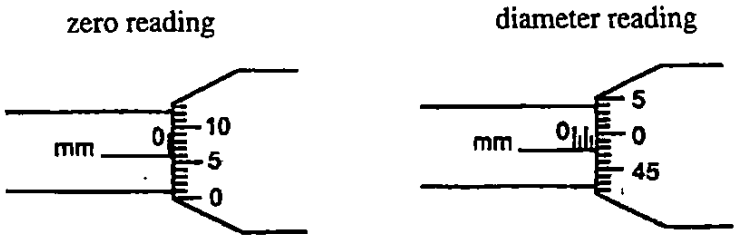
MARIS STELLA.

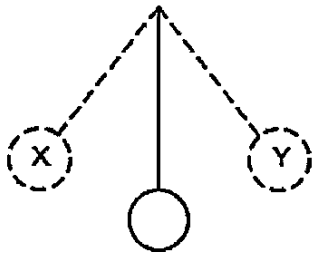
MCQ (Answer All Questions)

1 The diameter of a ball is measured using a micrometer screw gauge. A student takes an intial zero error reading and then a reading of the diameter. The diagrams show an enlargment of the screw gauge readings.



What is the diameter of the ball?
A 1.42 mm
B 1.92 mm
C 1.98 mm
D 2.04 mm

2 It takes 36.5 s for a pendulum to swing from X to Y and back again twenty times.

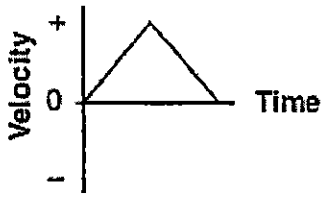


What is the frequency of the pendulum?
A 0.274 Hz
B 0.548 Hz
C 1.830 Hz
D 2.740 Hz

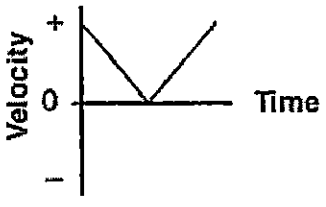
3 A stone is thrown vertically upwards with a velocity of 5.0 m/s. After time ***t***, it reaches the original position. Neglecting air resistance, the time required for the ball to reach the highest position is
A 10.0 t
B 5.0 t
C 2.5 t
D 0.5 t

4 A student throws a baseball vertically upward and then catches it. If vertically upward is considered to be the positive direction, which graph best represents the relationship between velocity and time for the baseball? [Assume air resistance is negligible.]

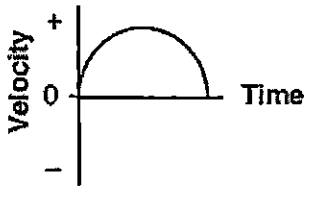
A



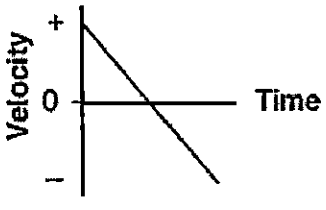
B



C



D



5 Which of the following statements concerning the motion of a body is/are <u>correct</u>?

(I) A body can have zero acceleration but still in motion.
(II) A body can have zero velocity but is also accelerating.
(III) A body can have constant speed but varying velocity.

A (I) and (II) only
B (I) and (III) only
C (II) and (III) only
D (I), (II) and (III)

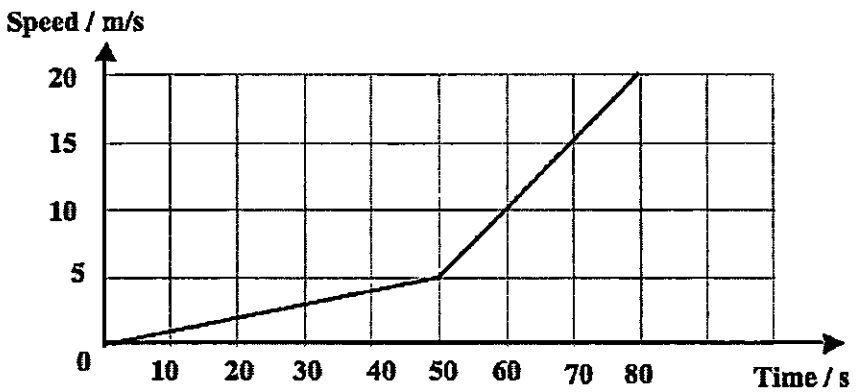
6 A wooden block of mass 3.0 kg moves with uniform speed when it is pulled by a constant horizontal force of 6.0 N on a horizontal surface. What will happen to the motion of the wooden block if the horizontal force is increased to 12.0 N?

A Moves at a constant speed of 2.0 m/s.
B Moves at a constant speed of 4.0 m/s.
C Moves with an acceleration of 2.0 m/s^2.
D Moves with an acceleration of 4.0 m/s^2.

7 A bullet of mass 0.010 kg travelling horizontally at 100 m/s is stopped after penetrating through 0.20 m of wood. What is the average retarding force applied to the bullet by the wood?

A 10 N
B 250 N
C 500 N
D 1000 N

8 The graph below shows how the speed of a car varies over a 80 s period.



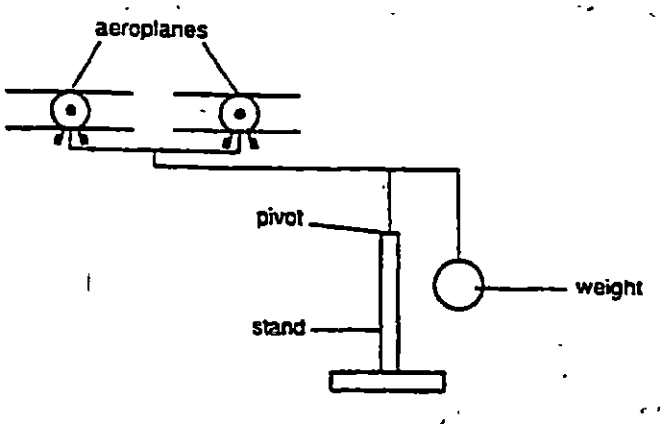
What is the average speed of the car?

A 3.25 m/s
B 6.25 m/s
C 7.25 m/s
D 12.5 m/s

9 The density of a metal bar is 12.0 g cm^{-3}. When a hole of volume 1.0 cm^3 is drilled into the bar, what will its density be?

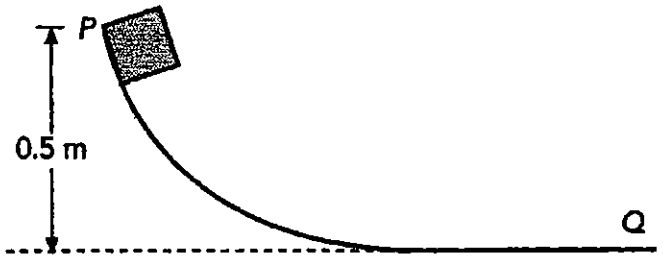
A 11.0 g cm^{-3}
B 12.0 g cm^{-3}
C 12.5 g cm^{-3}
D 13.0 g cm^{-3}

10 The diagram shows a balancing toy pivoted on a stand.If the toy is tilted slightly, it does not overbalance but returns to its original position.
This is because the centre of gravity of the toy is



A between the aeroplanes.
B below the pivot.
C exactly at the pivot.
D inside the weight.

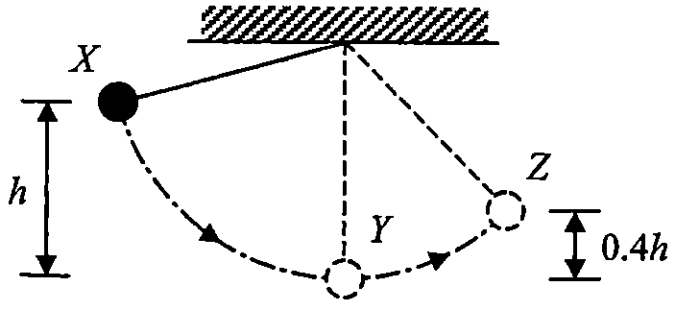
11 A block of mass 2.0 kg is released from rest at point P as shown in the figure below. It is found that the block finally comes to rest at point Q.



Length of the track PQ is 2.5 m. What is the average value of frictional force acting on the block when it is moving from P to Q?

