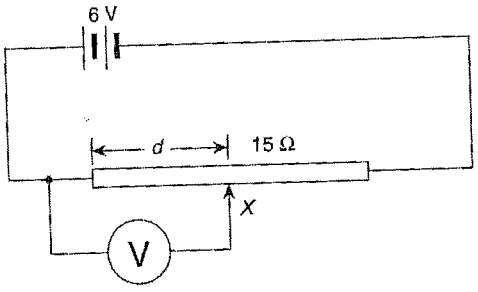
A The electromotive force of the battery is 3 V.
B The electromotive force of the battery is 27 V.
C The current flowing in the circuit is 1 A.
D The resistance in the circuit is 3 Ω.

32 A lamp is rated 100 W, 200 V.

What is the resistance of the lamp and the current drawn during normal operation?

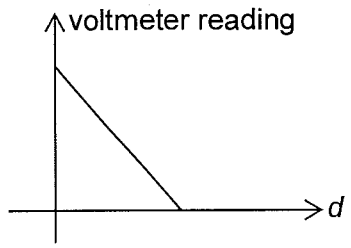
	Resistance / Ω	Current / A
A	2.0	2.0
B	200	0.5
C	200	2.0
D	400	0.5

33 A 6 V battery is connected across a 15 Ω uniform resistance wire as shown in the diagram.

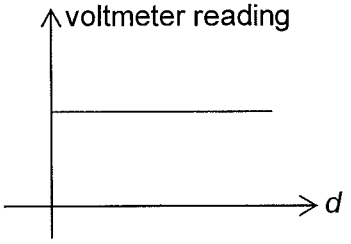


Which of the following graphs best represents the variation of the voltmeter reading with the distance *d*?

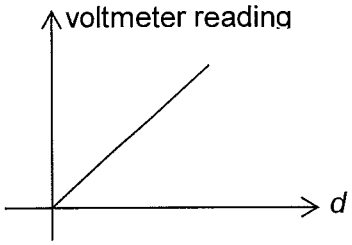
A



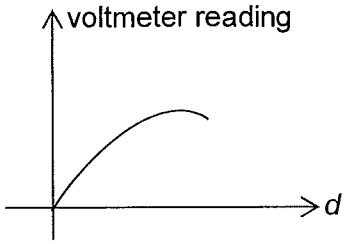
B



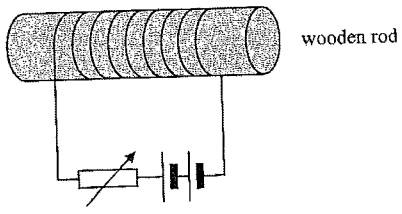
C



D



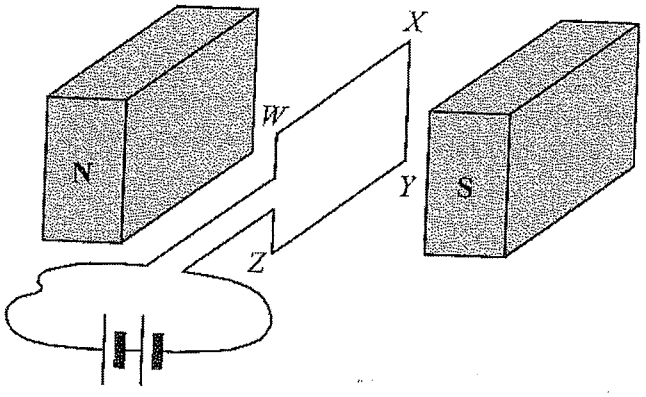
34 The figure shows a circuit with a solenoid wound on a wooden rod.



How can the magnetic field around the solenoid be increased?

A increase the resistance of the rheostat.
B increase the length of the wooden rod.
C increase the voltage of the battery.
D decrease the current in the circuit.

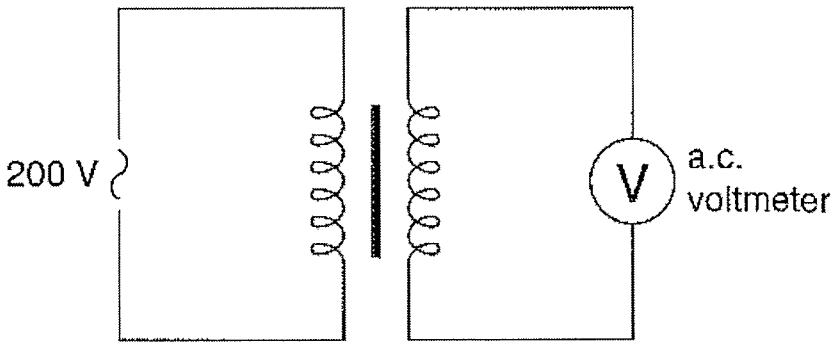
35 The diagram shows the position of the coil after it has rotated through 90° in a magnetic field.



Which of the following statements is true about the coil in this position?

A The part of the wire WX has no force acting on it.
B The part of the wire ZY has no force acting on it.
C There is no moment produced by both the parts of the wire WX and YZ.
D There is no current through the coil.

36 The diagram shows a transformer.

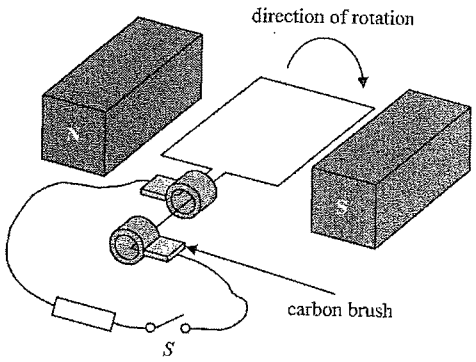


The number of turns in the secondary coil is 100, the primary voltage is 200 V and the voltmeter reads 10 V.

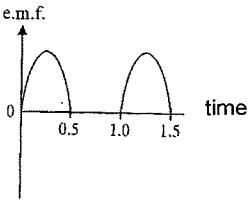
What is the number of turns in the primary coil?

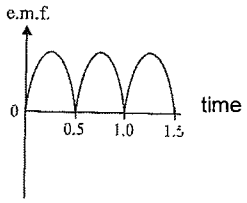
A 2000
B 1000
C 200
D 50

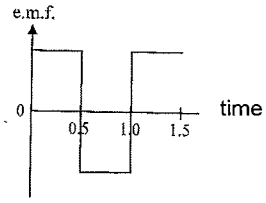
37 The diagram shows a simple generator.

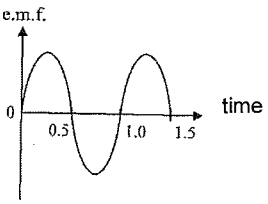


Which of the following shows the variation of the electromotive force (emf) generated with time?

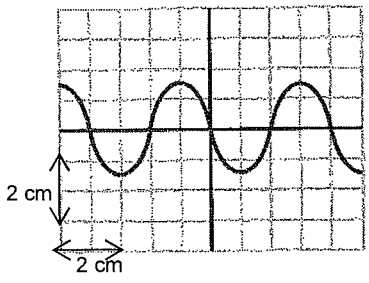
A.


B.


C.


D.


38 An electrical signal is fed into a cathode ray oscilloscope. The diagram shows the waveform displayed on the screen at a particular instant.



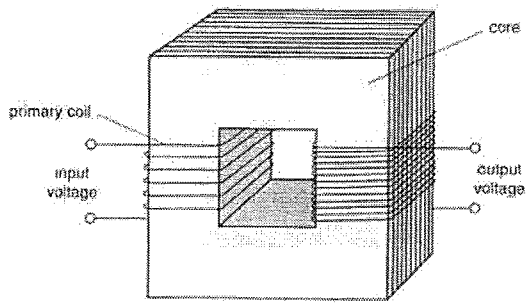
Y-gain control: 4 V cm^{-1}

Time base: 10 ms cm^{-1}

What is the peak voltage and the frequency of the signal?

	peak voltage / V	frequency / Hz
A	1.5	25
B	1.5	40
C	6.0	25
D	6.0	40

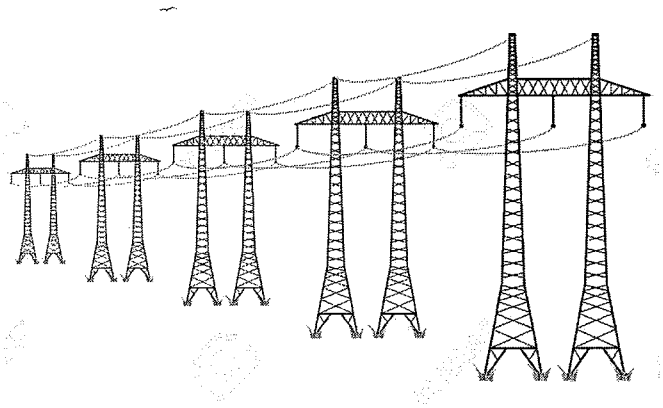
39 The core of a transformer is usually laminated.



What is the purpose of this design?

A improves the circulation of air in the core.
B increases the flux linkage in the coil.
C reduces heat loss in the core.
D reduces heat loss in the coil.

40 Electricity is transmitted at very high voltage over long distance.

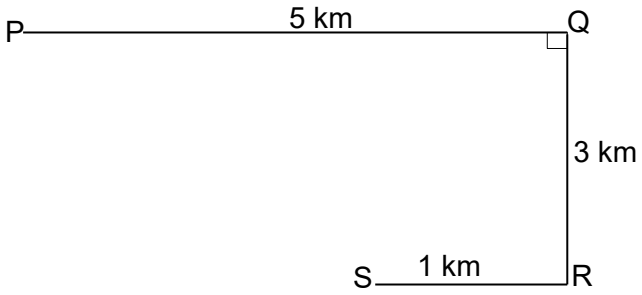


What is the reason for doing this?

A Electricity is transmitted faster along the cables when the voltage is high.
B Less energy is lost in the cables.
C It is safer to transmit electricity when the voltage is high.
D The cables do not require insulation.

End of Paper

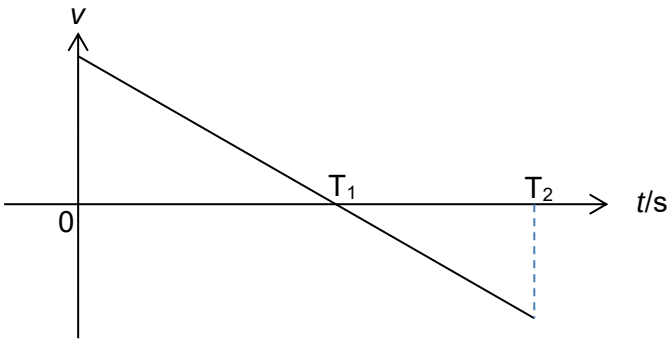
1 The diagram shows the path travelled by a car from P to S.



What is the displacement of the car?

A 5.0 km **B** 6.8 km **C** 8.2 km **D** 9.0 km

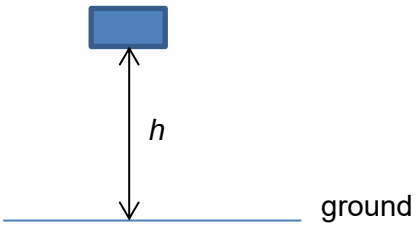
2 The velocity-time graph shown represents the motion of an object from $t = 0$ to $t = T_2$ s



Which of the following describes the motion of the object?

	From 0 to T_1	From T_1 to T_2
A	increasing acceleration	decreasing acceleration
B	uniform acceleration	decreasing acceleration
C	uniform deceleration	uniform deceleration
D	uniform deceleration	uniform acceleration

3 A brick, initially at rest, falls from a height of h and took 2.0 s to reach the ground.



The acceleration of free fall, g = 10 m/s^2.

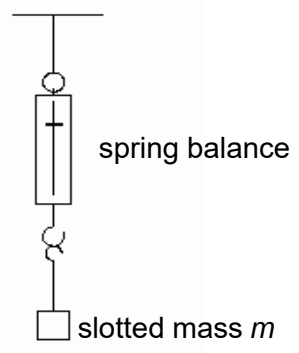
What is the height h of the brick?

A 10 m
B 20 m
C 30 m
D 40 m

4 Which statement about the net force acting on an object is correct?

A A net force is needed to keep an object moving with uniform velocity.
B A net force is needed to keep an object moving with increasing velocity.
C A net force is needed to keep an object moving with constant speed in a straight line
D Net force is zero if the object is slowing down.

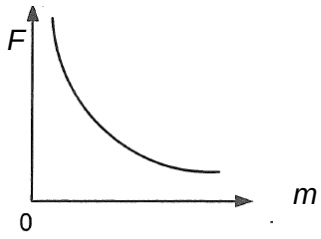
5 Different slotted masses *m* were hung on the end of a spring balance.



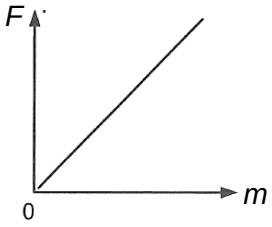
The gravitational force *F* acting on each of the mass was measured using the balance.

Which graph shows the relationship between the gravitational force, *F* and the mass *m*?

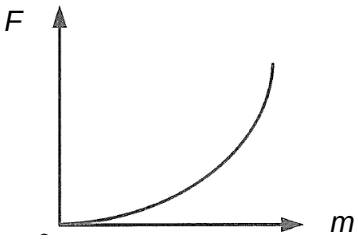
A



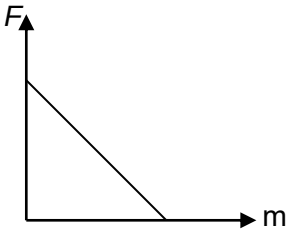
B



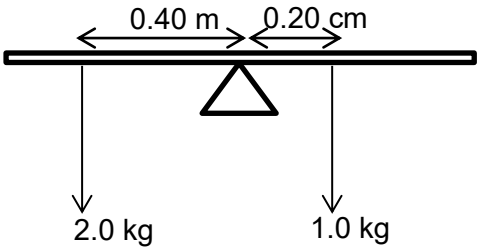
C



D



6 The diagram shows a uniform beam pivoted at the centre.



Two loads 2.0 kg and 1.0 kg are suspended as shown.

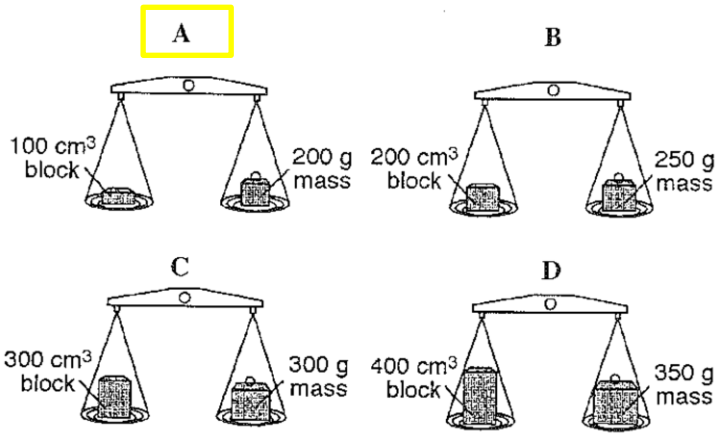
In order to balance the beam, a third load is added to the right of the pivot.

What is the mass of the load and how far from the pivot must it be attached?

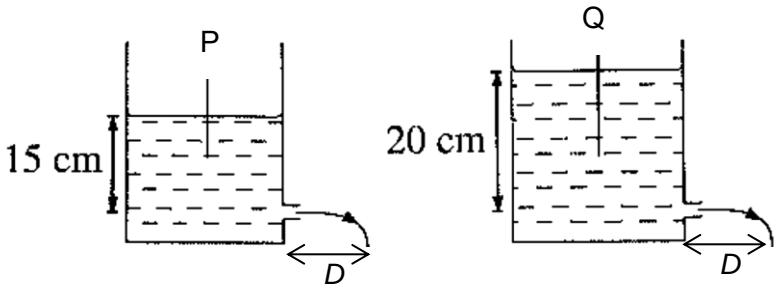
	Load/kg	Distance from pivot /m
A	1	0.40
B	2	0.10
C	2	0.30
D	3	0.10

7 Four blocks, each made from a different material, are placed on scales and balanced as shown in the diagrams.

In which diagram does the block have the greatest density?



8 The diagram shows two identical containers containing liquid P and liquid Q.



Water spurts out the same horizontal distance *D* when the depth of liquid P is 15 cm and the depth of liquid Q is 20 cm,

The density of liquid P is 2.00 g/cm^3.

What is the density of liquid Q in g/cm^3 ?

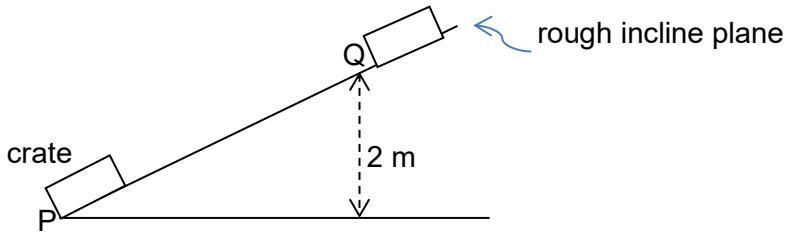
A 0.67 **B** 1.30 **C** 1.50 **D** 2.70

9 Mark holds a bowling ball in a fixed position.

Which statement regarding the work done on the ball is correct?

A The work done depends on the weight of the ball.
B The work done depends on mass of the ball.
C The work done is zero.
D The work done depends on the way he holds the ball.

10 A crate of mass 25 kg is pushed up a rough inclined plane.



The total work done on the crate from P to Q is 1500 J.

The gravitational field strength, g = 10 N/kg.

How much work is done against friction?

A 250 J
B 500 J
C 1000 J
D 2000 J

11 Sam of mass 75kg runs up to the top of a building in 5 minutes.
There are 260 steps, each 0.18 m high.

The gravitational field strength, g = 10 N/kg.

What is Sam's mechanical power?

A 11.7 W
B 65.0 W
C 117 W
D 7020 W

12 Two marbles, A and B are dropped to the ground from the roof of the school.

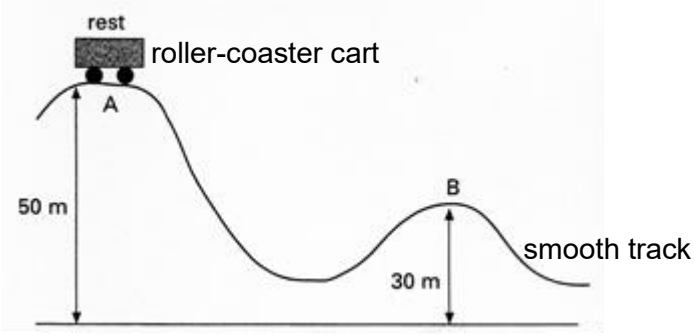
The mass of marble A is 2 times the mass of marble B.

Air resistance can be neglected.

What is the kinetic energy of marble A just before hitting the ground?

A the same kinetic energy as marble B.
B 2 times the kinetic energy of B.
C ½ the kinetic energy of B.
D 4 times the kinetic energy of B.

13 The diagram shows a roller-coaster cart starting from rest at point A and moving down a smooth track to past point B.



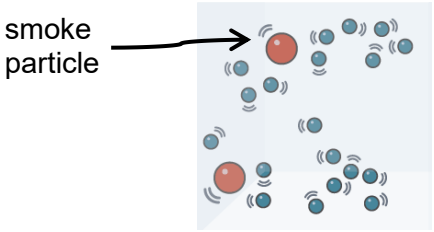
The gravitational field strength, g = 10 N/kg.

What is its speed at point B?

A 10 m/s
B 20 m/s
C 30 m/s
D 40 m/s

14 Illuminated smoke particles, suspended in air, are viewed with a microscope.

They are seen to move randomly.



What does the motion of smoke particles tell us about the molecular movement of air molecules?

A Air molecules are in continuous motion.
B Air molecules moves in clusters.
C Air molecules move just as fast as smoke particles
D Air molecules have the same amount of average kinetic energy at different temperature.

15 Which of the following about internal energy is correct?

A The temperature of a body is a measure of the total internal energy of the body.

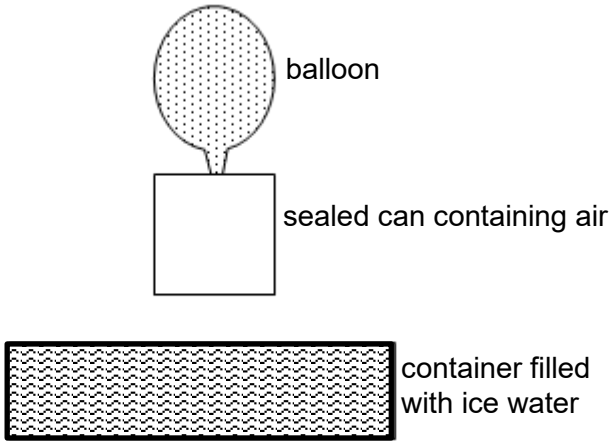
B The internal energy is a measure of the total kinetic and potential energy of the molecules in the body.

C Two bodies at the same temperature always have the same amount of internal energy.

D The internal energy of a body will increase if the temperature decreases.

16 Air was pumped into a balloon. The balloon is then connected to a sealed can.

The can is then placed in a container of ice water as shown in the diagram.



What will happen to the balloon when placed inside the container of ice water?

A The balloon will increase in size because the pressure inside the balloon decreases.

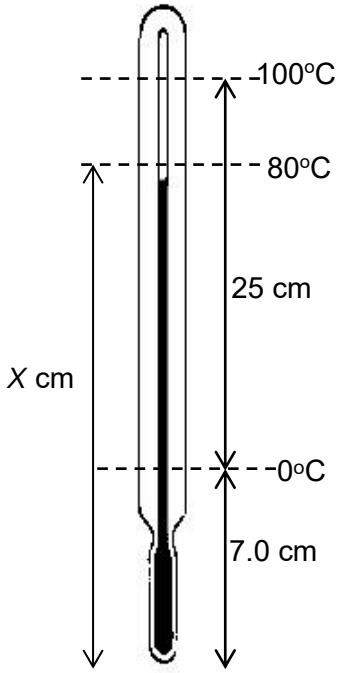
B The balloon will increase in size because the pressure outside the balloon decreases.

C The balloon will decrease in size because the pressure inside the balloon decreases.

D The balloon will decrease in size because the pressure outside the balloon increases.

17 When a thermometer was placed in pure melting ice the mercury thread has a length of 7.0 cm measured from the end of the thermometer bulb,as shown in the diagram.

When placed in steam from water boiling at 100°C the mercury thread increases by a length of 25.0 cm.

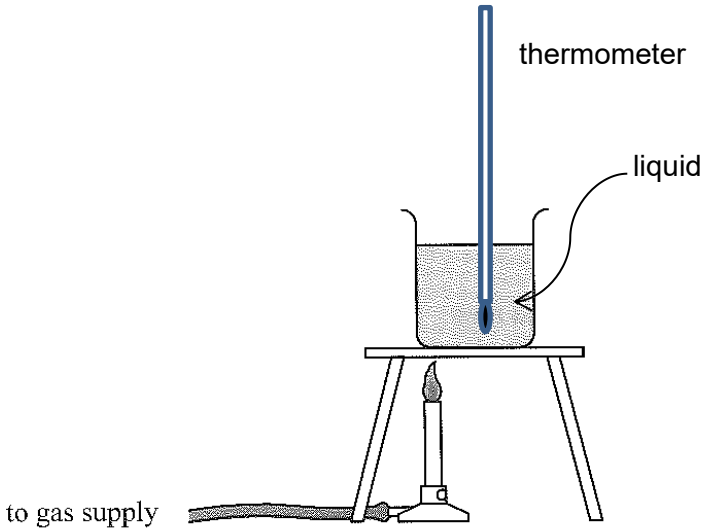


What is the length of the thread X in cm if the thermometer measures 80°C ?

A 20
B 21
C 27
D 28

18 The experimental setup shown is used to determine the specific heat capacities of four different liquids W, X, Y, and Z.

The bunsen burner is switched on for the same period of time for each substance of the same mass.



Neglecting energy loss to the surroundings, which of the following substances has the largest specific heat capacity?

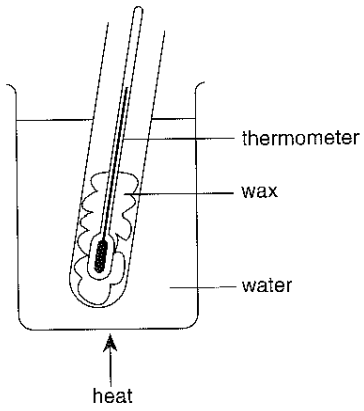
	Liquid	Rise in temperature /^{o}C
A	W	8
B	X	7
C	Y	6
D	Z	5

19 A piece of iron feels colder than a piece of wood when touched.

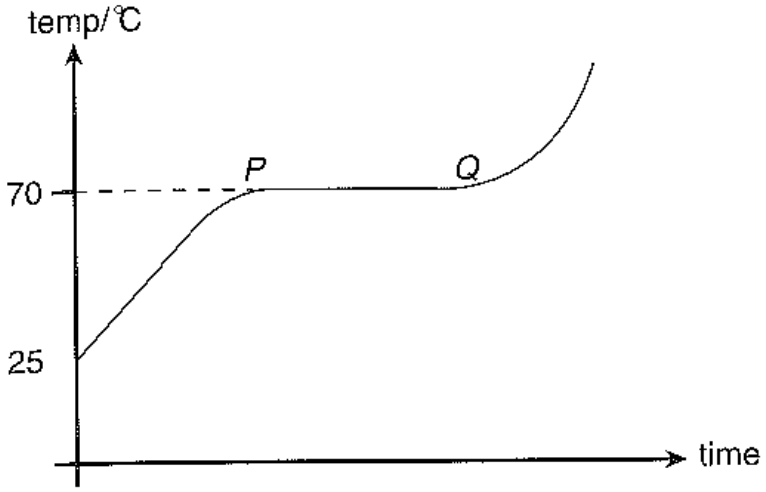
Which of the following statements explains why?

A Iron is a better thermal conductor than wood.
B Iron surface is smoother than wood.
C The temperature of the piece of iron is lower than the wood.
D Wood is a better thermal conductor than iron.

20 A piece of solid wax in a test-tube is heated in a water bath.



A graph of temperature-time graph is plotted.



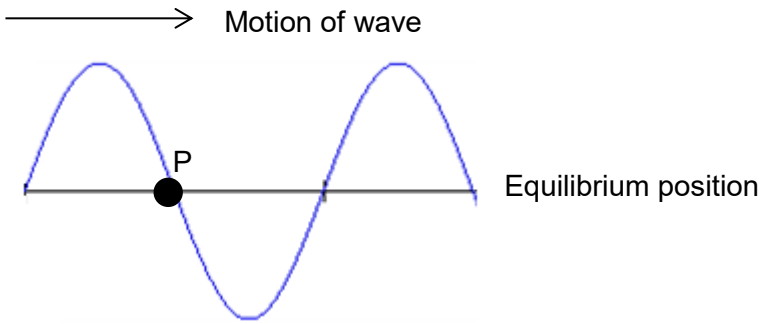
Which of the following statements is correct?

A The boiling point of wax is 70°C.
B Only liquid wax is present between P and Q.
C No thermal energy is absorbed by the wax between in the horizontal section PQ.
D There is an increase in internal energy of the wax in the horizontal section PQ.

21 Which of the following statements about wave motion is **incorrect**?

A Longitudinal waves are characterized by rarefactions and compressions.
B Longitudinal waves can be represented by displacement-distance graphs.
C Transverse wave transmit energy by transferring matter.
D Transverse waves are characterized by crests and troughs.

22 A transverse wave is travelling to the right as shown.

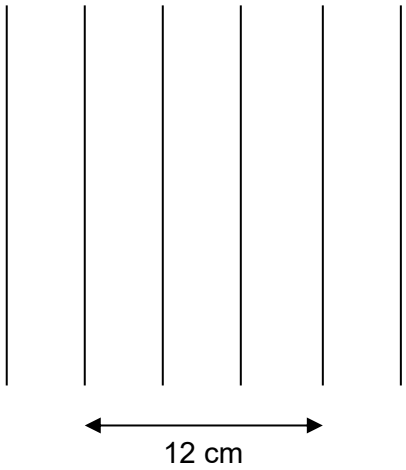


What is the direction of motion of P at this instant?

A momentarily at rest.
B moving downwards.
C moving to the right.
D moving upwards.

23 A ripple tank filled with water is used to study waves.

The diagram shows some wavefronts when viewed from the top.



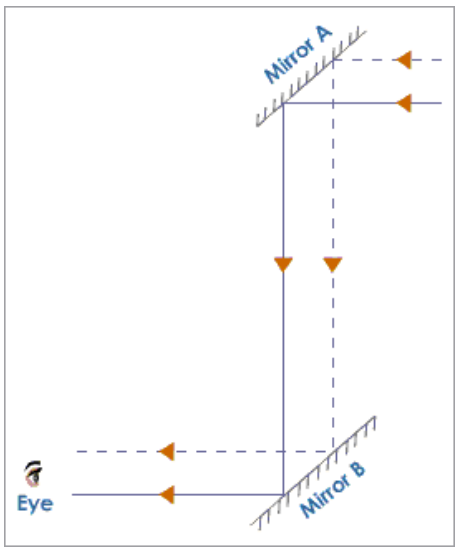
The frequency of the water waves is 20 Hz.

What is the wave speed in m/s?

A 0.20
B 0.40
C 0.80
D 1.20

24 A boy sees an object is through a periscope.

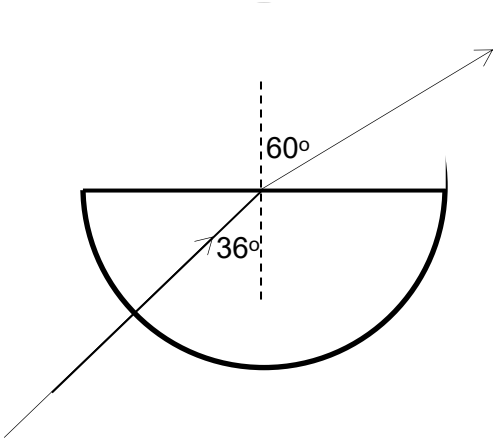
The periscope is made from 2 mirrors as shown in the diagram.



Which of the following statements is correct?

A The image is magnified.
B The image is laterally inverted.
C The image is virtual.
D The image is inverted.

25 A ray of light travelling in air enters a semi-circular glass block.



A student measures the angle of incidence 36° and the corresponding angle of refraction as 60°.

What is the refractive index of the glass block?

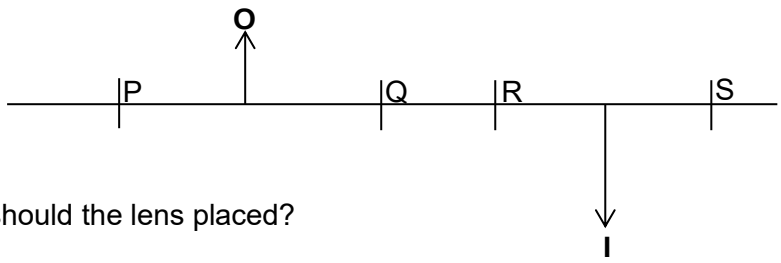
A 0.60
B 0.69
C 1.47
D 1.67

26 An object is placed at a distance between one focal length and two focal lengths from the centre of a converging lens.

Where is the image formed?

A on the opposite side of the object and formed more than two focal length from the lens.
B on the opposite side of the object and formed very close to the lens.
C on the same side as the object and formed more than two focal lengths from the lens.
D on the same side as the object and formed very close to the lens.

27 In the diagram **I** is the image of an object **O** formed by the lens.



Where should the lens placed?

	Position of lens
A	P
B	Q
C	R
D	S

28 Which of the following electromagnetic waves has the longest wavelength?

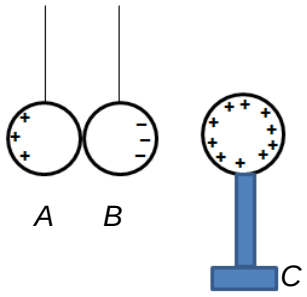
A infra-red radiation
B red light
C ultra-violet radiation
D violet light

29 *A* and *B* are two insulated uncharged metal spheres touching each other and hung on threads.

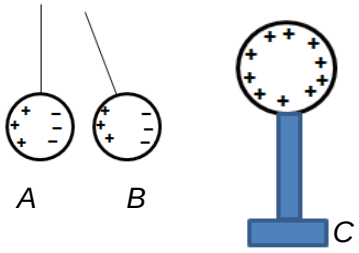
A positively-charged sphere C mounted on a plastic stand is brought near to *B*.

Which of the following diagrams shows the correct distribution of the charges on the spheres?

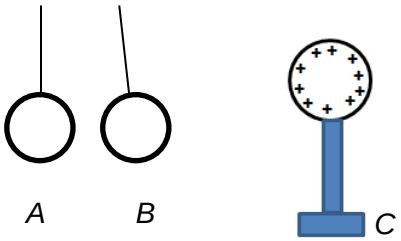
A



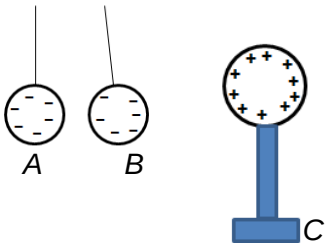
B



C



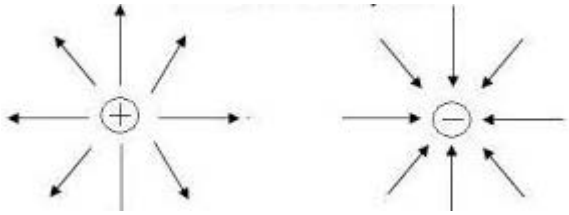
D



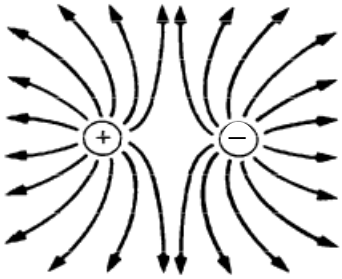
30 Two opposite charged spheres are shown in the diagram.

Which of the following diagrams best represent the resultant electric field between the 2 charged spheres?

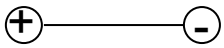
A



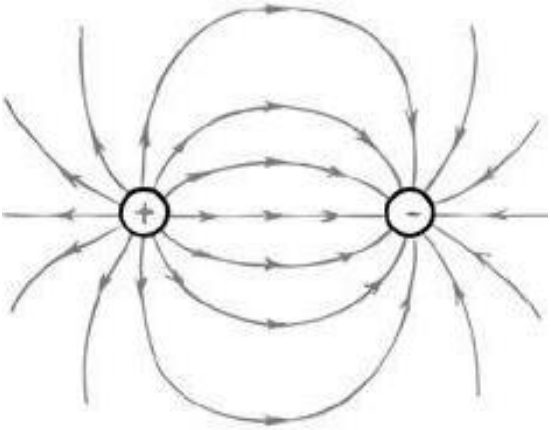
B



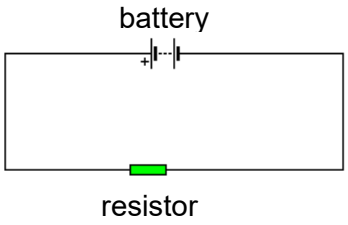
C



D



31 In the circuit 9 J of energy is supplied by a battery when 3 C of charges passes through it.



Which of the following statements is true?