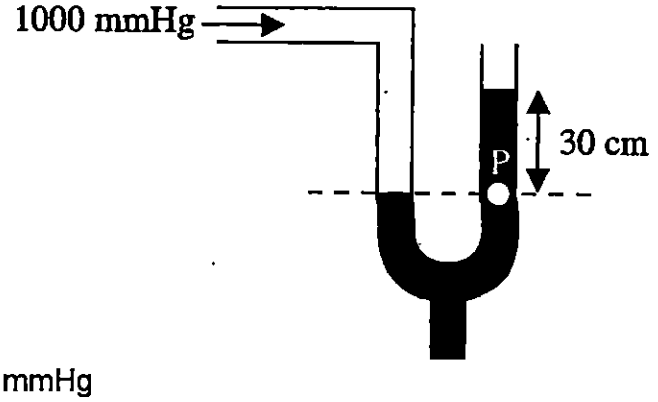
A 2.0 N
B 2.5 N
C 3.0 N
D 4.0 N

12 A pendulum bob is released from rest at position **X** which is at a height ***h*** above its lowest position **Y** and then passes through position **Z**. Position **Z** is 0.4***h*** above **Y**. Assuming air resistance is negligible, find the ratio of the speed of the bob at position **Y** to that at position **Z**.



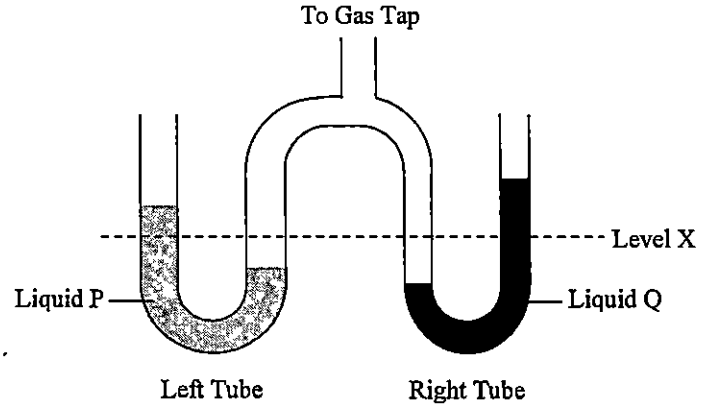
A 1.29 : 1
B 1.58 : 1
C 1.67 : 1
D 2.50 : 1

13 A manometer is connected to a 1000 mmHg air pressure at one end and the other end is left open as shown below. Given that the manometer is filled with mercury, what is the pressure at point **P**?



A 300 mmHg
B 700 mmHg
C 1000 mmHg
D 1300 mmHg

14 The apparatus shown is connected to a gas tap in order to measure the pressure of the gas. The left tube contains liquid P whereas the right tube contains liquid Q. The levels in the tube were originally at X.

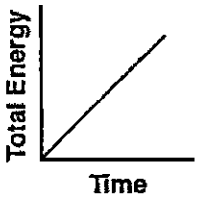


When the gas tap is turned on, liquid Q in the open limb of the right tube rises to a higher level than liquid P in the open limb of the left tube as shown. Why is this so?

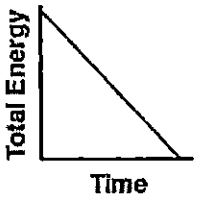
A Liquid P has a higher density than liquid Q.
B The right tube has a smaller cross-sectional area than the left tube.
C There is more liquid Q in the right tube than liquid P in the left tube.
D The gas exerts a greater pressure on the right tube as it is nearer to the gas inlet.

15 A ball is dropped from the top of a cliff. Which graph best represents the relationship between the ball's total energy and elapsed time as the ball falls to the ground? (Assume air resistance is negligible.)

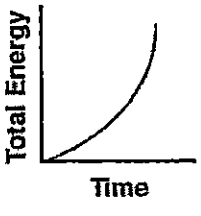
A



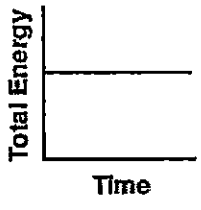
B



C



D

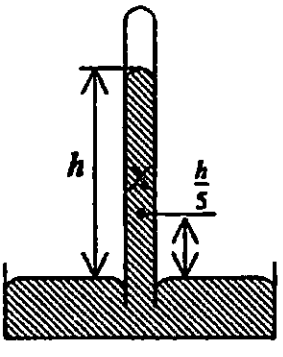


16 In the Brownian motion experiment involving smoke particles in the air, heavy particles settle quickly but very small particles remain suspended for long periods of time. This is because

A air pressure has a greater effect on smaller particles.
B the small smoke particles have the same density as air.
C the Earth's gravitational field has a negligible effect on very small particles.
D smaller particles are more easily affected by the bombardments of the air molecules.

17 The height of a mercury barometer is h when the atmospheric pressure is 100 000 Pa.
What is the pressure at **X**?

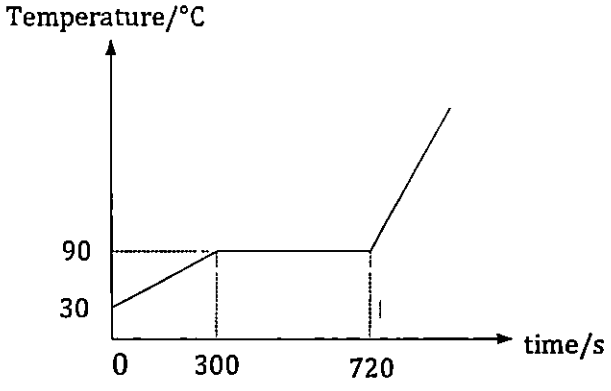
A 20 000 Pa
B 80 000 Pa
C 120 000 Pa
D 180 000 Pa



18 A piece of aluminium of mass m has a specific heat capacity of c. A piece of metal Y of mass $2m$ has a specific heat capacity of $2c$. Both of these metals receive the same quantity of heat and the temperature of the metal Y rises by 10°C. By how much did the temperature of the aluminium rise?

A 5°C
B 10°C
C 20°C
D 40°C

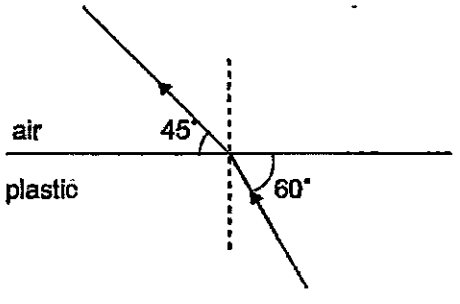
19 The diagram shows a graph of temperature against time when 0.5 kg of salt is being heated.



If thermal energy is supplied to the salt at a rate of 100 W, what is the specific latent heat of fusion of the salt?

A 1.4×10^3 J/kg
B 2.1×10^4 J/kg
C 8.4×10^4 J/kg
D 1.4×10^5 J/kg

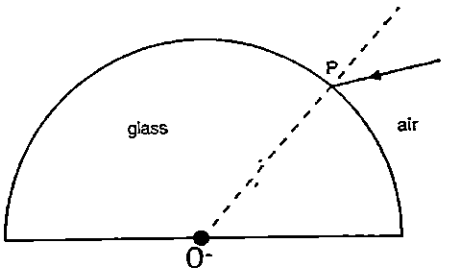
20 The diagram shows a ray of light moving from plastic to air.



What is the refractive index of plastic?

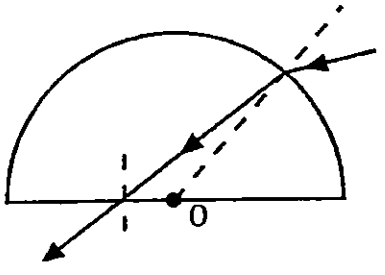
A 0.707
B 0.816
C 1.22
D 1.41

21

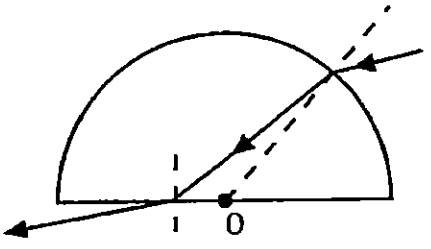


A ray of light in air is incident on a semicircular block of glass at point **P**, as shown in the diagram above. **OP** is a radius of the semicircle. Which of the following ray diagrams shows how the ray will pass through the block and into the air again?

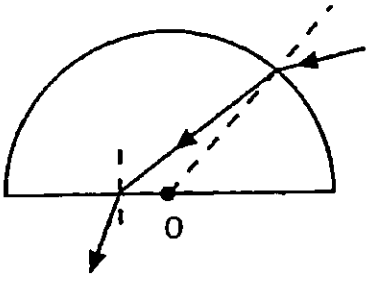
A



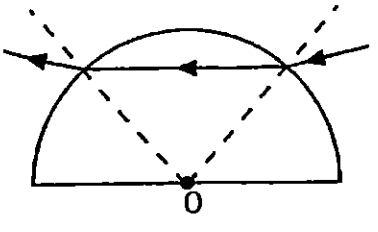
B



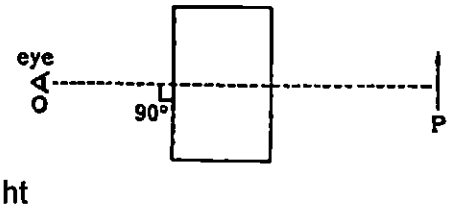
C



D



22 An observer looks straight through a rectangular glass block at an object **P**, as shown below. How does the object appear to the observer?

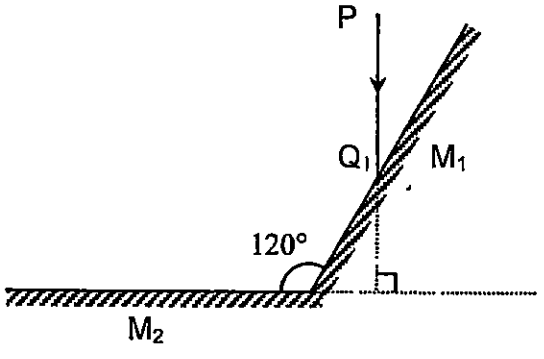


A Moved to the right
B In its true position
C Laterally inverted
D Nearer

23 When an object is placed 20 cm from a thin converging lens, a real image equal in size to the object is formed. The object is then moved 5 cm towards the lens. Which of the following describes the new image formed?

	Image Distance	Image Size
A	more than 20 cm	magnified
B	more than 20 cm	diminished
C	less than 20 cm	magnified
D	less than 20 cm	diminished

24 The following diagram shows two mirrors inclined at 120 °.



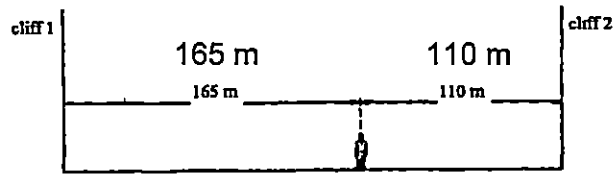
An incident ray **PQ**, whose direction of propagation is perpendicular to M_2, is reflected by M_1. What is the angle of reflection at M_2 ?

A 30°
B 45°
C 60°
D 75°

25 Which is one practical application of infra-red radiation?

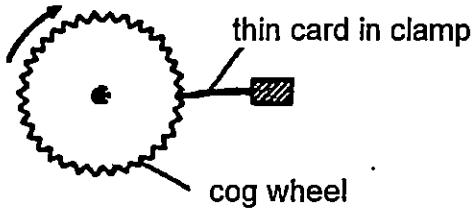
A Used to produce vitamin E
B Used to check for flaws in metals
C Used in the remote controls for various electrical appliances
D Used in mobile phones

26 A man stands between two cliffs as shown in the diagram and claps his hand once.
Assuming that the velocity of sound in air is 330 m/s, what will be the time interval between the two loudest echoes?



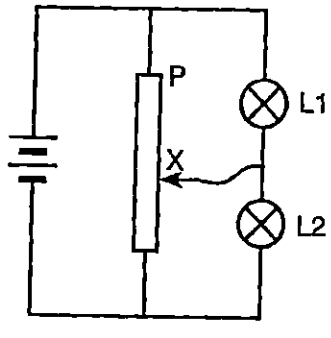
A 1/6 s
B 1/3 s
C 2/3 s
D 5/6 s

27 A piece of thin card was held against the teeth of a cog wheel. When the wheel is turned at the high speed a note is heard. How may the pitch of this note be raised?



A Using a thicker card
B Using a longer card
C Pressing the card against the teeth with a greater force
D Turning the wheel more quickly

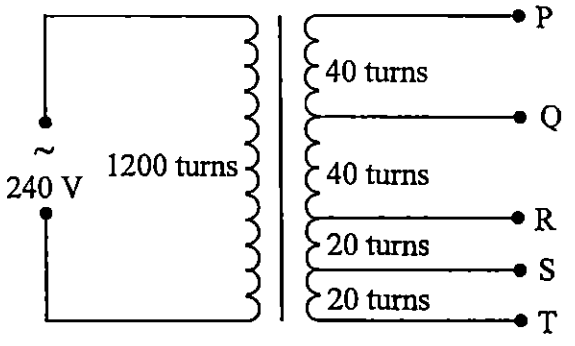
28 The diagram shows a potential divider circuit.



What happens to the brightness of lamp **1** and lamp **2** as the contact **X** is moved away from point **P** of the potential divider?

	lamp 1	**lamp 2**
A	brighter	stay the same
B	brighter	dimmer
C	dimmer	stay the same
D	dimmer	brighter

29 A transformer consists of one coil with 1200 turns and a second coil, with a total of 120 turns, which can be tapped at various points as shown.



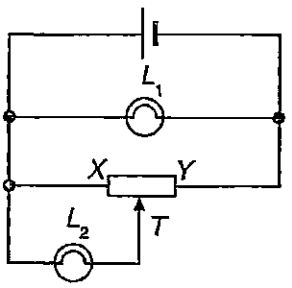
Which pair of terminals should be connected to a 12 V, 24 W lamp for it to be lit normally?

A PS
B QS
C RT
D PT

30 The school hall is fitted with 20 units of air-conditioner, each rated 2400 W. During the 10 days of school examination, the air-conditioners had to be switched on twice a day and each session lasted for 3 hours. If each unit of electricity costs 25 cents, how much do the school have to pay to provide air-conditioning for the students during the examination?

A $36.00
B $360.00
C $72.00
D $720.00

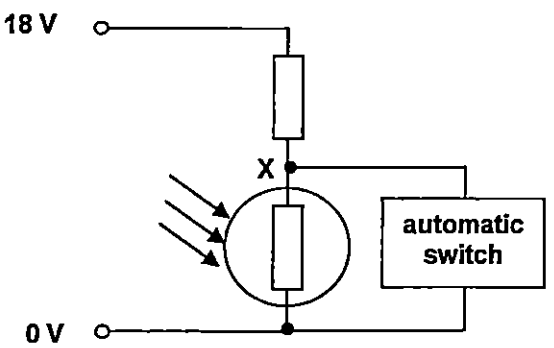
31 The figure below shows an electric circuit.



Which one of the following describes the brightness of L_2 in the given circuit when the tab T of the potential divider is moved slowly from X to Y?

A It is originally as bright as L_1 and then dims gradually.
B It is originally half as bright as L_1 and then dims gradually.
C Its brightness increases gradually and is finally as bright as L_1.
D Its brightness increases gradually and is finally half as bright as L_1.

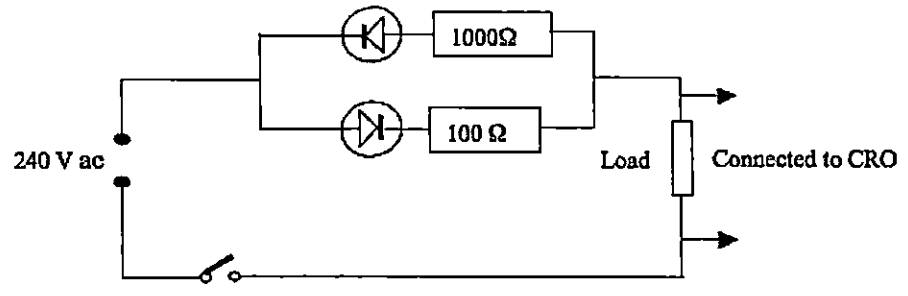
32 The circuit shown below is connected to an automatic switch for the lights in the garden. The automatic switch needs a voltage at X of 12 V or higher for the lights to be on. The lights are to come on at sunset and the value of the fixed resistor is 400 Ω.



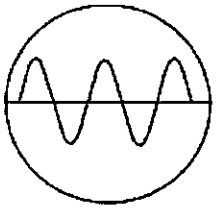
What must be the minimum resistance of the light-dependent resistor in order for the lights to come on at sunset?

A 400 Ω
B 800 Ω
C 1200 Ω
D 1600 Ω

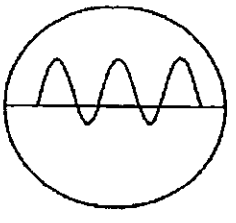
33 A circuit is set up as shown in the diagram below and a load is connected to the CRO. Which is the correct waveform on the CRO when the switch is closed?