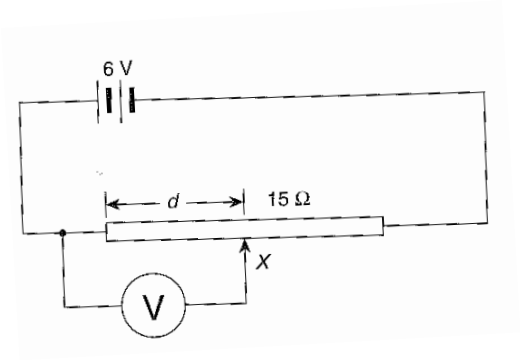
A The electromotive force of the battery is 3 V.
B The electromotive force of the battery is 27 V.
C The current flowing in the circuit is 1 A.
D The resistance in the circuit is 3 Ω.

32 A lamp is rated 100 W, 200 V.

What is the resistance of the lamp and the current drawn during normal operation?

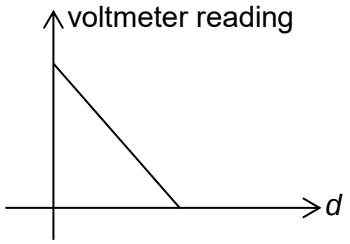
	Resistance / Ω	Current / A
A	2.0	2.0
B	200	0.5
C	200	2.0
D	400	0.5

33 A 6 V battery is connected across a 15 Ω uniform resistance wire as shown in the diagram.

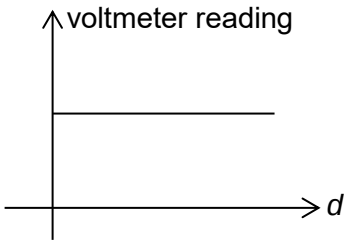


Which of the following graphs best represents the variation of the voltmeter reading with the distance *d*?

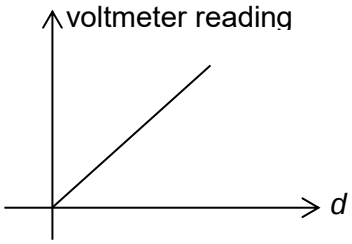
A



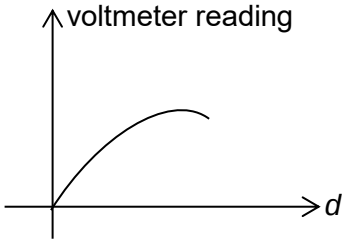
B



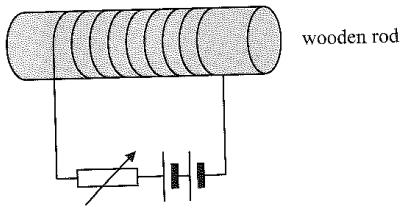
C



D



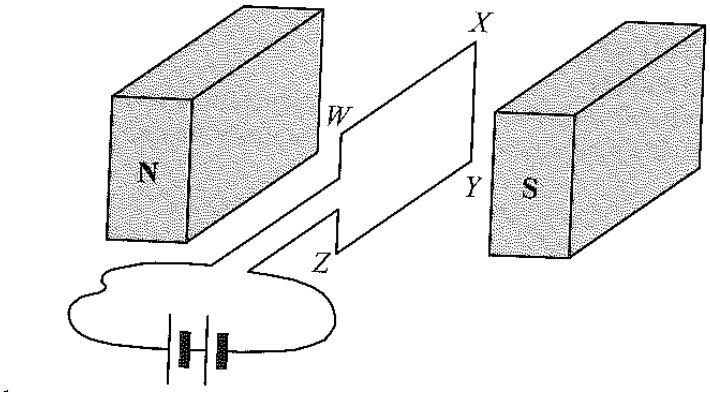
34 The figure shows a circuit with a solenoid wound on a wooden rod.



How can the magnetic field around the solenoid be increased?

A increase the resistance of the rheostat.
B increase the length of the wooden rod.
C increase the voltage of the battery.
D decrease the current in the circuit.

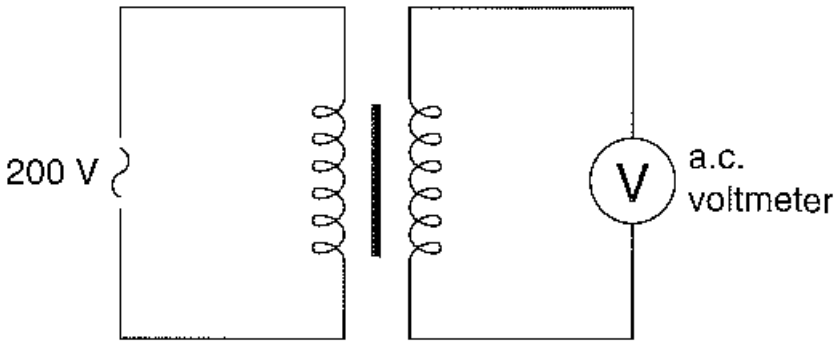
35 The diagram shows the position of the coil after it has rotated through 90° in a magnetic field.



Which of the following statements is true about the coil in this position?

A The part of the wire WX has no force acting on it.
B The part of the wire ZY has no force acting on it.
C There is no moment produced by both the parts of the wire WX and YZ.
D There is no current through the coil.

36 The diagram shows a transformer.

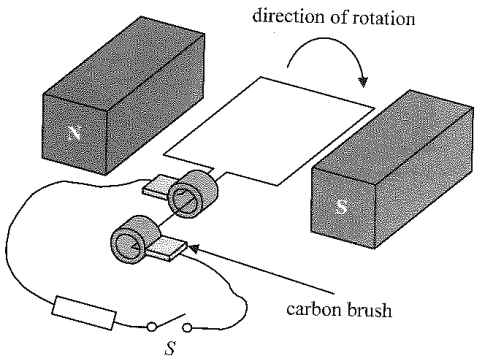


The number of turns in the secondary coil is 100, the primary voltage is 200 V and the voltmeter reads 10 V.

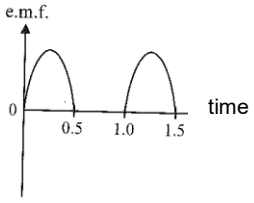
What is the number of turns in the primary coil?

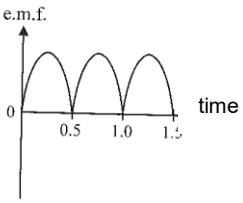
A 2000
B 1000
C 200
D 50

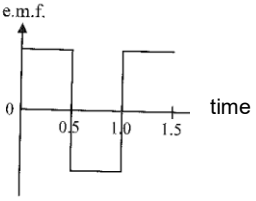
37 The diagram shows a simple generator.

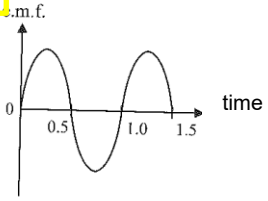


Which of the following shows the variation of the electromotive force (emf) generated with time?

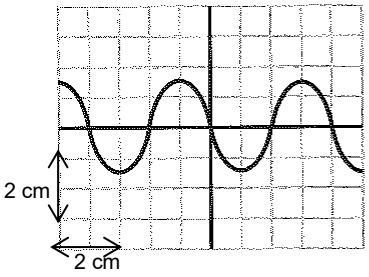
A.


B.


C.


D.


38 An electrical signal is fed into a cathode ray oscilloscope. The diagram shows the waveform displayed on the screen at a particular instant.



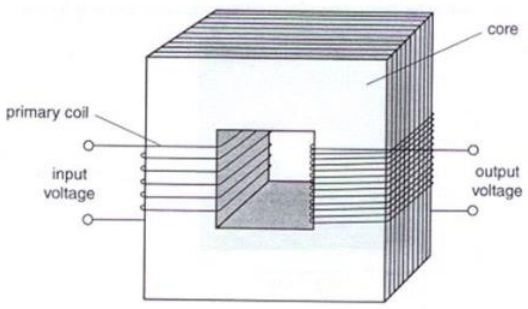
Y-gain control: 4 V cm^{-1}

Time base: 10 ms cm^{-1}

What is the peak voltage and the frequency of the signal?

	peak voltage / V	frequency / Hz
A	1.5	25
B	1.5	40
C	6.0	25
D	6.0	40

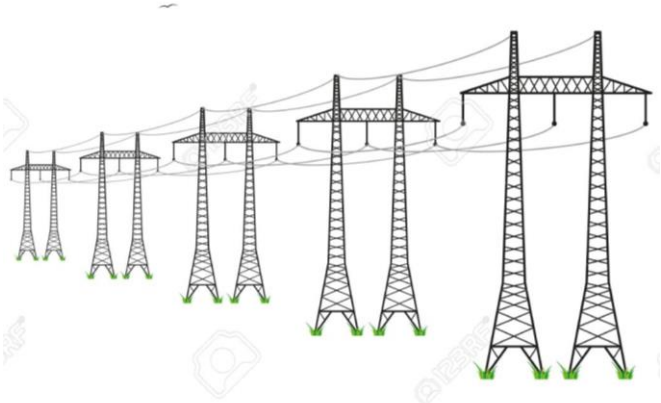
39 The core of a transformer is usually laminated.



What is the purpose of this design?

A improves the circulation of air in the core.
B increases the flux linkage in the coil.
C reduces heat loss in the core.
D reduces heat loss in the coil.

40 Electricity is transmitted at very high voltage over long distance.



What is the reason for doing this?

A Electricity is transmitted faster along the cables when the voltage is high.
B Less energy is lost in the cables.
C It is safer to transmit electricity when the voltage is high.
D The cables do not require insulation.

End of Paper

Section A [50 marks]

Answer **all** the questions in this section in the spaces provided.

1 It was a rainy day and Joanna looks out of her bedroom window. She noticed that drops of water were falling from a crack in the gutter as shown in Fig. 1.1.

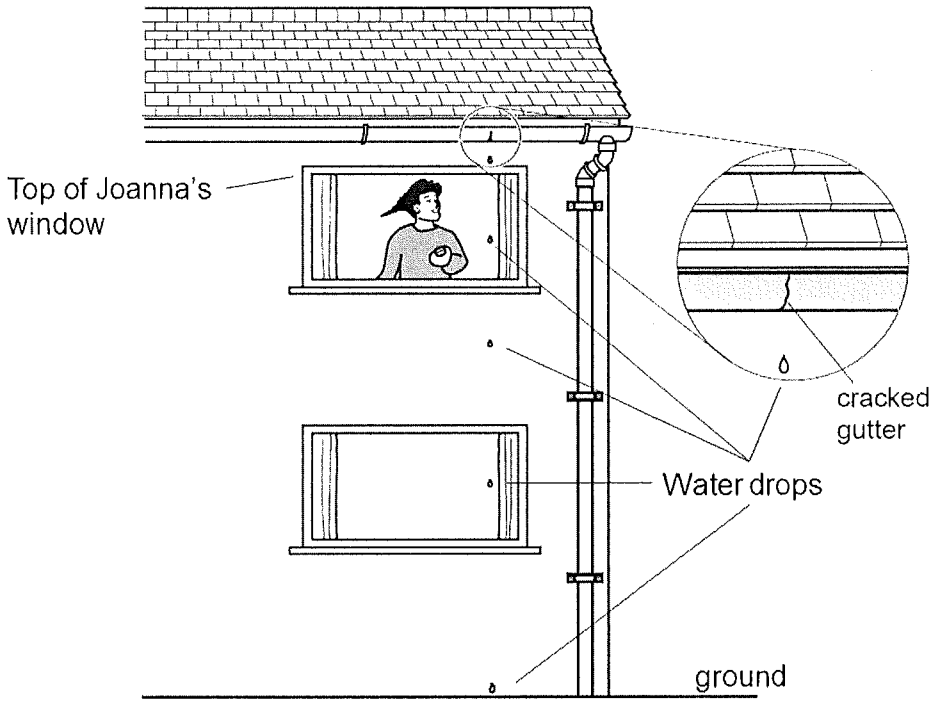


Fig. 1.1

Being a conscientious Physics student, she decided to find the time between one drop and the next.

She started her stopwatch when a drop came into view at the top of her window and count it as "zero". She stopped her stopwatch when the 20th drop came into view.

The reading on the stopwatch was 6.8 s.

(a) (i) Calculate the time interval between one drop and the next.

time = ... s [2]

(ii) Explain how timing 20 intervals instead of 1 interval will improve the accuracy of (a)(i).

.....

.....

.....

.....[1]

(b) Using Fig. 1.1, estimate the time for a drop to fall from the top of Joanna's window to the ground.

time = ... s [2]

(c) Fig. 1.1 shows that the drops get further apart as they fall closer to the ground.

Explain why this happens.

.....

.....

.....

.....[1]

2 A car is travelling on a straight level road. Fig. 2.1 shows two horizontal forces that act on the car. Force *P* is caused by air resistance and friction.

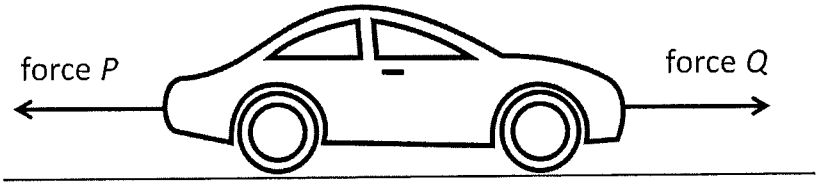


Fig. 2.1

(a) The forward force *Q* and the backward force *P* are equal.

Describe the motion of the car.

.....

.....

.....[1]

(b) The mass of the car is 1000 kg.

Force *Q* increases to 6000 N. This causes the car to accelerate initially at 1.5 m/s^2.

Determine the size of force *P*.

force P = ... [3]

(c) Force *Q* remains constant at 6000 N.

Explain why the acceleration of the car decreases as the car continues along the level road.

.....

.....

.....[2]

3 Fig. 3.1 shows a crane loading containers onto a ship.

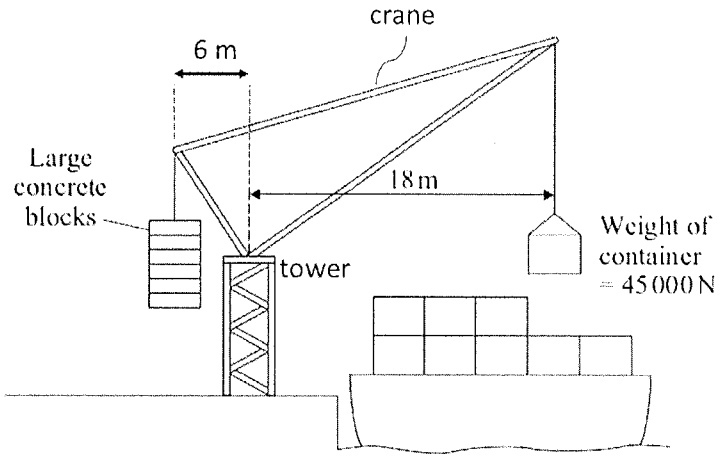


Fig. 3.1

(a) State the meaning of the term "*moment*" of a force. [1]

.....

.....

(b) Calculate the moment of the container about the tower shown in Fig. 3.1.

moment of container = ... [1]

(c) The large concrete blocks are meant to counterbalance the effect of the container. Determine the weight of the concrete blocks.

weight of concrete blocks = ... [2]

(d) The weight of the crane is 10500 N and it sits on the tower.
Calculate the normal force exerted by the tower on the crane.

normal force = ... [2]

4 (a) Fig. 4.1 shows a paper cup in which hot tea is served at a fast-food outlet. The paper cup is constructed from two layers of cardboard as shown in Fig. 4.2.

Paper cup

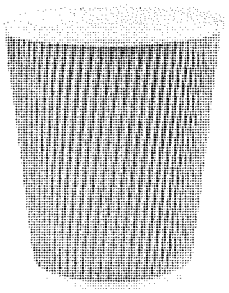
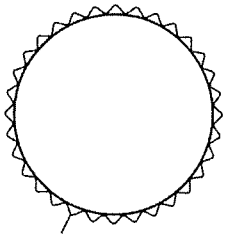


Fig. 4.1

Cross-section view of paper cup



Layer of corrugated cardboard glued onto a layer of cardboard, with air trapped between them

Fig. 4.2

It is covered with a thin plastic lid.

(i) State two ways in which thermal energy loss may be reduced by the lid.

1. .....

2. ..... [2]

(ii) State two reasons why the layer of corrugated cardboard enables a person to hold the cup with her fingers even though the tea inside the cup is at a high temperature.

1. .....

.....

2. .....

..... [2]

(b) (i) State the meaning of the term *heat capacity.*

.....

.....

.....[1]

(ii) At another fast-food outlet, tea may be served in 2 types of clay mugs. The 2 types of mugs have the same dimensions but have different heat capacities as they are made from different types of clay.

When hot tea is poured into either one of the 2 types of mugs, the temperature of the tea always drop due to absorption of some thermal energy by the mugs.

If type A mug has a higher heat capacity than type B, state and explain which mug causes the least drop in temperature of the hot tea.

mug: .....

explanation: .....

..... [2]

5 A stretched string is vibrating between two fixed ends. Fig. 5.1 shows how the string is vibrating.

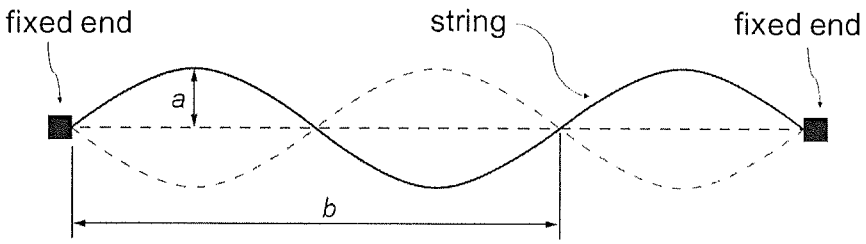


Fig. 5.1

(a) State the name of the quantity *a* and *b* labelled in Fig. 5.1.

a: ..... [1]

b: ..... [1]

(b) The string causes sound to be transmitted through the air.

(i) Describe how the string causes the sound.

.....

.....

.....

.....[2]

(ii) State what happens to the sound as the quantity, *a* decreases.

.....

.....[1]

(i) Describe and explain:

the movement of charges (if any) between the conducting sphere and the aluminium ball.

.....

.....

.....

.....[2]

(ii) Draw on Fig. 7.3 the final position of the aluminium ball and label it as d(ii). [1]

8 Fig. 8.1 shows a type of electric door lock.

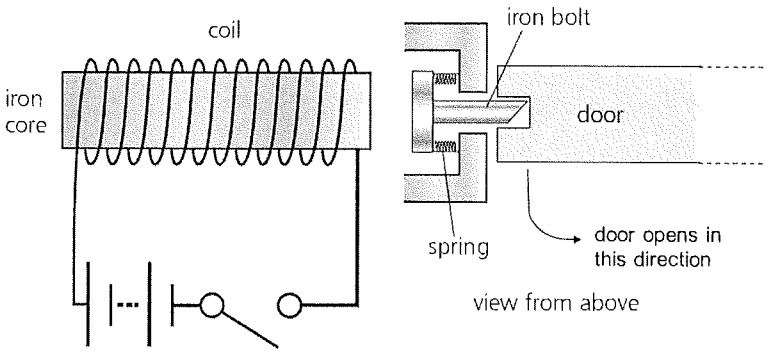


Fig. 8.1

The lock is closed when the position of the iron bolt is as shown in Fig. 8.1.

(a) Explain how closing the switch in the circuit allows the door to be opened.

.....

.....

.....[2]

(b) The door's iron bolt is changed, and a thicker, stronger piece of iron is used. When the switch is closed, the lock remains closed.

Without changing the bolt, suggest and explain two changes that could be made, each of which would open the lock.

Change number 1 and explanation:

.....

.....

..... [2]

Change number 2 and explanation:

.....

.....

..... [2]

6 Fig. 6.1 shows components in the electromagnetic spectrum.

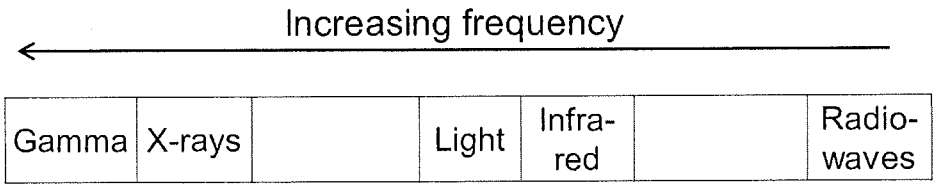


Fig. 6.1

Two components are missing from Fig. 6.1.

(a) Complete Fig. 6.1 by adding the names of these missing components. [1]

(b) State one property, other than speed, that all electromagnetic waves have in common.

.....

.....[1]

7 Fig. 7.1 shows a conducting sphere that has been given excess positive charges. The sphere is mounted on an insulating stand.

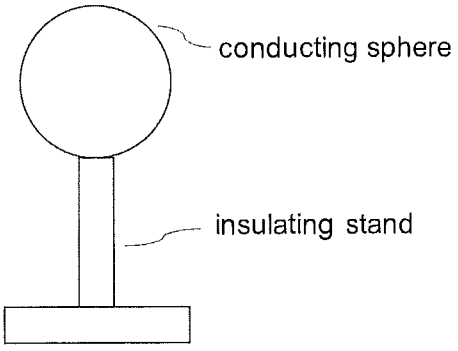


Fig. 7.1

(a) Draw in Fig. 7.1 the distribution of the excess charges on the conducting sphere. [1]

(b) Draw in Fig. 7.1 the electric lines of force produced by these excess charges. [1]

(c) An electrically neutral aluminium ball suspended from a nylon string is brought near to the conducting sphere. It is attracted towards the conducting sphere but NOT touching the sphere as shown in Fig. 7.2.

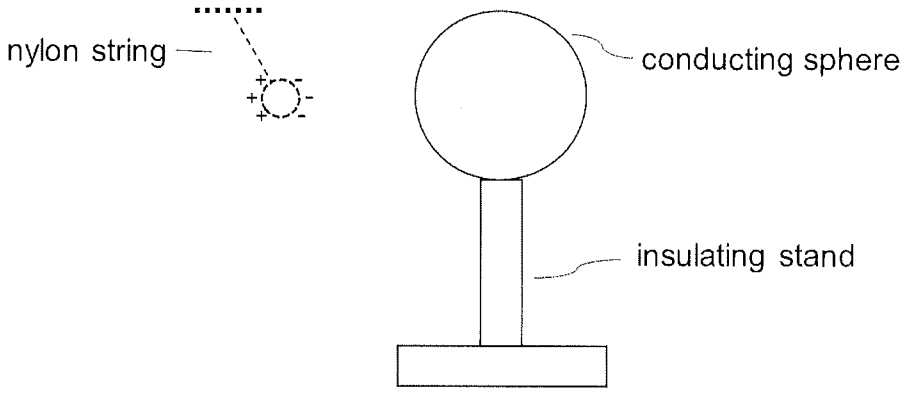


Fig. 7.2

Charges are induced on the aluminium ball as shown in Fig.7.2.

Explain, in terms of electric forces, why the aluminium ball is attracted towards the positively charged conducting sphere.

.....

.....

.....

.....

.....[2]

(d) The aluminium ball is moved to the right such that it is allowed to touch the conducting sphere as shown in Fig. 7.3.

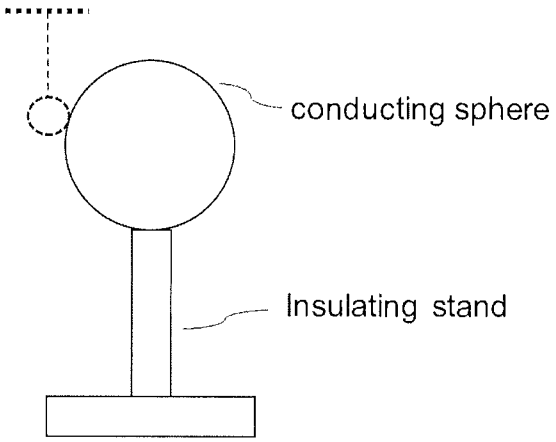


Fig. 7.3

9 Fig.9.1 shows a bar magnet on a wooden turntable which is rotated by an electric motor at a constant speed so that the ends of the magnet rotates pass the end, *P*, of a solenoid which is connected to a centre-zero galvanometer.

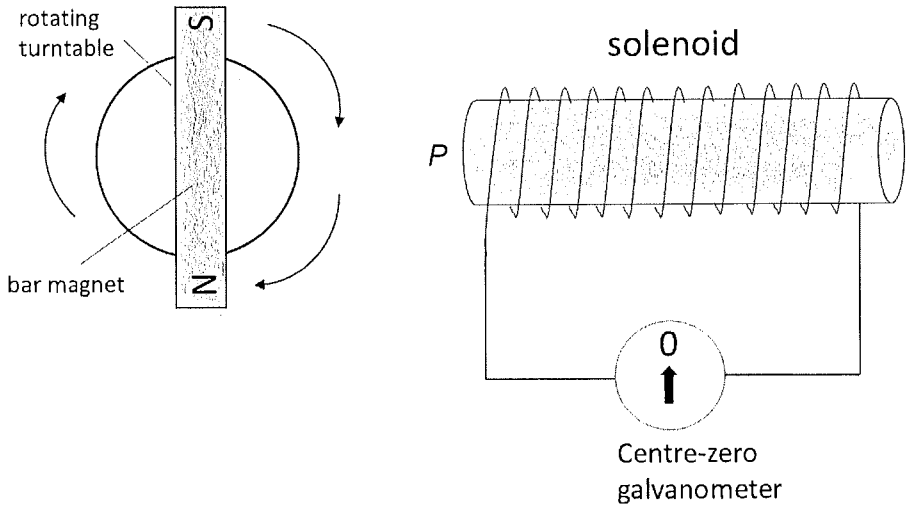


Fig. 9.1

(a) Describe the movement of the pointer of the galvanometer when the S-pole of the magnet rotates pass *P* of the solenoid.

.....

.....

..... [2]

(b) Describe the movement of the pointer of the galvanometer when the N-pole of the magnet rotates pass *P* of the solenoid.

.....

.....

..... [1]

(c) On the axes shown in Fig. 9.2, sketch the graph to show how the voltage reading shown on the galvanometer varies with time for a *complete rotation* of the turntable. [2]

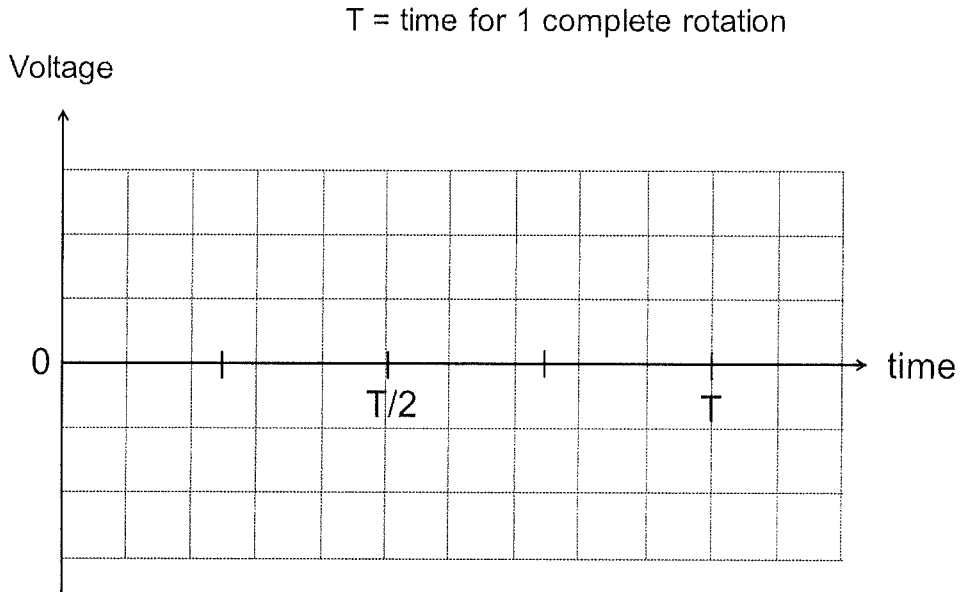


Fig. 9.2

Class | Index Number

Name : _____

Section B (30 marks)

Answer **all** the questions in this section in the spaces provided. Answer only one of the two alternative questions in Question 12.

10 Ultrasound waves are high frequency sound waves that can pass through the human body to produce medical images.

When ultrasound waves are directed at human skin, most of the waves are reflected. In fact, ultrasound waves are reflected at the boundaries of organs.

When a material known as 'coupling agent' is placed on the skin, most of the ultrasound waves is able to pass through the skin and into the body. The coupling agent used is usually a gel. Water is a good coupling agent. However, water is not used as it will run off the surface of the skin.

(a) A scientist tests different coupling agents in an experiment.

Fig 10.1 shows a coupling agent being tested.

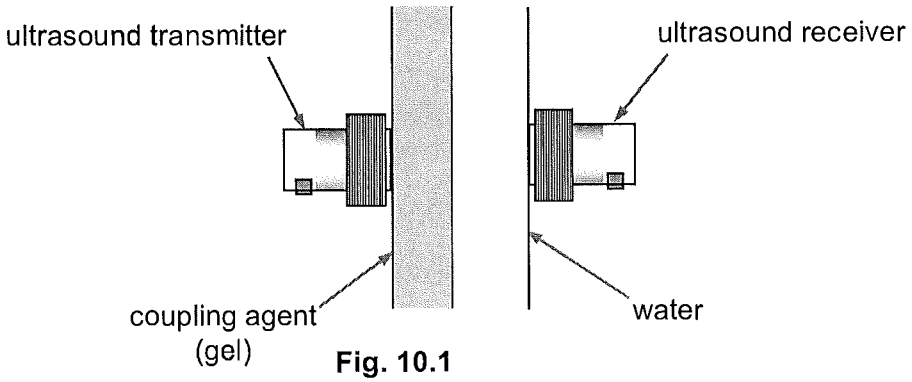


Fig. 10.1

The width of the coupling agent and the layer of water is kept constant by the scientist during the experiment.

The table in Fig. 10.2 shows the results for coupling agents A, B, C, D, E, F and G. They were tested using ultrasound of two different frequencies, 1.1 MHz and 3.0 MHz. The results show how well the waves pass through the coupling agent compared with how they pass through water.

The results are shown as a percentage. 100% means that the coupling agent behaves the same as water.

coupling agent	coupling agent percentage using 1.1 MHz / %	coupling agent percentage using 3.0 MHz / %
A	108	100
B	105	100
C	104	98
D	100	98
E	98	90
F	89	89
G	88	92

Fig. 10.2

(i) State which coupling agent allows the most ultrasound to pass through at both frequencies.

[1]

.....

(ii) State which coupling agent perform the poorest in allowing ultrasound to pass through.

.....

[1]

.....

Fig. 10.3 shows an ultrasound device sending ultrasound waves into a patient's body.

The waves enter the skin and body tissue and move towards a kidney. The body tissue is mainly made of water.

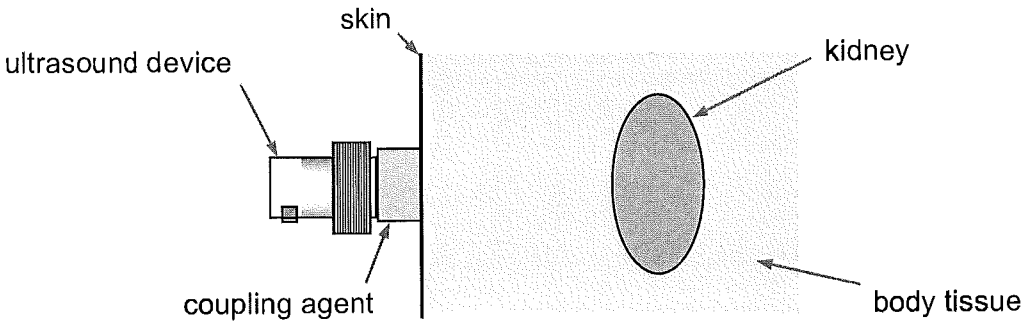


Fig. 10.3

The ultrasound device also detects ultrasound waves and is connected to an oscilloscope.

Fig. 10.4 shows the trace on the screen of the oscilloscope. The intensity of the ultrasound waves is measured in terms of voltage, μV.

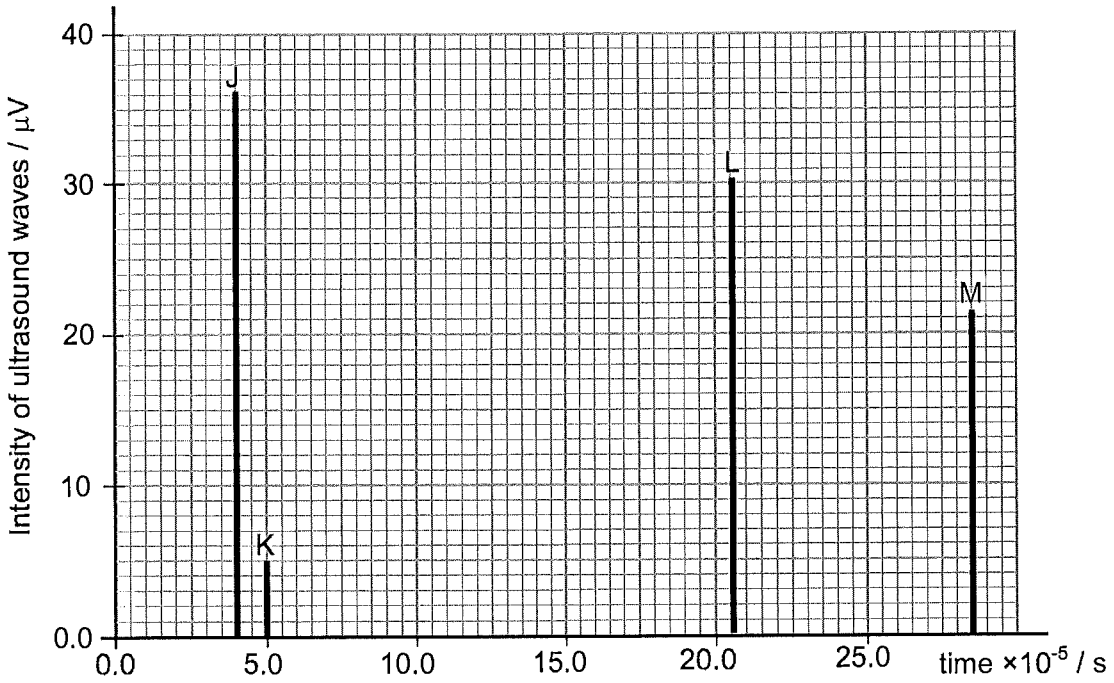


Fig. 10.4

J represents the intensity of the waves emitted by the ultrasound device.

(b) From Fig. 10.3 and the information in Fig. 10.4, explain the presence and intensity of

(i) K

.....

.....

[2]

.....

(ii) L

.....

.....

[1]

.....

(iii) M

.....

.....

[2]

.....

(c) The speed of ultrasound waves in the body is 1500 m/s.

Use the information from Fig. 10.4 to calculate the maximum width of the kidney.

maximum width = ... [3]

11 (a) Fig 11.1 shows a piston supported by some gas trapped in a cylinder.