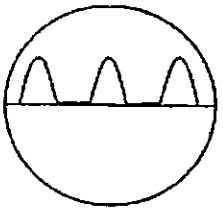
A.



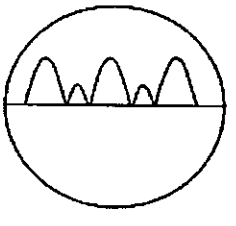
B.



C.



D.

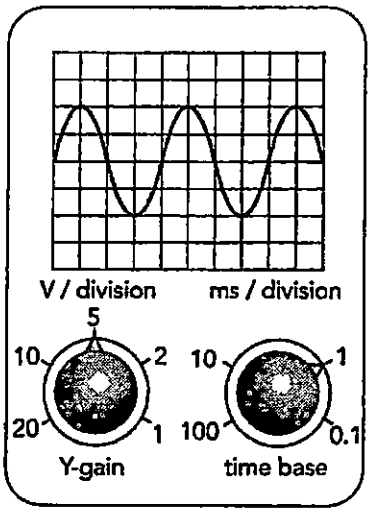


34 Two foam balls which are wrapped with aluminium foil, suspended from adjacent silk threads, attract each other. Which of the following is/are possible explanations for this scenario?

(I) The magnetism is strong
(II) They are oppositely-charged.
(III) Only one of them is charged.

A (I) only
B (II) only
C (I) and (II) only
D (II) and (III) only

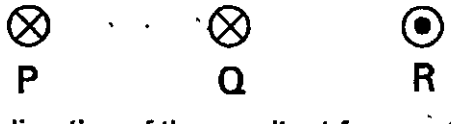
35 An alternating voltage signal is displayed on an oscilloscope, with the settings shown in the figure below.



Which of the following combinations gives the correct values for the peak voltage and frequency of the signal?

	Peak voltage / V	Frequency / Hz
A	10	100
B	10	250
C	20	250
D	20	1000

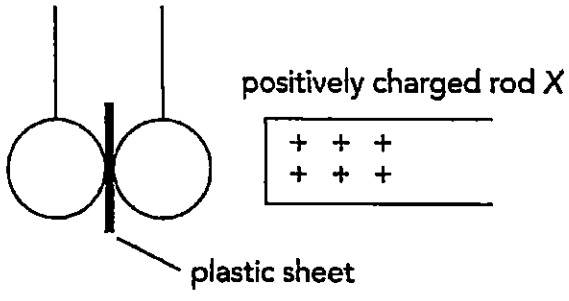
36 The figure below shows three parallel long straight wires **P**, **Q** and **R**. **P** and **Q** carry currents flowing into the paper and **R** carries a current flowing out of the paper.



What is the direction of the resultant force acting on **Q**?

A ↑ B ↓ C ← D →

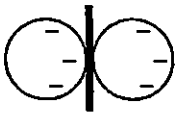
37 The figure below shows two uncharged metal spheres suspended by insulating threads and separated by a plastic sheet. A positively charged rod **X** is brought near them as shown.



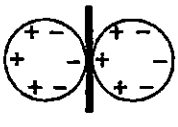
Which of the following diagrams shows the resulting charge distribution on the spheres?

A.

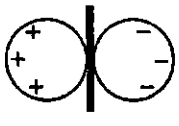
B.



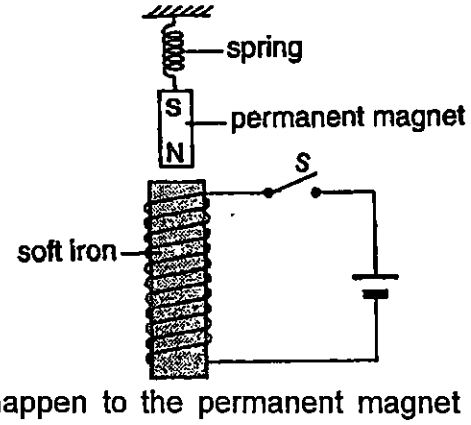
C.



D.



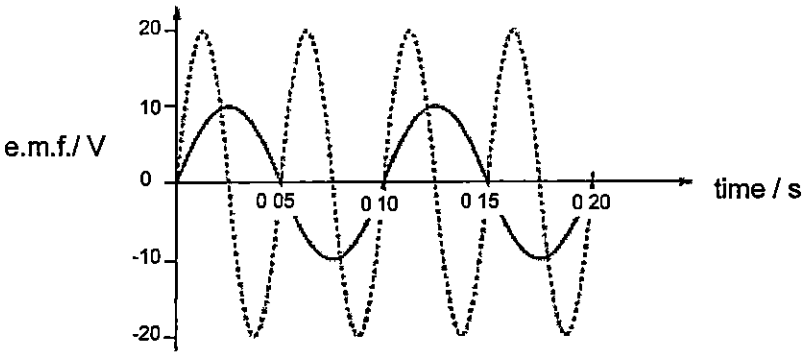
38 The figure below shows a permanent magnet suspended from a spring placed right on top of an electromagnet.



What will happen to the permanent magnet once the switch **S** is turned on?

A The magnet is pulled downwards.
B The magnet is pushed upwards.
C The magnet is stationary.
D The magnet starts to swing from left to right.

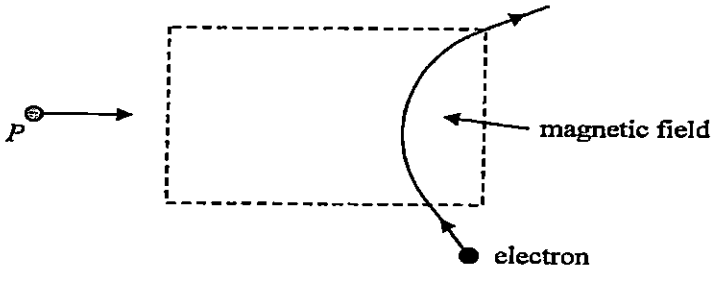
39 In the graph shown, the solid curve shows how the e.m.f. produced by a simple generator varies with time. The dashed curve is the output from the same generator after a modification has been made to the generator.



Which modification was made to produce the result shown?

A The area of the coil was doubled.
B A split-ring commutator was added.
C The number of turns in the coil was doubled.
D The speed of rotation of the coil was doubled.

40 When an electron enters a magnetic field, it is deflected in the direction as shown below.
When a positively-charged particle **P** enters the magnetic field from the left, it will be deflected



A to the top
B to the bottom
C out of the paper
D into the paper

For Examiner's Use

Section A (50 marks)
Answer all Questions

1 A ball was given a push and it rolled up a smooth slope. **Figure 1** below describes the motion of the ball.

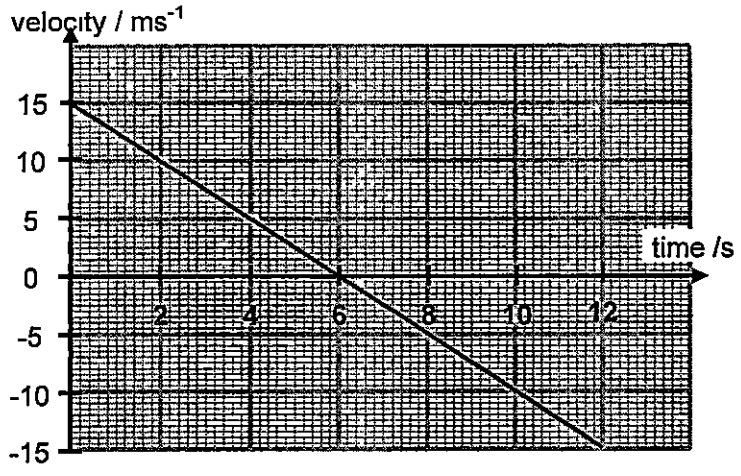


Figure 1

(a) Describe the motion of the ball for the **first half of the journey.** [1]

(b) Find the displacement of the ball for the first 8.0 s. [2]

(c) Define the term ***velocity.*** [1]

(d) Define Newton's First Law of Motion [1]

---

2 A large vessel is towed by two tug boats P and Q as shown in **Figure 2.** [4]

The vessel of mass 5000 kg moves forward with an acceleration of 1.2 ms^{-2}.

By drawing a suitable scaled diagram, determine the tension in the two ropes T_P and T_Q.

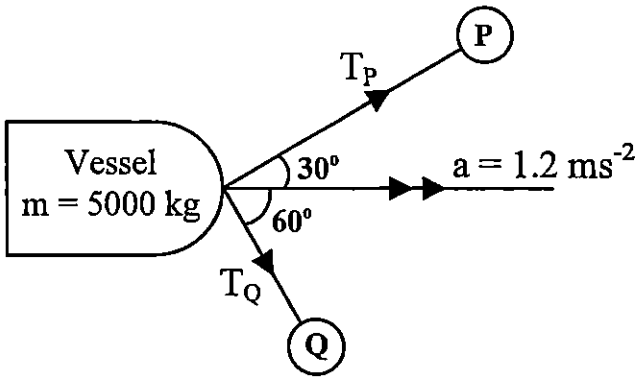
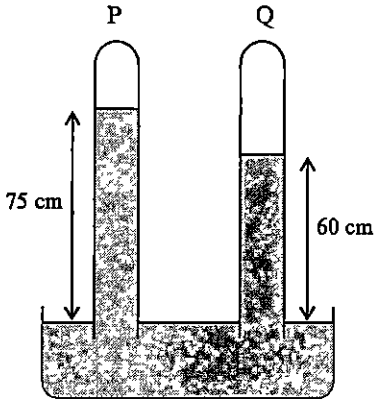


Figure 2

3 Figure 3 below shows two vertical tubes **P** and **Q**, each closed at the upper end. The space above the mercury meniscus of tube **P** is a vacuum but not that of tube **Q**.

The density of mercury is 1.36×10^4 kg/m^3.



(a) (i) Determine the pressure, in Pa, exerted by the air in the space above the mercury meniscus of tube **Q**. [2]

(ii) Tube **Q** is pushed further into the trough such that its lower end is immersed more deeply in the reservoir of mercury. How would the height of the mercury column in tube **P** and tube **Q** be affected respectively? [1]

(b) Explain in terms of the movement of the molecules,

(i) how the air inside a car tyre exerts a pressure on the walls of the tyre, [2]

(ii) why the air pressure in the car tyre increases after a long journey. [2]

4 Some electrical components are easily damaged if electric charge is placed on them. They are often stored by placing them in contact with a conductor.

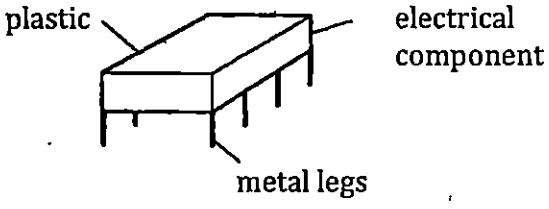


Figure 4.1

(a) When the component shown in **Figure 4.1** is rubbed with a cloth, the metal legs become negatively charged. Explain how this happens. [1]

(b) **Figure 4.2** shows the negatively charged metal legs placed near a piece of aluminium foil which rests on an insulator.

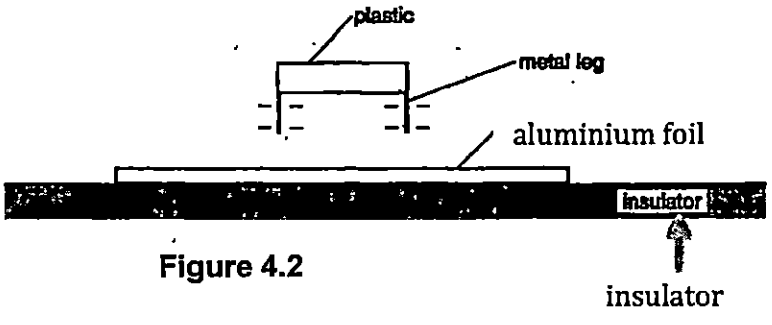


Figure 4.2

(i) On **Figure 4.2**, draw the induced charges that form on the aluminium foil. [1]

(ii) The metal legs are placed in contact with the aluminium foil. Describe what happens to the foil and on the legs. [2]

5 **Figure 5** shows a simple setup used to study the flow of current from terminal **X** to terminal **Y** through the solenoid.

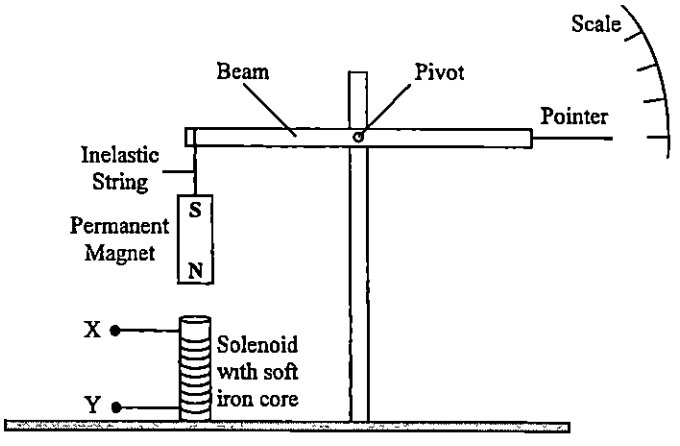


Figure 5

(a) Describe how the setup works to measure the magnitude of current flow. [3]

(b) Suggest two ways to increase the sensitivity of this setup. [1]

(c) The setup will not work if the polarity of the current flow is reversed (i.e. current flows from terminal **Y** to terminal **X** through the solenoid).

(i) Explain why this is so. [2]

(ii) Suggest and explain how the setup can be modified to correct this problem. [2]

6 **Figure 6.1** shows a drill that is being spun with a magnet attached to the drillbit. A coil of wire around an iron core is placed above the rotating magnet. The ends of the coil are connected to the y-input of the cathode ray oscilloscope(CRO).

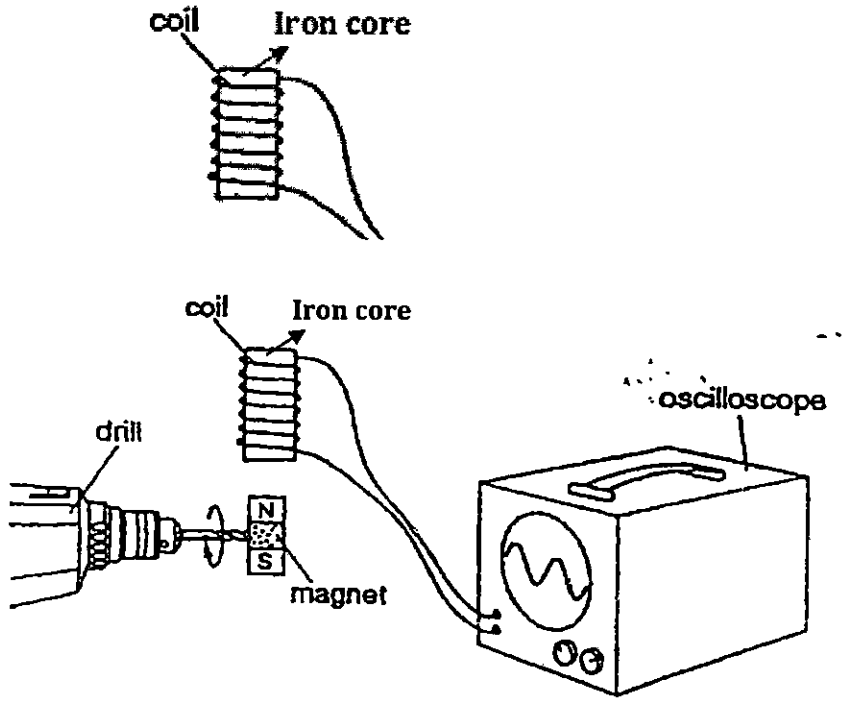


Figure 6.1

(a) Explain why there is a current induced in the coil when the drillbit rotates. [1]

(b) Draw clearly on **Figure 6.1** the direction of the current in the coil as the N-pole of the magnet approaches the coil. [1]

(c) The following display **B** is seen on the CRO screen in **Figure 6.2**. Draw on the figure, the display when the speed of the drill bit is halved. Label it as **curve C**. [2]