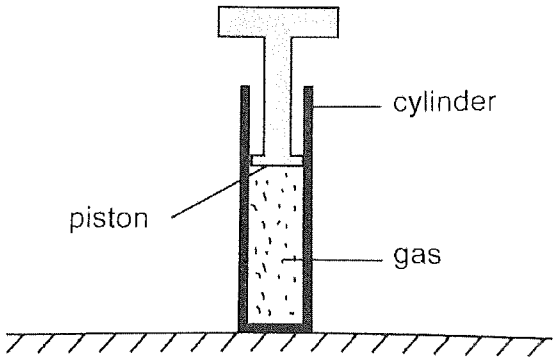


Fig 11.1

(i) Define pressure.

.....

.....[1]

(ii) The cross sectional area of the piston is 4.0×10^{-4} m^2. The pressure of the gas inside the cylinder is 1.5×10^5 Pa. Atmospheric pressure is 1.0×10^5 Pa. The gravitational field strength g is 10 N/kg.

Determine the mass of the piston.

mass = ...[3]

(b) Fig 11.2 shows air in another cylinder at room temperature. The piston is free to move in and out of the cylinder.

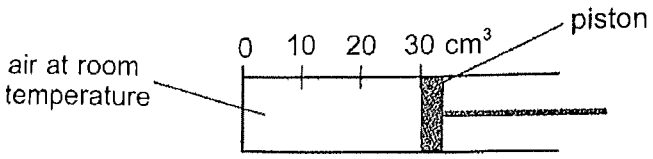


Fig 11.2

The cylinder is placed in a very cold freezer. The piston is observed to move inwards and comes to rest as shown in Fig 11.3.

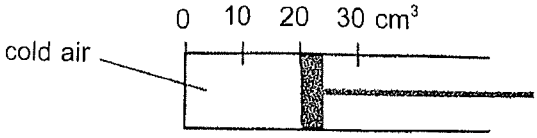


Fig 11.3

(i) The pressure of air in the cylinder in Fig 11.2 is the same as the pressure of the air in the cylinder in Fig 11.3.

I. Explain in terms of the movement of particles, how the air in the cylinder exerts a pressure.

.....

.....

.....

..... [2]

II. Explain why the pressure of the air in the cylinder remains unchanged in both instances in Fig 11.2 and Fig 11.3.

.....

.....

.....

..... [2]

(ii) Explain what causes the piston to move inwards as the cylinder is cooled when placed in a freezer.

.....

.....

.....[2]

EITHER

12 (a) Fig. 12.1 shows a circuit with an ammeter reading of 0.50 A.

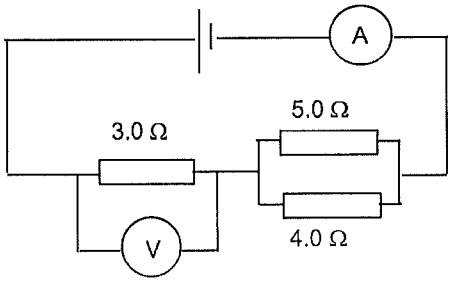


Fig 12.1

(i) Calculate the total resistance of the circuit.

total resistance = ... [3]

(ii) Determine the reading of the voltmeter.

voltmeter reading = ... [2]

(b) Fig 12.2 shows a graph of potential difference against current of two resistance wires A and B.

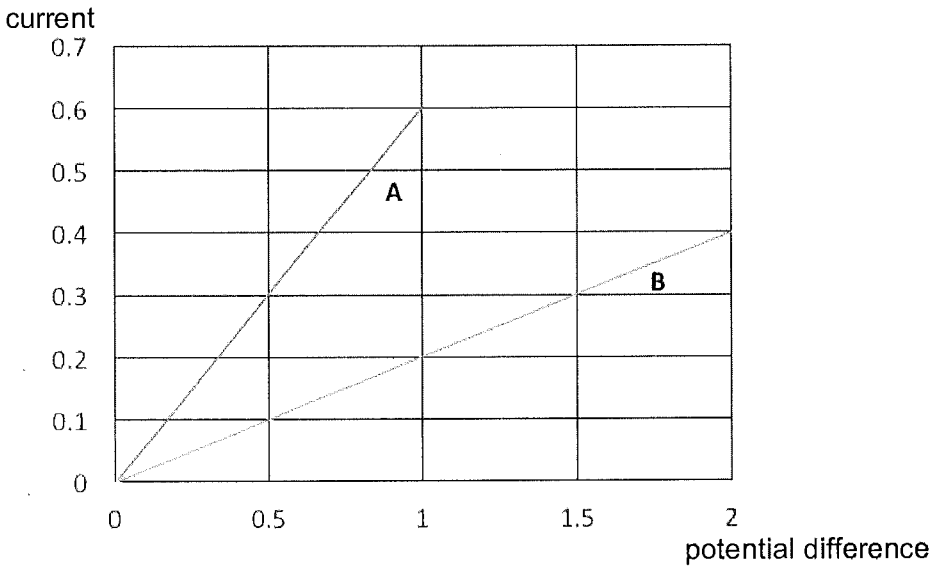


Fig 12.2

(i) Define the term "electrical resistance" of a resistance wire.

.....

.....[1]

(ii) From the graph in Fig 12.2, state and explain which resistance wire has a higher electrical resistance.

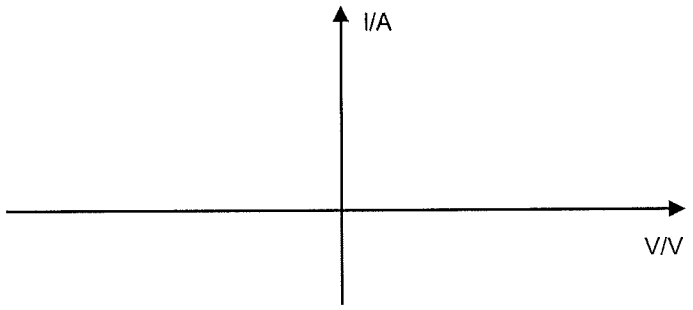
.....

.....

.....[2]

(c) A semi-conductor diode is a non-ohmic conductor that allows current to flow in one direction only.

In Fig 12.3, sketch the graph of a semi-conductor diode.



[2]

Fig 12.3

OR

(a) Fig 12.3 shows a typical marking for electrical appliances, usually located on the casing.

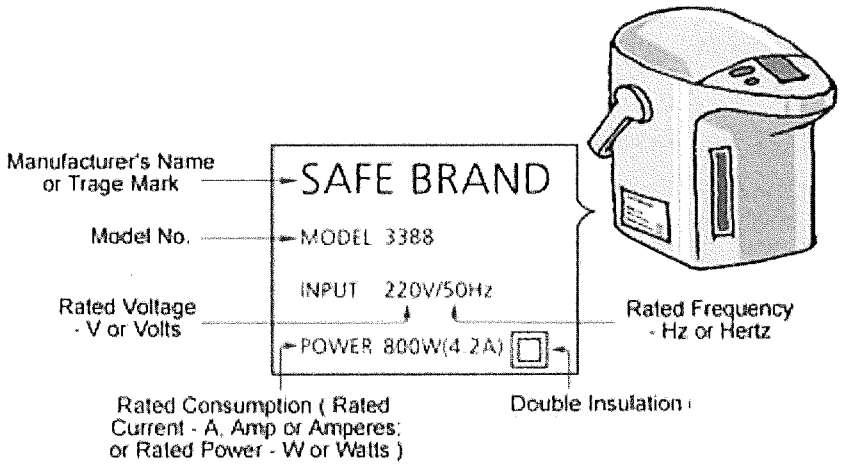


Fig 12.3

(i) State and explain why it is safer to use a 3-pin plug instead of a 2-pin plug.

.....

.....[2]

(ii) An electrical appliance using a 2-pin plug is usually double insulated. State the meaning of the term "double insulated" and explain its purpose in terms of electrical safety.

.....

.....[2]

(iii) "An electrical appliance of rated voltage less than 200 V must not be connected directly to the 230 V a.c. household power supply."

Explain the warning in terms of power.

.....

.....[1]

(b) A lamp with a rating of "230 V, 500 W" is plugged into a socket of a household unit. The voltage of the mains supply is 230 V. The cost of electrical energy is $0.90 per kWh.

(i) Determine and explain the most suitable fuse rating for this lamp from the following list: 1 A, 5 A & 13 A.

.....

.....

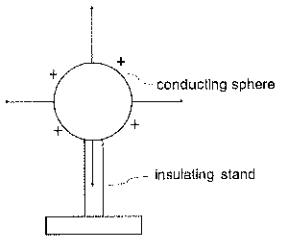
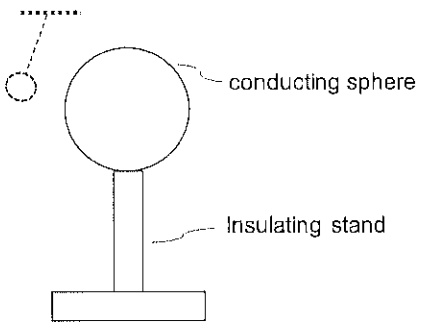
.....[3]

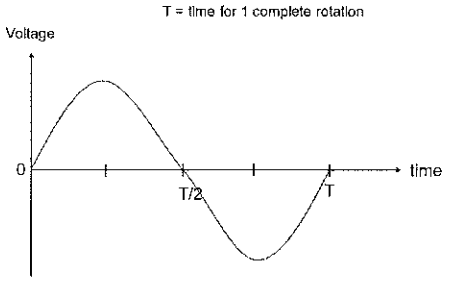
(ii) Calculate the cost of using this lamp for 3 hours.

cost = ...[2]

End of Paper

		Physics Answers – Paper 2A Prelims 2016	
1	a(i)	6.8s/20	C1
		0.34 s	A1
	(ii)	Reduce error due to human reaction time. [more accurate not accepted as it is already stated in the question]	B1
	b	4 × (a) OR (4 and a bit) × (a) OR 5 × (a) ecf 1.36s 1.36 s < any value < 1.70 s 1.70s	C1
		1.36 – 1.70 (s)	A1
	c	drops accelerate/fall faster / increase speed / distance increase per unit time	B1
		due to gravitational force acting on drop	
2	a	Moves with constant / uniform velocity / speed	B1
	b	Resultant force, F = ma	C1
		= 1000 x 1.5	
		= 1500 N	
		F = Q - P	B1
		1500 (ecf) = 6000 - P	
		P = 6000 – 1500	
		= 4500 N	A1
	c	Air resistance increases as the car's velocity increases.	B1
		Resultant force decreases.	B1
3	a	Moment = turning effect of force about a fixed point/pivot OR Formula: F x perpendicular distance	B1
	b	Moment = 45000 x 18 = 8.1×10^5 Nm (81000 Nm)	B1
	c	Taking moments about the tower: Anticlockwise moments = clockwise moments W x 6 = 81000 where W = weight of concrete blocks W = 1.35×10^5 N (13500 N)	B1 A1
	d	normal force exerted by tower on crane = downward force on tower normal force = 45000 + 13500 + 10500 = 6.90×10^4 N	B1 A1
4	a (i)	Radiation, convection, evaporation - any 2	B1, B1
	(ii)	Cardboard is a poor conductor or good insulator Air is a poor conductor or good insulator Reduced surface area in contact with fingers ANY 2	B1 B1
	b(i)	Heat or thermal energy to raise or lower or change temperature of a **body** OR heat or energy to heat up a **body** by 1 C or by 1K or by unit temperature. **Substance** not accepted	B1
	(ii)	Mug with low thermal / heat capacity. less heat needed to raise temperature OR absorbs less heat	B1 B1
5	a(i)	amplitude	B1
	(ii)	Wavelength	B1

	b(i)	String moves air / vibrates air Backwards and forwards OR Up & down OR Compressions & rarefactions	M1 A1
	(ii)	Gets quieter OR softer OR less loud.	B1
6	(a)	Ultraviolet, microwaves	B1
	(b)	Do not need medium to transmit.	B1
7	(a) (b)	 At least 4 charges and 4 lines of electric force (originate from centre of sphere)	B1, B1
	c	Negative charges nearer to sphere - B1 Attractive force stronger than repulsive force - B1	B1 B1
	d(i)	some negative charges / electrons move from aluminium ball to conducting sphere due to attraction of net positive charges on sphere. [unlike charges attract without referring to net positive charge on sphere NOT accepted.]	B1 B1
	d(ii)	 	B1
8	a	Current flows through coil, coil becomes electromagnet (energised), attracts iron bolt. iron bolt moves to the left, allowing door to be opened.	B1 B1
	(b)	ANY 2 increase current (by increasing voltage of supply) – stronger electromagnet, stronger attraction on bolt. increase number of turns on coil – increase strength of electromagnet, stronger attraction on bolt. move electromagnet / solenoid / iron core nearer to bolt – stronger magnet field near to bolt, attraction on bolt.	B2 B2

9	a	The pointer deflects momentarily to one side and then back to zero.	B1 B1
	b	Pointer shows the same deflection as in (a) but in the opposite directions.	B1
	c	 Shape (sine curve or any curve that is "sine" like – B1 Curve peak at T/4 (either up or down) and at 3T/4 (opposite to T/4) - B1	B1 B1

Answer Scheme (Sec 4 Prelim Exam 2016)
Section (B)

10 (a) (i) A — B1

(ii) performs the same for both frequency but poorer/worse off then water — B1

(b) (i) reflection from skin — B1
very little reflection, so small intensity/peak — B1

(ii) large reflection from front of kidney — B1

(iii) reflection from back of kidney — B1
smaller intensity/peak due to absorption of ultrasound in kidney OR further from source OR front of kidney already reflected a lot, so there is now less to be reflected — B1

(c) Δt $= 28.5 \times 10^{-5}\ s - 20.5 \times 10^{-5}\ s$
$= 8.0 \times 10^{-5}\ s$ (e.c.f.) — B1
width $= ½ \times 1500\ m/s \times 8.0 \times 10^{-5}\ s$ — M1
$= 0.060\ m$ OR $6.0\ cm$ — A1

11 (a) (i) Pressure is the ratio of force per unit area — B1

(ii) Wt of piston/Area + Patm= P gas
Mg/A + Patm = P — C1
$M = (1.5x10^5 - 1.0 \times 10^5) \times 4x10^{-4}/10$ — C1
$= 2.0\ kg$ — A1

11 (b) (i)

A Molecules collide with walls of cylinder and exert force on the wall. — B1
The average force exert by air is the pressure — B1

B As temp decreases, vol of air decreases. The number of collisions hitting wall per unit time increases correspondingly. — B1 B1

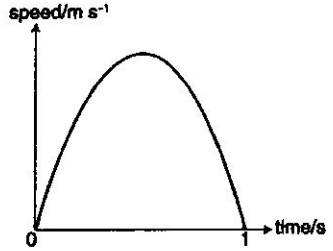
(ii) The pressure difference between cold air and atmospheric pressure pushes piston in. — B1

12 (a) (i) $Rt = (1/5 + 1/4)^{-1}$ — C1
$+ 3$ — C1
$= 5.2\ \Omega$ — A1

(ii) $V = IR = 3 \times 0.5$ — C1
$= 2.1\ V$ — A1

	(b)		
	(i)	Ratio of PD across component to I flowing thru it	B1
	(ii)	From the graph, wire B has the lower gradient and hence higher R.	B1
		1/R is the gradient of I V graph.	B1
	(c)	Correct shape of graph	B1
		Forward bias on positive side of x axis	B1
OR	(a)		
	(i)	3 pin plug has earth wire	B1
		that channels current to earth in event of appliance fault.	B1
	(ii)		
		Casing is made of insulator	B1
		Hence stray wire will not be able to conduct current out of casing to user.	B1
	(iii)		
		Large current will be drawn into appliance, overheating it.	B1
	(b)		
	(i)	Indicates the voltage that appliance is designed to work with at certain current.	B1
	(ii)	I=P/V	
		=500/230	M1
		=2.17 A	
		Therefore 5 A fuse.	A1
		Exceed 1A hence will blow. 13 A fuse is too high a rating to prevent any current surge.	B1
	(c)	Cost = 0.5kW x 3 x 0.9	C1
		= $1.35	A1

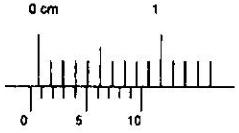
1 The graph shows the speed-time graph of a pendulum bob oscillating from a point.



What is the period of the oscillation of the pendulum bob?

A 5 s **B** 1.0 s **C** 1.5 s **D** 2.0 s

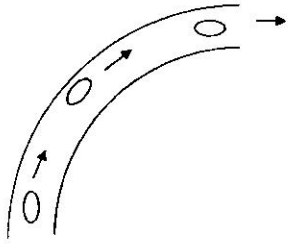
2 The diagram below shows part of a vernier scale when the jaws of the vernier calipers are closed.



What is the zero error of the vernier calipers shown?

A +0.04 cm **B** -0.04 cm **C** +0.06 cm **D** -0.06 cm

3 A car travels at *constant speed* round a bend.

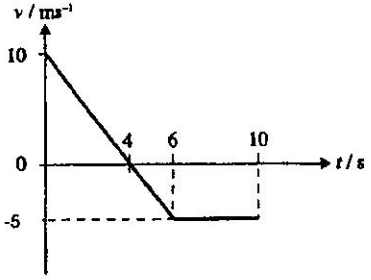


Which of the following statements about the motion of the car is **not** correct?

A The car is accelerating.
B The velocity of the car is uniform.
C The displacement of the car increases.
D The distance covered per unit time by the car is constant.

CWSS16

4 The velocity-time graph below shows the motion of an object moving in a straight line.



Which of the following statements is/are true?

1. The object is stationary at 4 s.
2. The object is 5 m behind the starting point at t = 6 s.
3. The object is furthest away from its starting point at t = 10 s.

A 1 only
B 1 and 2 only
C 1 and 3 only
D All of the above

5 The engine of an 800 kg sports car exerts a constant forward force of 500 N on the car.

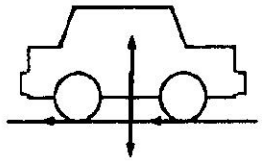
When the parachute is opened, the car decelerates at 2.5 ms^{-2} while the engine continues to provide the forward force of 500 N.

What is the tension in the cord at this instant? (Assuming that there is no other resistive force.)

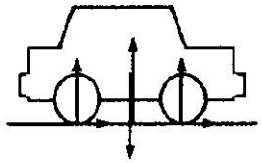
A 500 N
B 1500 N
C 2000 N
D 2500 N

6 A car starting from rest accelerates towards the right without skidding along a horizontal road. Which diagram below illustrates the forces acting on the car?

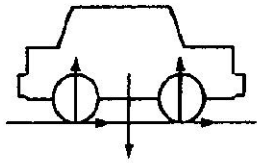
A



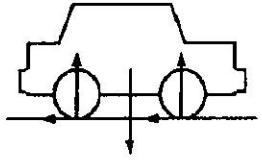
B



C



D

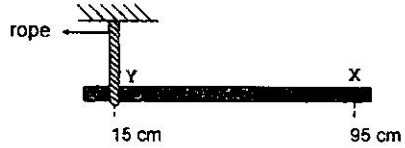


7 The gravitational field strength of a particular planet is 5 N/kg. On earth, the gravitational field strength is 10 N/kg. A rock weighs 80 N on that planet.

What would be its weight on earth?

A 10 N B 16 N C 80 N D 160 N

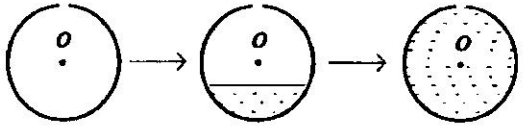
8 In the diagram below, the uniform metre rule is pivoted at **X** and held up at the point **Y** by a rope.



Given that the weight of the metre rule is 4.0 N, calculate the tension in the rope that is needed to ensure that the ruler stays horizontal.

A 1.8 N B 2.3 N C 3.1 N D 5.1 N

9

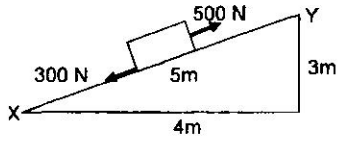


The above diagram shows a uniform hollow metal sphere with a small opening on top. ***O*** is the position of the centre of gravity of the hollow sphere.

What will happen to the position of the centre of gravity of the system as the sphere is being slowly filled with oil from the opening?

A It will remain unchanged throughout the process.
B It will fall gradually, and its final position will be below ***O***.
C It will rise gradually and its final position will be above ***O***.
D It will fall gradually at first and then rise to its original position.

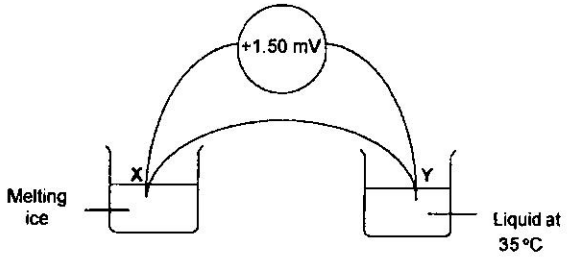
10 A force of 500 N is applied to a box to move it up the ramp as shown. The friction acting on the box is 300 N.



How much work is done against friction?

A 300 J B 1 200 J C 1 500 J D 3 000 J

11 The diagram shows a thermocouple thermometer when junctions X and Y are placed in melting ice and in a liquid at 35°C respectively.



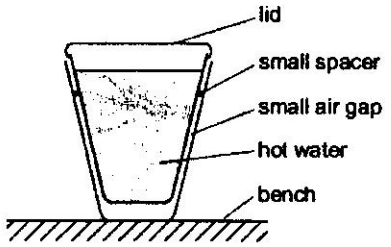
What is the voltmeter reading when junction X is removed and placed in boiling water instead?

A -2.79 mV
B -1.92 mV
C +1.50 mV
D +2.79 mV

12 Which of the following best explains steam point?

A The temperature of pure water when it boils at a pressure of 1 atm.
B The temperature of pure water just after it boils at a pressure of 1 atm.
C The temperature of steam from pure boiling water at a pressure of 1 atm.
D The temperature of the air above pure boiling water at a pressure of 1 atm.

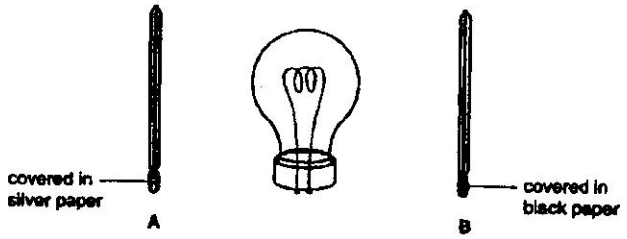
13 Two plastic cups are placed one inside the other. Hot water is poured into the inner cup and a lid is put on top, as shown.



Which statement is correct?

A No heat passes through the sides of either cup.
B The lid is used to reduce heat loss by convection.
C Heat loss by radiation is prevented by the small air gap.
D The bench is heated by convection from the bottom of the outer cup.

14 The experiment is set up using a light bulb and two thermometers, **A** and **B**. The light bulb is switched on. After two minutes the thermometers show an increase in temperature. Thermometer **B** shows a greater increase in temperature.



Which of the following is/are **true** statements about this experiment?

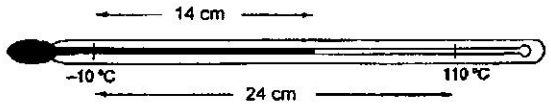
1. The silver paper is a better reflector of radiation.
2. The black paper is a better absorber of radiation
3. Heat is transferred to the thermometers mainly by radiation.

A 2 only
B 1 and 2 only
C 2 and 3 only
D 1, 2 and 3

15 What happens when a liquid is being heated at its boiling point?

A An increase in molecular size
B An increase in molecular spacing
C An increase in the total number of molecules
D An increase in the average kinetic energy of the molecules

16 The figure below shows a mercury thermometer. The distance between the -10°C and 110°C markings is 24 cm.



What temperature does the thermometer read?

A 48 °C
B 58 °C
C 60 °C
D 70 °C

17 Which statement is true about water molecules at 70 °C?

A There are forces between the molecules and no molecules have enough energy to escape the liquid.
B There are forces between the molecules and some molecules have enough energy to escape the liquid.
C There are no forces between the molecules and no molecules have enough energy to escape the liquid.
D There are no forces between the molecules and some molecules have enough energy to escape the liquid.

18 The diagram below shows a frying pan.

The table shows three solid materials with their respective specific heat capacities.

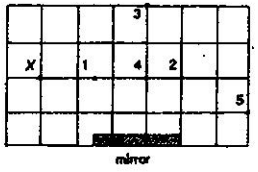
Solid Material	*Specific Heat Capacity (J/kg°C)*
K	440
L	920
M	4250

Assuming all these materials have reasonably high melting points, which materials are best suited to make the base and handle?

	Base	Handle
A	K	M
B	L	M
C	M	K
D	M	L

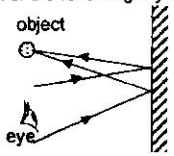
19 A person stands at point *X* as shown in the diagram.

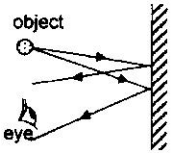
Which of the pins (1, 2, 3, 4 and 5) will the person be able to see in the mirror?

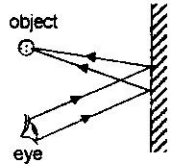


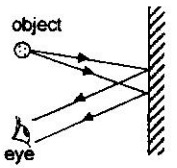
A 1, 3
B 2, 3 and 4
C 2, 4
D 2, 4 and 5

20 Which of the following ray diagrams is correct?

A


B


C


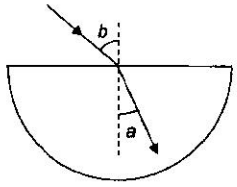
D


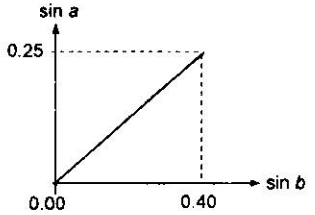
21 A ray of light travels with speed v_1 through medium 1 and then passes into another medium 2, where it travels at speed v_2. The refractive index for medium 1 and medium 2 are n_1 and n_2 respectively.

Which row in the following table correctly compares the speeds and refractive indices for each medium?

	Speed of light	Refractive index
A	v_2 is less than v_1	n_1 is less than n_2
B	v_2 is less than v_1	n_2 is same as n_1
C	v_2 is greater than v_1	n_2 is same as n_1
D	v_2 is greater than v_1	n_1 is less than n_2

22 A light beam is incident into a semi-circular glass block and refracted out as shown. A graph of sin *a* against sin *b* is plotted as shown.



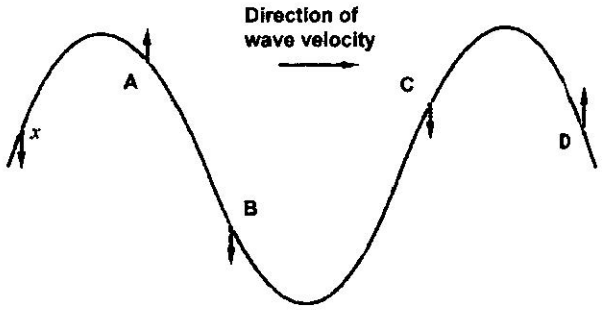


What is the critical angle of the glass?

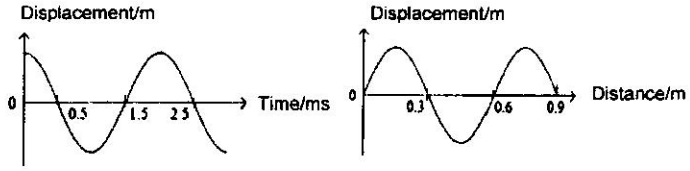
A 36.9°
B 38.7°
C 51.3°
D 53.1°

23 The diagram shows a section of a wave motion. The particle at position x moves in the direction of the arrow shown.

Which of the following particles at the labelled positions, **A**, **B**, **C** and **D** is incorrect?



24 The two graphs shown below refer to the same wave.

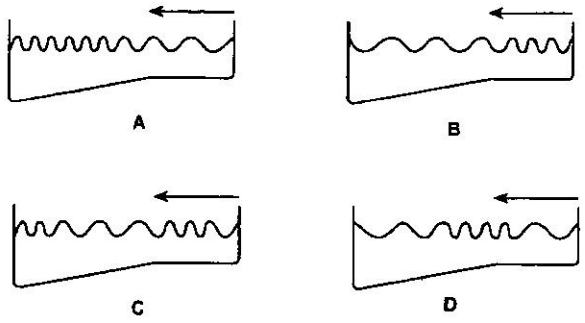


What is the speed of the wave?

A 0.3 ms^{-1}
B 1.2 ms^{-1}
C 150 ms^{-1}
D 300 ms^{-1}

25 A ripple tank contains water of varying depths.

Which diagram correctly represents the water waves as they travel from the shallow to the deep region?



26 Below are three statements about electromagnetic radiation.

- Microwaves may cause the ionisation of cells.
- Radio waves are use in cancer radiotherapy.
- Ultraviolet radiation is used in remote controls for television sets.

How many of the statements is/are correct?

A 0
B 1
C 2
D 3

27 Radio waves, visible light and X-rays are all part of the electromagnetic spectrum.

What is the correct order of increasing wavelength?

	shortest ⟶ longest		
A	radio waves	visible light	X-rays
B	radio waves	X-rays	visible light
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

28 The speed of a sound wave is reduced by half when it passes from medium A to medium B.

Which statement below describes the change in the sound wave correctly?

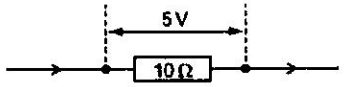
A The frequency is reduced by half.
B The wavelength is reduced by half.
C The frequency becomes twice its initial value.
D The wavelength becomes twice its initial value.

29 Sam plays a note on the guitar. He then plays a louder sound of the same pitch.

Which of the following correctly compares the speed and wavelength of the second note with the first note?

	Speed of second sound	Wavelength of second sound
A	Same	Same
B	Same	Different
C	Different	Same
D	Different	Different

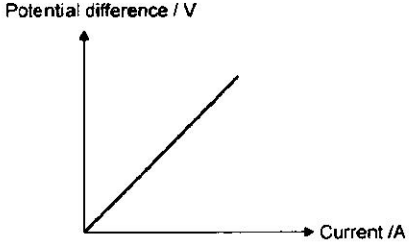
30 The potential difference across a 10 Ω resistor is 5 V.



How much charge passes through the 10 Ω resistor in 30 seconds?

A 2 C B 15 C C 60 C D 1500 C

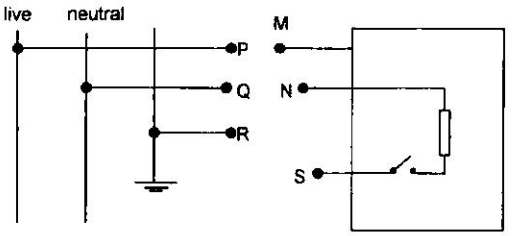
31 The graph below shows the variation of potential difference across a uniform resistance wire against the current in the wire.



Which of the following changes will make this graph steeper?

A A thinner wire is used.
B A shorter wire is used.
C The wire is made of a material of lower resistivity.
D A similar wire is connected in parallel to this wire.

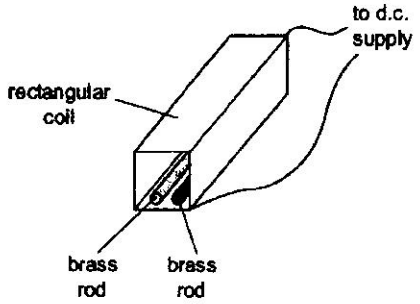
32 An electrical appliance with a metal case is to be connected to the mains supply as shown below.



Which of the following shows the correct connection of the wires from P, Q and R respectively?

	P	Q	R
A	S	M	N
B	S	N	M
C	N	M	S
D	N	S	M

33 The diagram shows two brass rods, side by side, at the bottom of a rectangular coil. The wires of the rectangular coil are insulated.

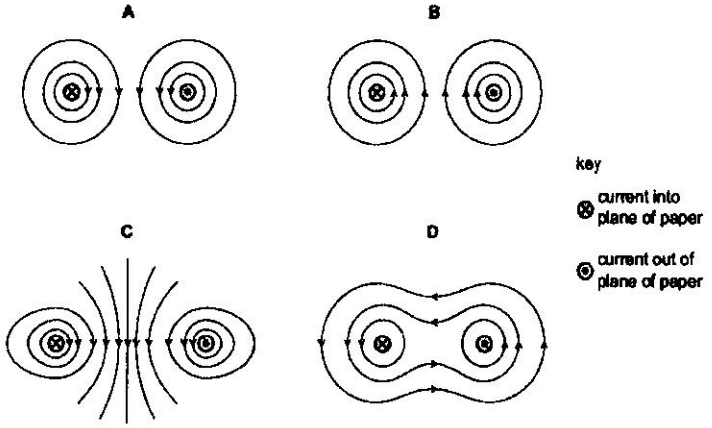


What happens when a direct current passes through the coil?

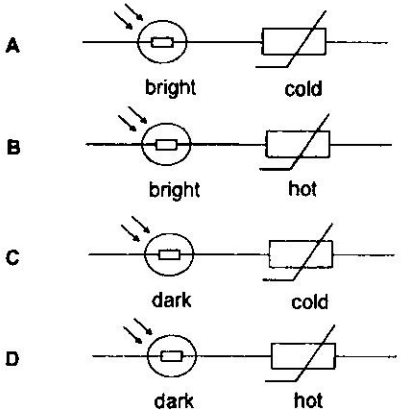
A Nothing happens.
B The two rods move towards each other.
C The two rods move away from each other.
D The two rods will move towards and then away from each other.

34 Two straight electrical conductors are parallel to one another. Each carries a current, one into the plane of the paper and one out of the plane of the paper.

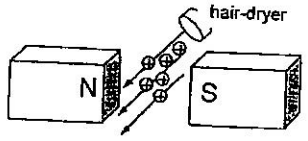
Which diagram shows the magnetic field around the two wires?



35 Given that the resistance of a thermistor decreases with increasing temperature, which of the following conditions will create the largest combined resistance in the circuit?



36 Hot air from a hair-dryer contains many positively charged ions.

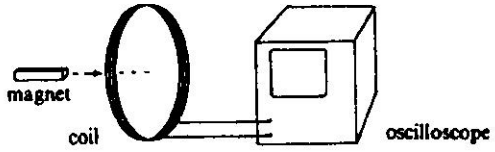


The hot air is directed between the poles of a strong magnet, as shown in the diagram above.

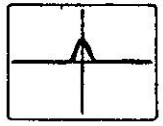
Which direction would the ions be defected?

A upwards.
B downwards.
C towards the north pole.
D towards the south pole.

37 A bar magnet is moved slowly into a coil of wire which is connected to an oscilloscope.

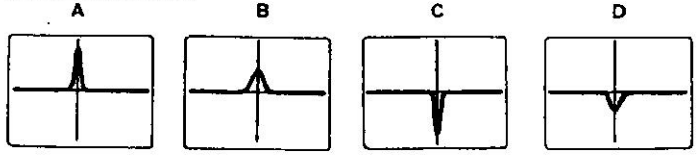


The trace on the oscilloscope is shown below:

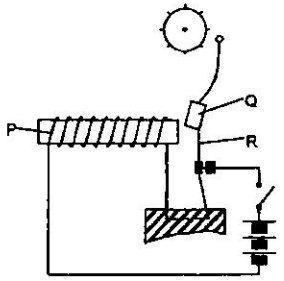


The magnet is then moved back from the coil at a greater speed.

Which trace shows this?