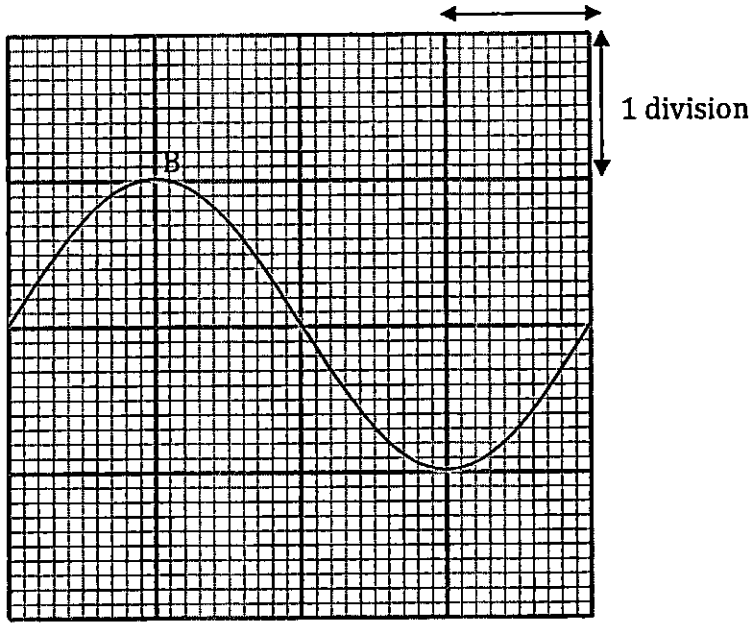


Figure 6.2

(d) The time-base of the CRO is currently 6 ms/division. Draw also on **Figure 6.2** what happens to **curve B** when the time-base is doubled to 12 ms/division. Label it as **curve D.** [1]

(e) State the effects on the amplitude and frequency of the display if the soft iron core is replaced by a copper core. [1]

_____

_____

_____

_____

7 The graph in **Figure 7.1** shows the relationship between temperature, **θ** , and time, **t** , of two objects **Y** and **Z** of the same material and water. The masses of **Y**, **Z** and water are m_1 kg and $3m_1$ kg and **1.5** kg respectively. They are heated with the same heater for the same period of time. The specific heat capacity of water is 4200 J/kg.

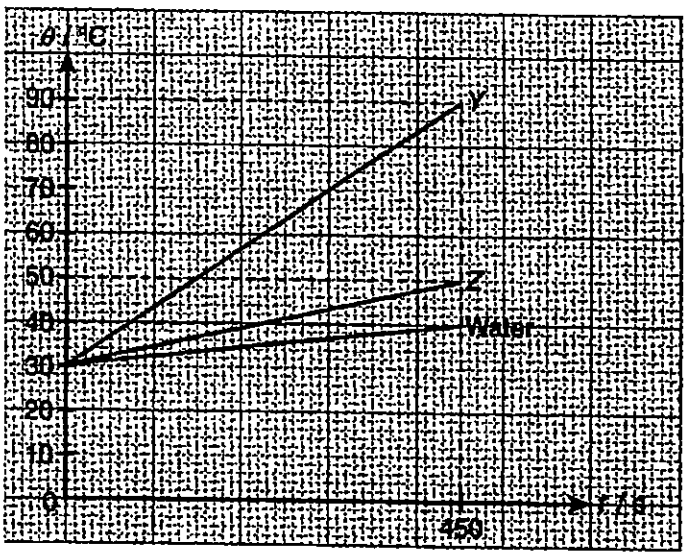


Figure 7.1

(a) From the graph, find the heat capacity of **Y** and **Z**. [2]

(b) If m_1 = 2 kg, what is the specific heat capacity of objects **Y** and **Z**? [2]

8 **Figure 8.1** shows a rectangular glass block **KLMN**.

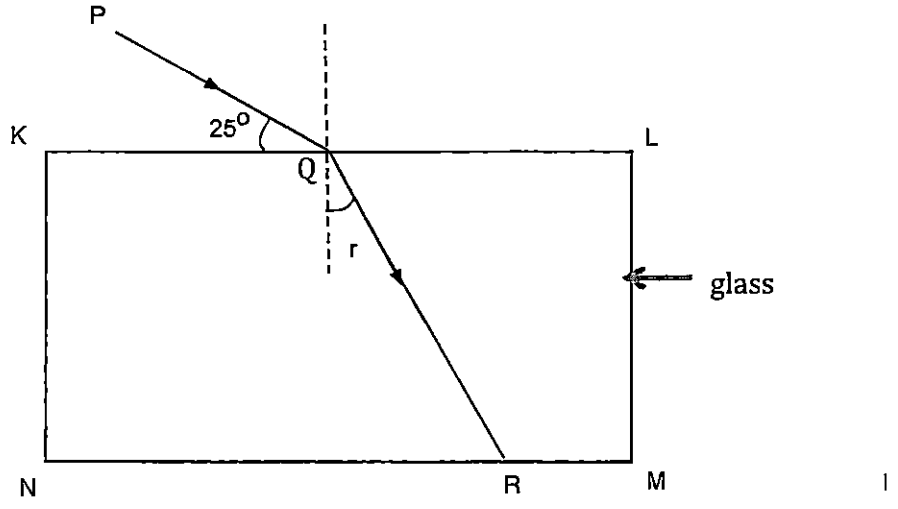


Figure 8.1

The refractive index of the glass is 1.50. The ray of light **PQ** is refracted when passing through the rectangular glass block.

(a) Explain why the ray is refracted. [1]

(b) Calculate angle of refraction, **r** of the ray **PQ** passing through the surface **KL**. [1]

(c) The rectangular glass block is displaced slightly to the left, as shown in **Figure 8.2**.

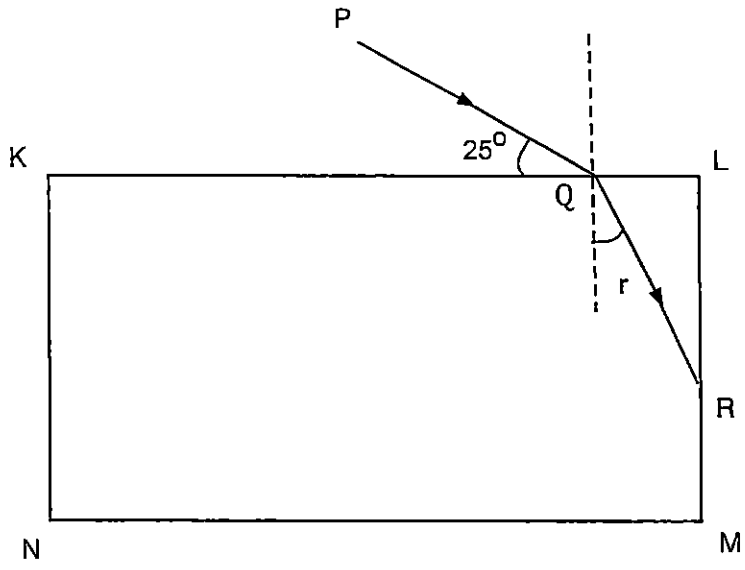


Figure 8.2

(i) Using a pen, complete the diagram in **Figure 8.2** to show the path of the ray immediately after it strikes the surface **LM** till it emerges from the glass block. [1]

(ii) Explain your answer in **(c)(i).** [2]

(d) What are the two conditions required for total internal reflection to take place? [1]

---

9 **Figure 9.1** shows a converging lens producing an image I of an object **O**. It is drawn to scale.

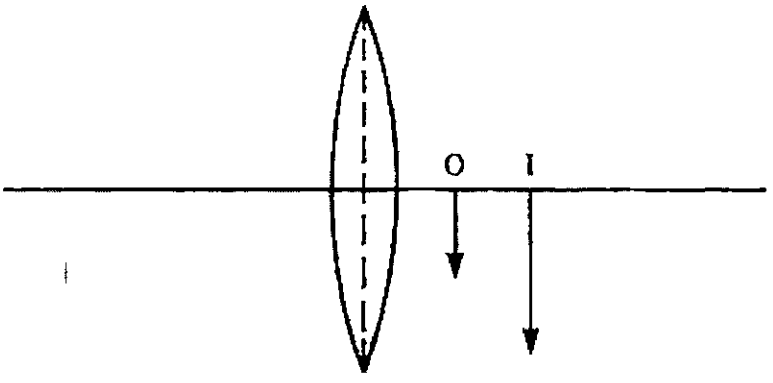


Figure 9.1

(a) (i) By adding rays to the diagram, find the position of the principal focus and label it **F**. Hence, determine the focal length of the lens. [2]

(ii) Name one use of this arrangement. [1]

(b) Optical fibres have taken the place of wires in telecommunications. A length of a glass optical fibre carrying a ray of light is shown in **Figure 9.2** below. In this situation the glass has a refractive index of 1.5.