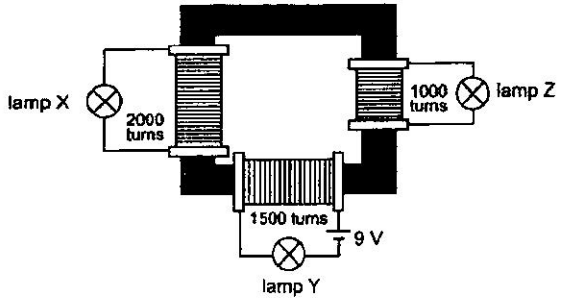


38 In an electric bell, what are parts P, Q and R made of?



	P	Q	R
A	copper	soft-iron	spring steel
B	copper	steel	spring steel
C	steel	soft-iron	copper
D	steel	steel	copper

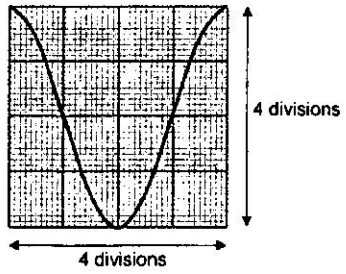
39 Three identical filament lamps, X, Y and Z, are connected to a transformer with multiple coils. The resistance of each lamp is 4.5 Ω and each requires a current of 2.0 A to light up normally.



What can be observed about the brightness of the three lamps?

	Lamp X	Lamp Y	Lamp Z
A	Dimmer than normal	Normal brightness	Brighter than normal
B	Brighter than normal	Normal brightness	Dimmer than normal
C	Not lit	Normal brightness	Not lit
D	Not lit	Not lit	Not lit

40 The diagram illustrates the trace obtained on the screen of an oscilloscope when a given signal is applied to the input terminals.



The time-base is set to 2.0 ms/div and the voltage sensitivity is 2.0 V/div.

Which of the following correctly represents the peak voltage and frequency of the signal?

	Peak voltage	Frequency
A	4.0 V	83.3 Hz
B	4.0 V	125 Hz
C	8.0 V	83.3 Hz
D	8.0 V	125 Hz

Paper 1

1	D	11	A	21	A	31	A
2	D	12	C	22	B	32	B
3	B	13	B	23	B	33	A
4	A	14	D	24	D	34	C
5	D	15	B	25	B	35	C
6	C	16	C	26	A	36	A
7	D	17	B	27	D	37	C
8	B	18	A	28	B	38	A
9	D	19	D	29	A	39	C
10	C	20	B	30	B	40	B

CWSS16.

SECTION A (50 marks)

Answer **all** questions. Write your answers in the spaces on the question paper.

1 Fig. 1.1 shows the velocity-time graph of a moving object.

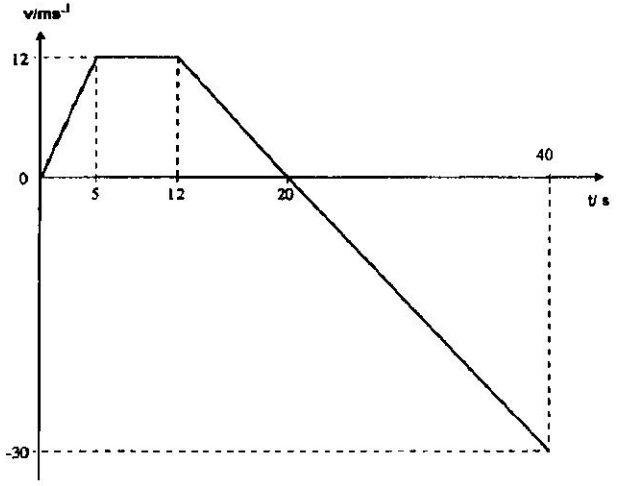


Fig. 1.1

(i) Calculate the acceleration of the object from t = 12 s to t = 20 s. [2]

Acceleration = ...

(ii) Describe the motion of the object from t = 12 s to t = 40 s. Indicate the direction of motion clearly throughout the entire duration. [2]

.....

.....

.....

2 A sky-diver jumps from a high-altitude helicopter as shown in Fig. 2.1.

Fig. 2.1

(a) Explain why the acceleration of the sky-diver

(i) is 10.0 ms^{-2} at the start of the jump. [1]

.....

.....

(ii) decreases with time. [2]

.....

.....

.....

(b) At one point during the dive, the acceleration of the sky-diver was 7.5 ms^{-2}. The sky-diver and his equipment have a total mass of 90 kg.

Determine the total resistive force acting on the sky-diver at that point. [2]

total resistive force = ...

3 Two identical barometers P and Q containing mercury are set up at sea level as shown in Fig. 3.1.

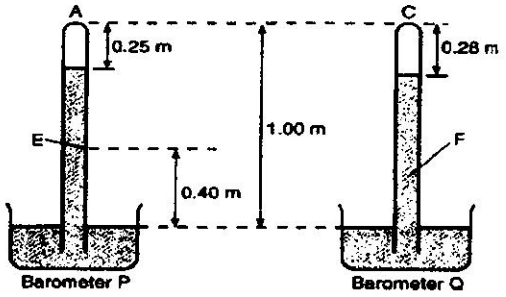


Fig. 3.1

The column of space A in barometer P is a perfect vacuum. The density of mercury is 13 600 kgm^{-3}

(a) State the atmospheric pressure as measured by barometer P. [1]

.....

(b) Calculate the pressure at point E, giving your answer in Pascal. [2]

pressure = ...

(c) Suggest a possible reason why the column of space C is more than A. [1]

.....

(d) State the pressure within the space C. [1]

.....

4 The piston for the bicycle pump in Fig. 4.1 is pushed in slowly until the air pressure inside the pump in Fig.4.2 is three times greater. The air in the pump remains at a constant temperature of 20 °C.

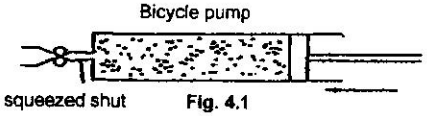


Fig. 4.1

Fig. 4.2

(i) Explain in terms of molecular motion why the pressure in Fig. 4.2 should be three times greater than in Fig. 4.1. [2]

.....

.....

.....

(ii) If the piston had been pushed in quickly, the temperature of the air in the pump would have increased.

Explain in terms of molecular motion how this would affect the pressure in the pump. [3]

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5 Fig. 5.1 shows the path of a light ray through a converging lens.

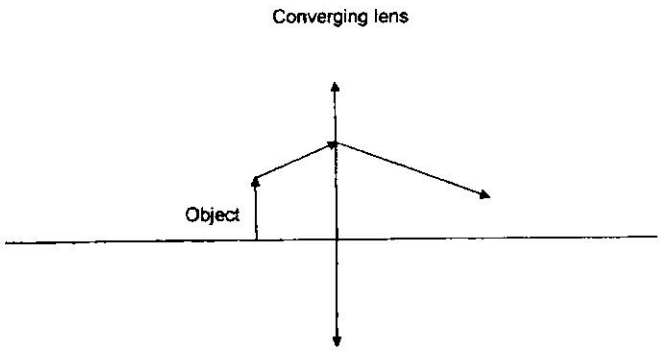


Fig. 5.1

(i) Complete the ray diagram in Fig. 5.1, locate and draw the image of the object. [2]

(ii) Explain how your diagram shows that the image is virtual. [1]

.....

.....

(iii) Complete the ray diagram in Fig. 5.1, locate the Principal Focus of the converging lens and label the point **F**. [2]

6 Fig. 6.1 shows wavefronts of a water wave in a ripple tank.

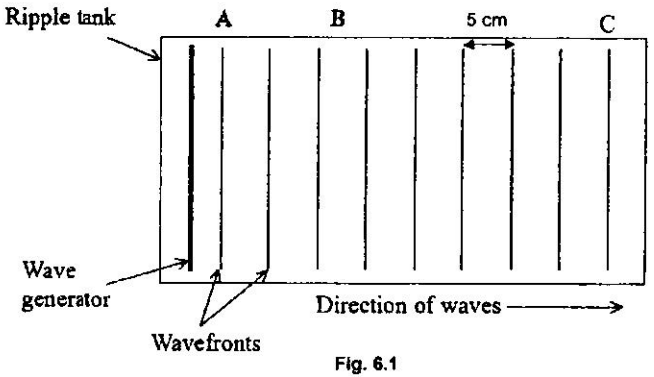


Fig. 6.1

(i) State the meaning of "*wavefront*". [1]

.....

.....

(ii) Determine the wavelength of the wave. [1]

Wavelength = ...

(iii) A wavefront takes 1 second to travel from **A** to **C**. Determine the frequency of the wave. [1]

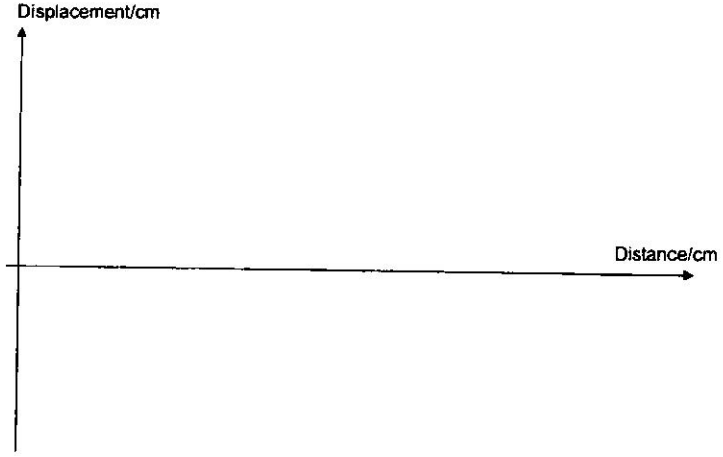
Frequency = ...

(iv) Calculate the speed of the wave. [2]

Speed = ...

(v) The wave generated has an amplitude 1.5 cm.

Sketch a displacement-distance graph. Indicate the position of **A** and **B** clearly in your graph. [2]



7 (a) The honey industry in Britain is under serious threat from a parasite that attacks bees. A company has developed a patented natural wax powder that keeps the parasites away from the bees. The formulated powder is added to a specially designed applicator placed in the doorway of the hive. Bees have specially modified hairs on their bodies that develop a static electricity charge.

Explain how the powder can adhere to the bodies the bees when they enter the hive. [2]

.....

.....

.....

(b) Large amounts of grains such as wheat can generate charges as they are poured from one storage bin to another. These organic materials are highly explosive when there is ample supply of oxygen.

State the method of charging of the grains during pouring and explain the main reason for the grains to be highly explosive. [3]

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8 Fig. 8.1 shows an electrical circuit with three identical lamps **X**, **Y** and **Z**, a switch, a 12 V battery, an ammeter, a voltmeter and a variable resistor.

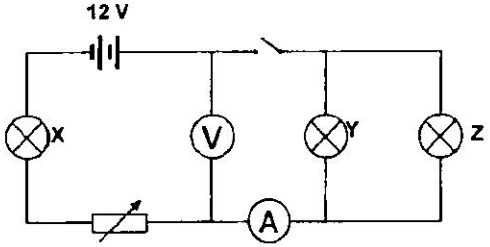

Fig. 8.1

(a) State the ammeter and voltmeter readings when the switch is opened. [2]

ammeter reading: .....

voltmeter reading: .....

(b) When the switch is closed, the ammeter reading is 1.50 A and the voltmeter reading is 3.00 V.

(i) Calculate the resistance of each lamp. [2]

resistance = ...

(ii) Calculate the power dissipated by Lamp **X**. [2]

power = ...

(iii) Calculate the potential difference across the variable resistor. [2]

potential difference =.....

(c) State what happens to the brightness of Lamp **Y** when the resistance of the variable resistor is increased. [1]

.....

9 Fossil fuels will eventually run out. This has led to scientists looking for alternative sources of energy. Tidal stream systems use the kinetic energy of seawater to generate electrical energy during the incoming and outgoing tides.

Fig. 9.1 below shows a twin-turbine system in which flowing seawater turns the turbine blades.

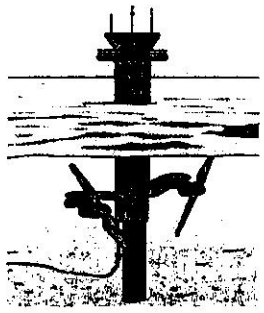

Fig. 9.1

When operating, 9.7×10^5 kg of seawater travelling at a speed of 3.0 ms^{-1} passes through each turbine every second. Each turbine generates 1.2×10^6 W of electrical energy.

(a) Define *power*. [1]

.....

(b) The input power to each turbine is the kinetic energy of the seawater that flows through each turbine in one second.

Calculate the input power of each turbine. [2]

Input power = ...

(c) Calculate the percentage efficiency of each turbine. [1]

Percentage efficiency =.....

(d) Suggest one advantage of tidal stream systems over conventional wind farms. [1]

.....

.....

SECTION B (30 marks)

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**

10 Four transformers, **A**, **B**, **C** and **D** are being investigated. For each transformer, the input voltage is changed and the output voltage measured each time. The results for each transformer are shown by the graphs in Fig. 10.1.

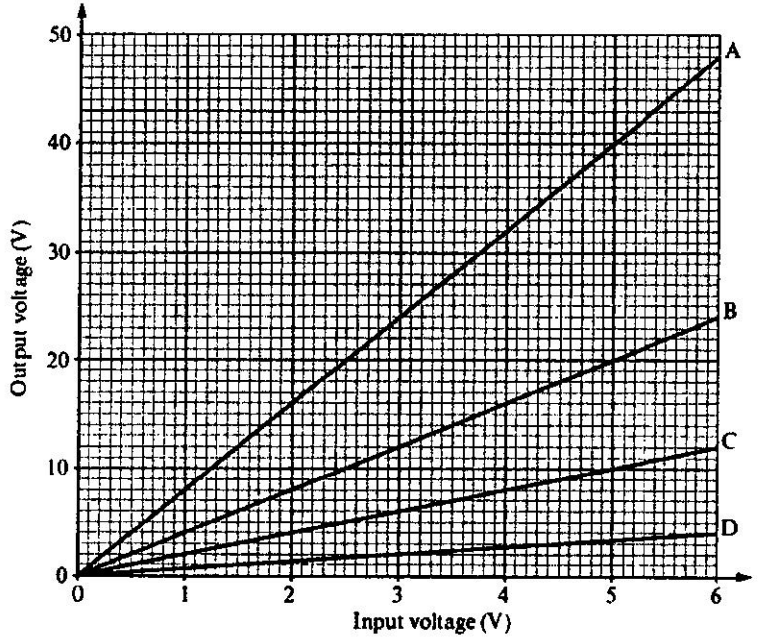

Fig. 10.1

One of the transformers is then used to light up a 12 V lamp from a 3 V power supply as shown in Fig. 10.2.

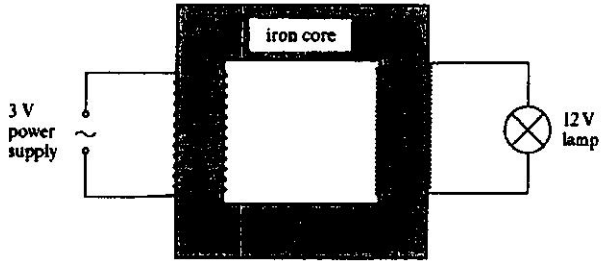

Fig. 10.2

(a) Explain how a current in the primary coil produces an output voltage in the secondary coil. [2]

.....

.....

.....

.....

(b) Describe the purpose of the iron core. [1]

.....

.....

(c) Using the data on the graphs in Fig. 10.1 to answer the following questions.

(i) State and explain which transformer, **A**, **B**, **C** or **D**, would be used to light the 12 V lamp to normal brightness, from a 3 V supply as shown in Fig. 10.2 [1]

.....

.....

(ii) Transformer **C** contains 50 turns on its primary coil. Calculate the number of turns on its secondary coil. [2]

Number of turns = ...

(iii) Transformer **A** has a current of 0.5 A in the primary coil. Calculate the current in the secondary coil. [2]

Current = ...

(iv) State and explain which transformer, **A**, **B**, **C** or **D**, is **not** suitable to be used for the transmission and distribution of energy from power stations to transmission cables. [2]

.....

.....

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11 A thermistor is placed in an environment where the surrounding temperature increases at constant rate of 1 °C/ minute. Fig. 11.1 shows how the resistance of a thermistor changes with its surrounding temperature.

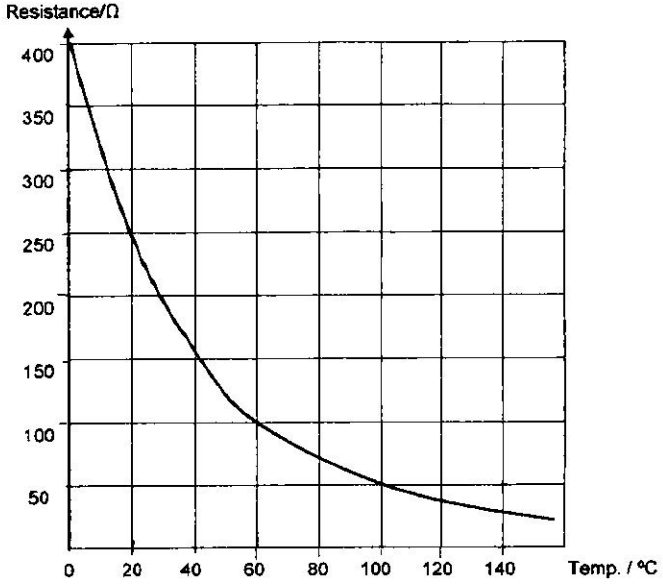


Fig. 11.1

(a) Describe how the resistance of a thermistor changes with surrounding temperature. [1]

.....

.....

The thermistor is connected in series with a bulb of resistance 10 Ω. They are then connected in parallel with a heating filament of resistance 10 Ω which is mounted very close to the thermistor as shown in Fig. 11.2.