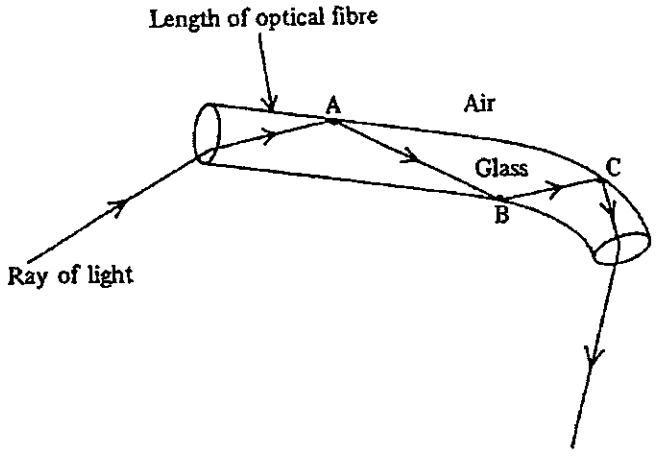


Figure 9.2

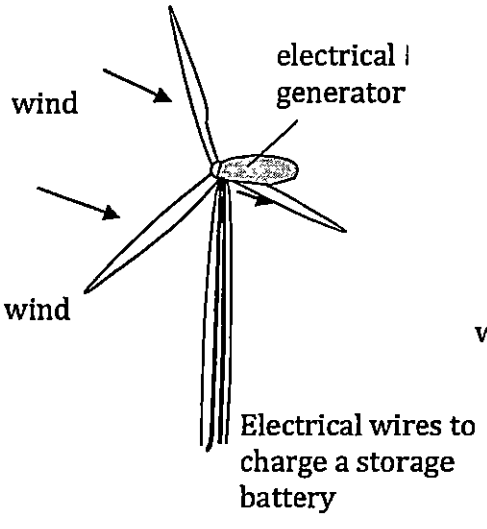
(i) Calculate the size of the largest angle that the light ray can make with the walls so that it does not escape through them. [1]

(ii) State two advantages of the use of optical fibre in telecommunications as compared to using copper wires. [2]

Section B (30 marks)

Answer all the Questions in this section. **Question 12** has a choice of parts to answer. Answer only one of the two alternative questions in **Question 12.**

10 **Figure 10.1** shows a wind turbine used to produce electricity. The turbine blades are turned by the wind and are connected to a d.c. electrical generator which then charges a battery.



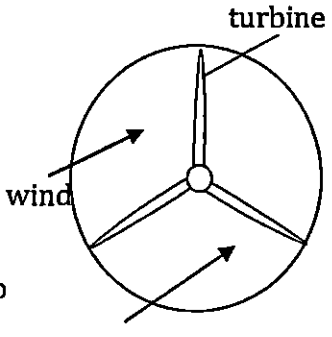


Figure 10.1 **Figure 10.2**

In one revolution the blades sweep out a circle as shown in **Figure 10.2.** In 60 s a mass of 54,000 kg of air traveling at a speed of 6.0 m/s is incident on that circle. 25% of this moving air hits the blades and leaves the turbine at a speed of 2.0 m/s. The rest of the moving air passes straight through the circle with the original speed of 6.0 m/s.

(a) Calculate

(i) the loss of kinetic energy of air in 60 s. [2]

(ii) the power of the turbine that is available to charge a storage battery. [2]

(b) The storage battery is used to light up street lamps, each having a power of 240 W.
Each street lamp is to be switched on for 8 hours per day.

(i) Calculate the amount of energy used by each lamp, in kWh. [1]

(ii) Estimate the maximum number of street lamps that can be operated if the wind is available for 10 hours per day. [2]

(c) Explain briefly why more energy is produced per second if

(i) the wind blows faster, [1]

(ii) the turbine blades are longer [1]

(iii) the turbine is more efficient. [1]

---

11 Ruth uses a mobile phone.

(a) She sets the ring tone of her mobile phone to produce a sound consisting of two notes, one after another. **Figure 11.1** shows the trace on a cathode-ray oscilloscope (CRO) screen produced by the first of the notes.

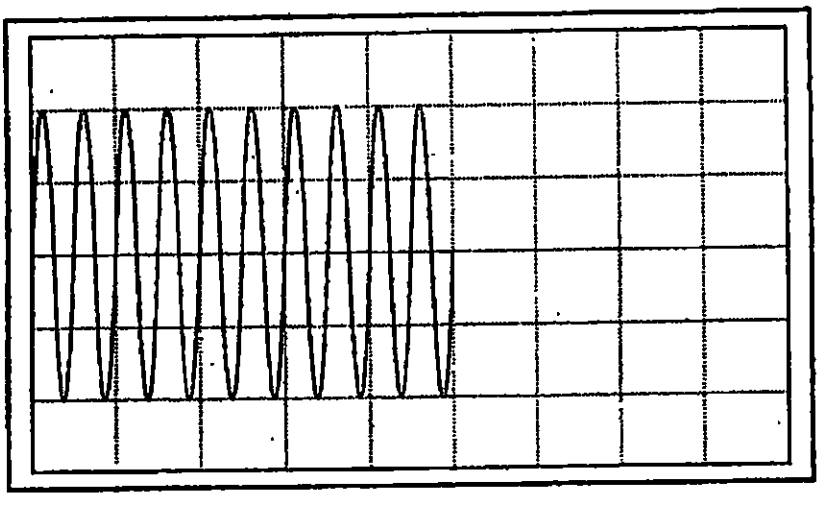


Figure 11.1

The second note is softer and has lower pitch. [2]

On **Figure 11.1**, continue the trace to show what happens when the second note is played.

(b) Ruth wonders if the energy from the radio waves of her mobile may cause a significant temperature rise in her brain. To investigate this effect, she calculates the heating effect of the mobile phone on a beaker of water placed next to it, as shown in **Figure 11.2**.

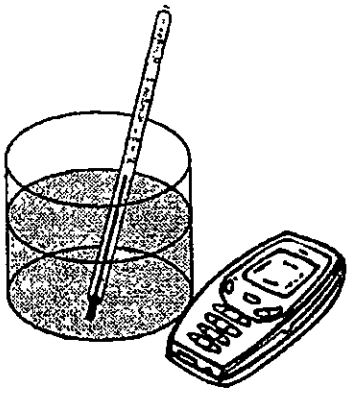


Figure 11.2

Figure 11.3 shows the relevant information about the mobile phone taken from the manual.

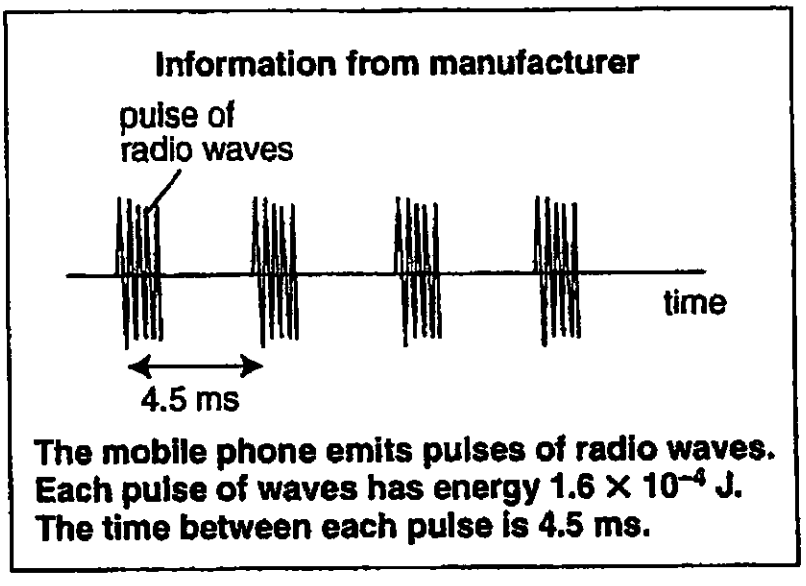


Figure 11.3

The mobile phone is used for 5 minutes next to a beaker containing 40 g of water.

(i) Determine the number of pulses of radio waves produced during the mobile phone call. [1]

(ii) Determine the total energy of the radio waves emitted during the mobile phone call. [1]

(iii) Determine the maximum temperature rise produced in 40 g of water if all the energy calculated in **(b)(ii)** is absorbed by the water. (The specific heat capacity of water is 4.2 J/gK). [1]

(iv) Explain why motorists choose to use water as the liquid in the car radiator? [1]

(v) Define the specific latent heat of fusion of a substance. [1]

(c) A small quantity of crushed ice was allowed to warm up from a temperature of -2°C. The graph in **Figure 11.4** below shows how the temperature of the ice varied with time.