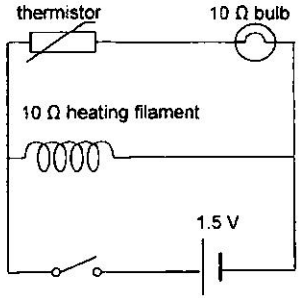


Fig. 11.2

Explain why the bulb

(i) fails to light up immediately when the switch is closed. [2]

.....

.....

.....

.....

(ii) lights up slowly after a while. [2]

.....

.....

.....

.....

(c) (i) Calculate the resistance of the thermistor when a current of 0.025 A flows through the light bulb [2]

Resistance = ...

(ii) Hence determine the temperature of the thermistor when a current of 0.025 A flows through the light bulb [1]

Temperature = ...

(d) When the temperature of the thermistor is 100 °C, calculate the effective resistance of the whole circuit. [2]

Effective resistance = ...

12 EITHER

A pendulum consists of a metal sphere of mass 200 g attached to a thin thread as shown in Fig. 12.1. The length of the thread is 1.0 m.

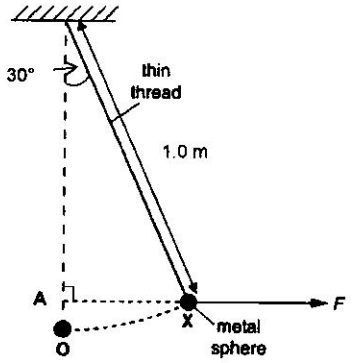


Fig. 12.1

When the thread is vertical, the metal sphere is at O. The metal sphere is moved from O to X and held in position by a horizontal force *F*. The angle between the thin thread and vertical is 30°.

(a) With an appropriate scale and drawing, determine *F* and the tension in the thread. [5]

Scale =.....

F = ...

Tension = ...

(b) Calculate the

(i) distance **OA**, which is the vertical displacement of the sphere from **O** to **X**. [1]

Distance **OA** =.....

(ii) work done to raise the sphere from **O** to **X**. [2]

Work done =.....

(iii) maximum speed of the sphere after it has been released. [2]

Maximum speed=.....

12 **OR**

A student poured 250 g of hot tea into a container. He placed a thermometer into the tea and started measuring the temperature with respect to time. After a while, he added ***m*** kg of ice cubes into the tea.

Fig. 12.2 below shows the temperature-time graph obtained.

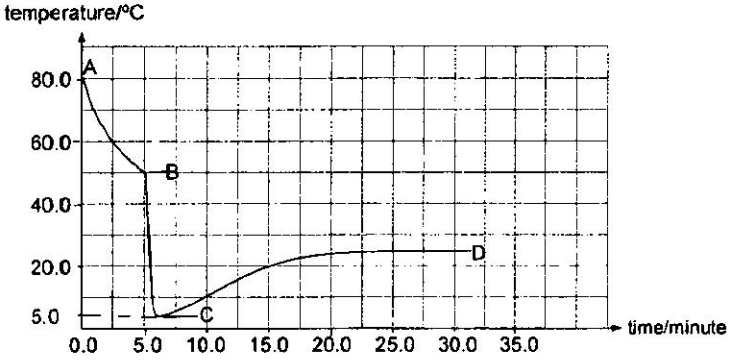


Fig. 12.2

The following information is provided :

specific heat capacity of ice = 2.10×10^3 J/kg°C
specific latent heat of fusion of ice = 3.36×10^5 J/kg
specific heat capacity of water or tea = 4.20×10^3 J/kg°C
specific latent heat of vaporisation of water or tea = 2.26×10^6 J/kg

The temperature of the ice cubes before being added into the hot tea is 0 °C.

(a) State and explain what time the student added the ice cubes into the tea. [1]

.....

.....

(b) Calculate the loss of thermal energy in the hot tea from B to C. [2]

loss of thermal energy = ...

(c) Calculate ***m***. You may assume that there is no loss of thermal energy to the surrounding. [3]

m = ...

(d) Explain why the temperature of the tea increases from C to D. [2]

.....

.....

.....

(e) Estimate the temperature of the surrounding. [1]

.....

(f) In another experiment, the student placed 250 g of hot tea in the same empty container. When the temperature of the hot tea was 80 °C, he started the stopwatch. He continued to measure the temperature of the tea without adding any ice cubes.

On Fig.12.2, draw the temperature-time graph for the second experiment. [1]

CWSS 16

Version 4 updated on 22 August 2016

Section A (50 marks)

1 (i) Acceleration = (12 – 0)ms^{-1}/(12-20)s [1]

= **-1.50 ms^{-2}** [1]

(ii) Object travel with **constant negative acceleration** [1]

Or: Decreasing velocity at a constant rate from 12 s to 20 s and increasing velocity at a constant rate from 20 s to 40 s.

The object **changes direction at t = 20s.** [1]
Or: The object moves in the positive direction from t = 12-20 s and it moves in the negative direction from t = 20-40 s.

To accept answer as long as student shows understanding that **the direction of motion is reversed at t = 20s.**

Total mark for Q 1 [4]

2 (a) (i) air resistance is **zero/negligible** [1]
or: weight / gravitational force is **only force**
Or: resultant force is the weight

(ii) **air resistance increases** as speed increases [1]
resultant force decreases [1]

2 (b) Resultant force = ma
= 90 kg x 7.5 ms^{-2}
= **675 N** [1]

Total resistive force = Weight – resultant force
= 900 N – 675 N
= **225 N** [1]

Total mark for Q 2 [5]

3 (a) Atmospheric Pressure: **0.75 mHg** or 75 cmHg or 750 mmHg [1]
Accept: 1.02 x 10^5 Pa

(b) identify h as **0.35 m** [1]

Pressure at E = 0.35 m x 13600 kg/m^3 x 10N/kg
= **47600 Pa** [1]

(c) There is **air** in C or C is not a perfect vacuum [1]

(d) P in C = **0.03 mHg** or 3 cmHg or 30 mmHg [1]
To accept answer in SI unit: 4080 Pa

Total mark for Q 3 [5]

4 (i) **The number of air molecules per unit volume is three times greater in Fig. 4.2.** [1]

Accept: Less space or distance deceases

As a result, the **frequency of collisions of the air molecules with the walls of the pump is three times greater.** [1]

Accept: 'three times' is mentioned once either in the first or second point.

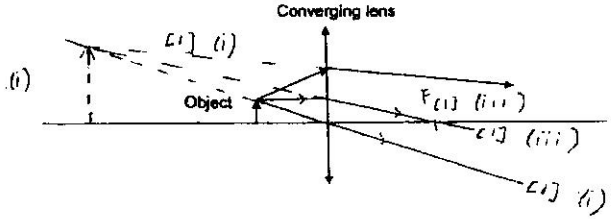
(ii) **Kinetic Energy** or **speed of air molecules increases** due to increase in temperature. [1]

The air molecules **collide more frequently and violently/forcefully with the walls** of the pump. [1]

Pressure increases [1]
Or: pressure is more than the previous se-up

Total mark for Q4 [5]

5



(i) A straight line passing through the tip of the object and Optical Centre and with extension. [1]

Extension of the given ray to intersect with the previous extension to form an upright image. Labelling of image is not required. Do not penalize if image is not dotted. [1]

(ii) The real rays do not intersect. [1]

(iii) A ray drawn parallel to Principal Axis, extended to tip of the image and passed through Principal Axis [1]

F correctly marked and labeled. [1]

To deduct a maximum of one mark for the following:
- missing arrows
- extension not in dotted lines
- arrows on extension
- arrows in wrong direction

Total mark for Q5 [5]

6 (i) A wavefront is an imaginary line **joining all the adjacent points in the same phase/adjacent crests/adjacent troughs.** [1]

(ii) Wavelength = **5 cm** [1]
Accept: 5.0 cm, 5.00 cm

(iii) Frequency = **8 Hz** [1]
Accept: 8.0 Hz, 8.00 Hz

(iv) Speed = frequency x wavelength
= **8 Hz x 5.0 cm** [1]
= **40 cms^{-1}** [1]
ecf from **(ii)** and **(iii)**

Accept: 0.4 ms^{-1}

(v) A sinusoidal wave with an amplitude of 1.5 cm [1]
B at the trough at 2.5 wavelength from **A.** [1]

Total mark for Q6 [7]

7 (a) By method of **induction** [1]
Or: a description of the induction process

The **charge of powder** nearer to the body of bee will be **opposite** to the **charge on the bee. Force of attraction is greater than the force of repulsion.** [1]

(b) Charging by **friction** or rubbing [1]

Large surface area of the grains and **charges accumulate fast** [1]
Or: large surface area of the grains and **large amount of charges accumulate** on the surface of the grains

Spark or **sudden discharge** might occur [1]
Or: high reaction/combustion rate

Total mark for Q7 [5]

Version 4 updated on 22 August 2016

8 (a) Ammeter reading = **0 A** [1]
voltmeter reading = **12 V** [1]

(b) (i) Since Y and Z are identical, current flowing through them = 1.50 A/2
= **0.75 A** [1]
R_Y = 3.00 V/0.75 A = **4.0 Ω** [1]
Hence resistance of each lamp = 4.0 Ω

(ii) $P = I^2R$ = **$(1.50\ A)^2 \times 4.0\ \Omega$** [1]
= **9.0 W** [1]

(iii) p.d. across lamp X, V = IR = 1.50 A x 4.0 Ω
= **6.00 V** [1]

p.d. across the variable resistor = 12 V – 6.00 V– 3.00 V
= **3.00 V** [1]

(c) The brightness **decreases** [1]
Or: Lamp Y becomes dimmer.

Total mark for Q8 [9]

9 (a) **Rate of work done** [1]
Or: **Rate of energy conversion**
Accept: Formula expressed in words (work done divided by time taken)
Accept: Rate of energy generated/consumed

(b) **½ $(9.7 \times 10^5\ kgs^{-1})\ (3.0\ ms^{-1})^2$** [1]
= **4.37×10^6 J/s or W** [1]

(c) $(1.2 \times 10^6 / 4.37 \times 10^6) \times 100\%$
= **27.5%** [1]
e.c.f. from (b)

(d) Any of the following: [1]

- Tidal energy has **more** consistent **efficiency** as it is not dependent on climatic condition/wind condition and direction.
- **No noise pollution** for tidal energy.
- **Do not require large clearance of land space.**
- A tidal stream turbine system of identical size to a wind turbine system will **produce greater power** for the same water or wind speed
- Does not obstruct the flight path of birds

Total mark for Q9 [5]

10 (a) The **current** in the primary coil is **alternating**/changing [1]
Or: The magnetic field is changing

hence the **magnetic flux in the secondary coil is changing** conlinuously, hence induces an emf in the secondary coil. [1]
Or: The magnetic field linked to the secondary coil is changing

(b) To **concentrate the magnetic field lines** [1]
Or: to **link magnetic field to the secondary coil**

(c) (i) **B** because the **the output voltage is 12 V when the input voltage is 3V.** (as shown on the graph) [1]
Or: **the turns ratio is 4**
or **the output voltage is four times the input voltage**

(ii) $N_s/50 = 12V/6V$ [1]
Or: The turns ratio is 2

$N_s = 100$ [1]

(iii) **48 V/ 6V = 0.5 A/I_s** [1]

I_s = **0.0625 A** [1]

(iv) **D** [1]

because it is a **step-down** transformer/current is stepped up hence the **power loss** in the cable is **higer** [1]

Total mark for Q10 [10]

11 (a) The resistance **decreases** as temperature **increases.** [1]

(b) (i) **Temperature is low** or the resistance of thermistor is high. [1]
Accept: Heating element has not been heated up
or the heating element takes time to get heated up

The p.d. across the thermistor is high hence the **p.d. across the bulb is low.** [1]
Or: No/low current through the bulb due to the high resistance in this path.

(ii) **Temperature of thermistor increases** due to the heat being transferred from the heating filament to the thermistor. [1]

The resistance and p.d of the thermistor decreases resulting in a **larger p.d. across the bulb.** [1]
Or: Current through the bulb increases due to the decrease in resistance in this path.

(c) (i) V = IR
1.5 V = 0.025 A (R_{th} + 10 Ω) [1]
Rth = 50 Ω [1]

Or:
P.d. across bulb = I x R = 0.025 x 10 = 0.25 V
P.d. across thermistor = 1.5 – 0.25 = **1.25 V** [1]
Resistance across thermistor = 1.25/0.025 = **50 Ω** [1]

(ii) Temperature = **100 °C** [1]
e.c.f. from (c) (i)
Accept: 80 °C to 100 °C for 60 Ω from (c) (i)

(d) R in series = 50 + 10 = 60 Ω
1/R = 1/60 + 1/10 [1]
R = 60/7 = 8.57 Ω [1]

Total mark for Q11 [10]

12 EITHER

(a) Accept either parallelogram or tip-to-tail method

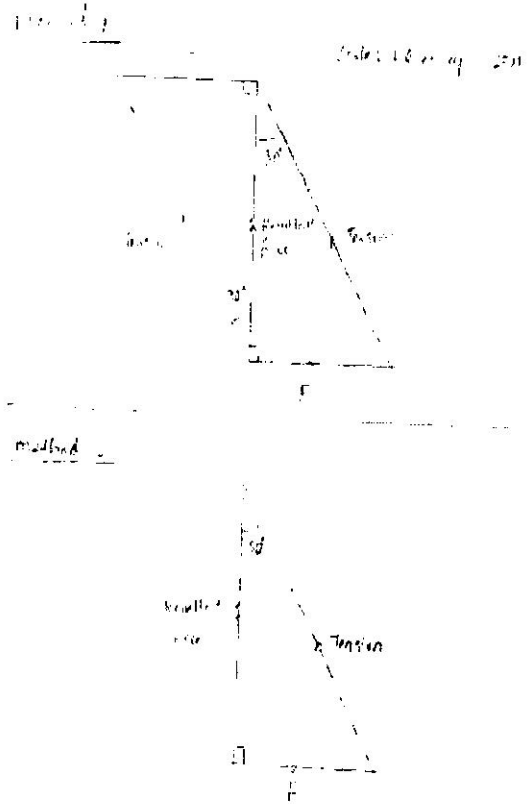
Vector diagram correctly constructed with **correct lengths for the 2.00 N vertical force** [1]

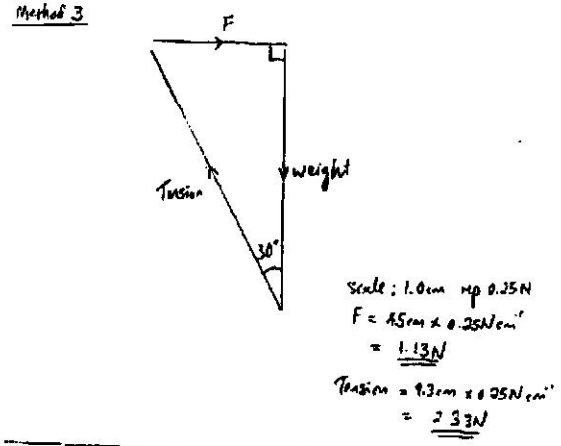
With an **enclosed angle of 30°** between vertical force and the tension [1]

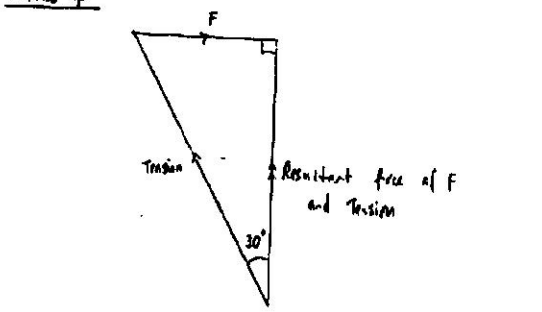
With **correct direction** of arrows for Tension, *F* and the 2.0 N vertical force. [1]

Values of *F* in the range from **1.02 N** to **1.25 N** [1]

Values of Tension in the range from **2.10 N** to **2.56 N** [1]







Method 5:
Similar to method 2 but with weight drawn with a single downward arrow

(b) **(i)** Distance **OA** = 1.0 m – (1.0 m cos 30°)
= **0.134 m** [1]

(ii) Work done = Gain in GPE
= mgh
= **0.200 kg x 10 Nkg^{-1} x 0.134 m** [1]
= **0.268 J** [1]
e.c.f. from (b) (i)

(iii) KE at **O** = GPE at **X** = 0.268 J
½ mv^2 = 0.268 J [1]
v = 1.64 ms^{-1} [1]
e.c.f. from (b) (ii)

Total mark for Q12 EITHER [10]

12 **OR**

(a) The student added the ice cubes at **5.0 minutes** (or at B). This is because there was a **sudden drop/decrease/change in temperature** from 5.0 minutes onwards. [1]

(b) Loss in thermal energy = $mc\theta$
= **0.250 kg x 4200 J /kg°C x (50.0 °C – 5.0°C)** [1]
= 47 250 J
= **47 300 J** (or 47 000 J) [1]

(c) Heat loss from tea = heat gained by ice cubes
47 300 = (m x 3.36 x 10^5) + (m x 4200 x 5.0)
= 336 000 m + 21 000 m
m = 47 250 / 357 000
= **0.132**

e.c.f. from (b)

Adding heat gained by ice in melting to heat gained by the melted ice in warming up: **(m x 3.36 x 10^5) + (m x 4200 x 5.0)** [1]
Equating heat gained by ice to answer in (b) [1]
Correct answer of 0.132 kg or 132 g [1]

(d) Since there is a **temperature difference** between the tea and the surrounding [1]
Or: the tea is at a lower temperature than the surrounding
Or: So to achieve equal temperature/equilibrium

thermal energy is transferred/gained/absorbed from the surrounding to the tea [1]
Or: heat flow from the surrounding to the tea

(e) **25.0 °C** (or 25 °C) [1]

(f) **Cooling curve** from 80°C to 25°C.
Final temperature of **25°C**
Takes a **longer time than 22.5 minutes** to reach 25°C

All three correct [1]

Total mark for Q12 OR [10]