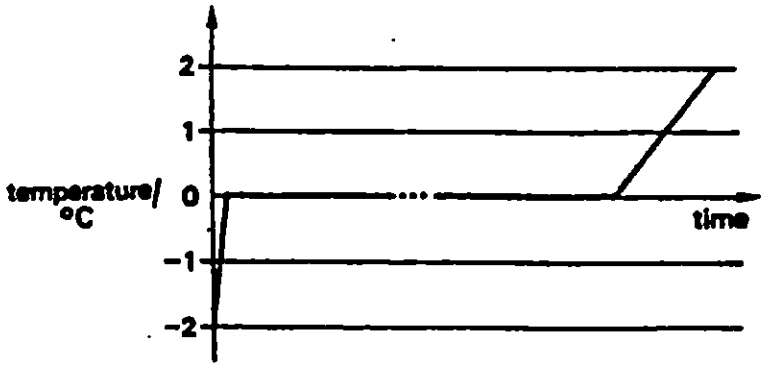


Figure 11.4

(i) Explain why, after an initial rise to 0°C, the temperature of the body remained constant. [2]

(ii) Suggest why the slope of the graph between -2°C and 0°C is greater than that between 0°C and +2°C. [1]

Answer only **one** of the following choice questions.

EITHER

12 **Figure 12** shows two insulated copper coils, **P** and **Q** mounted close together on a wooden rod. Coil **P** is connected to switch **S** and a battery. Coil **Q** is connected to a sensitive voltmeter V.

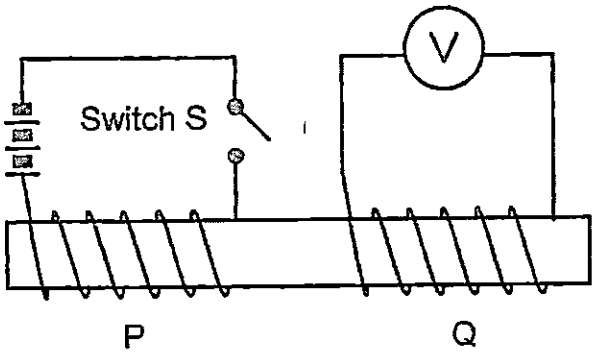


Figure 12

(a) When the switch S is closed, a deflection is seen on the meter. This deflection lasts for a very short time.

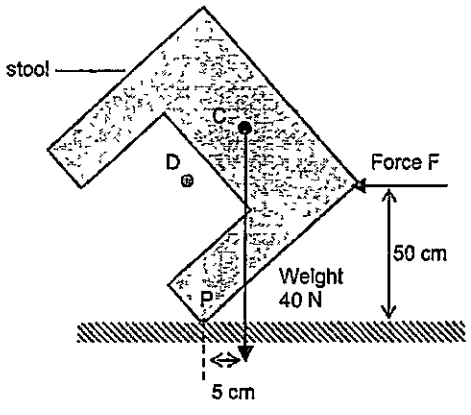
State the direction of the current flow through the meter? Justify your answer. [2]

(b)(i) Give two ways in which the efficiency of a transformer can be improved. [1]

(ii) Explain why the primary coil is made of thin wire and the secondary coil made of thick wire for a step-down transformer. [1]

(c) Define Faraday's Law of Electromagnetic Induction. [1]

(d) The figure below shows a stool. A horizontal force **F** keeps the stool balanced. **C** is the centre of gravity of the stool and the weight of the stool is 40 N.



(i) On the figure above, draw and label an arrow to show the vertical force that acts on the stool. [1]

(ii) Explain why a stool is more stable with a centre of gravity at **D** rather than at **C**. [2]

(iii) State two ways in which you can make a double-decker bus more stable? [1]

(iv) Define the centre of gravity of an object. [1]

OR

12 Jonah poured 250 g of hot tea into a container. He placed a temperature sensor into the tea and started measuring the temperature with respect to time. After a while, he added some ice cubes into the tea.
Figure 12.1 below shows the temperature-time graph obtained.

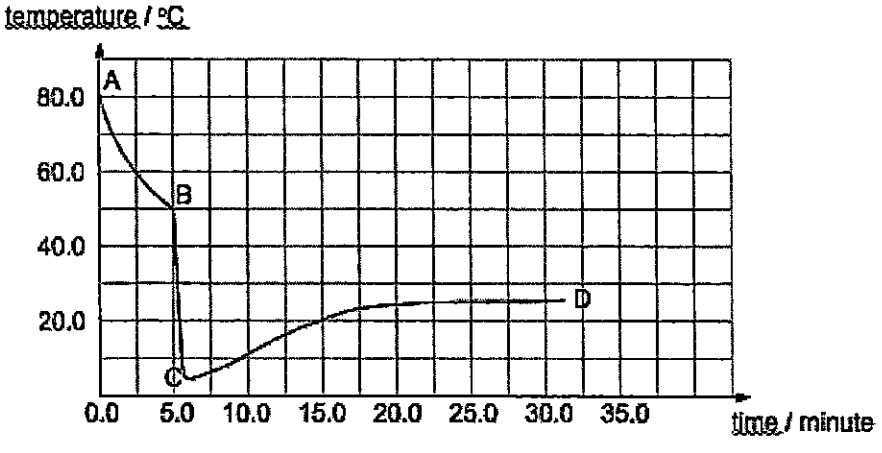


Figure 12.1

The following information is provided :

specific latent heat of fusion of ice	3.36×10^5 J kg^{-1}
specific latent heat of vaporisation of water or *tea*	2.26×10^6 J kg^{-1}
specific heat capacity of ice	2.10×10^3 J kg^{-1} °C^{-1}
specific heat capacity of water or *tea*	4.20×10^3 J kg^{-1} °C^{-1}

Assume there is no loss of thermal energy to the surrounding and the temperature of the ice cubes before being added into the hot tea is 0 °C.

(a) State the time that Jonah added the ice cubes into the tea. [2]
Explain your answer.

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

(c) Calculate the total mass of the ice cubes added into the hot tea. [2]

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

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

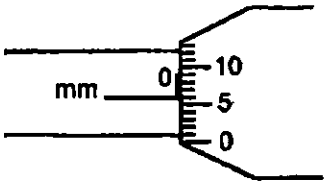
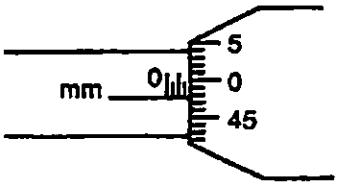
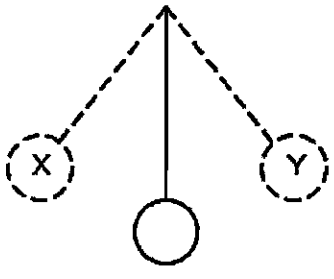
(f) In another experiment, Jonah placed 250 g of hot tea in the same empty container. When the temperature of the hot tea was 80 °C, he started the stopwatch. He continued to measure the temperature of the tea without adding any ice cubes.

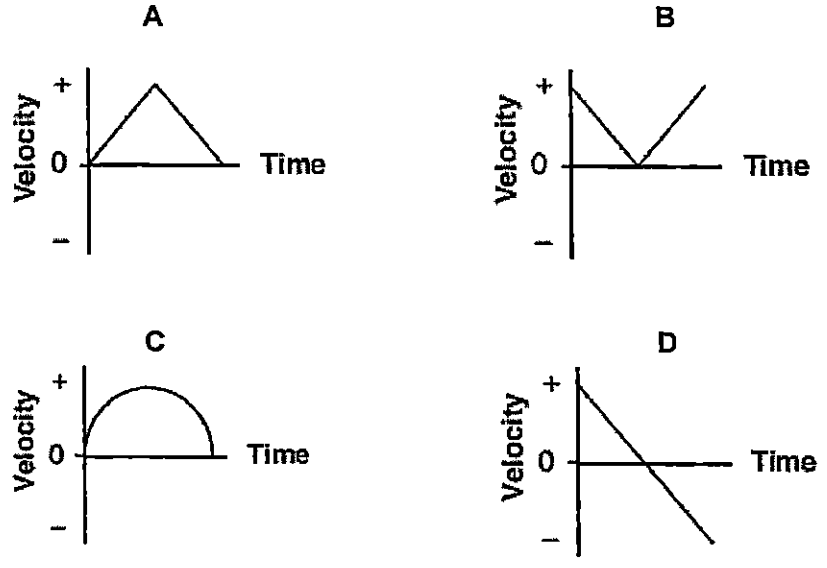
Draw the temperature-time graph for the second experiment on the same graph in **Figure 12.1**. [1]

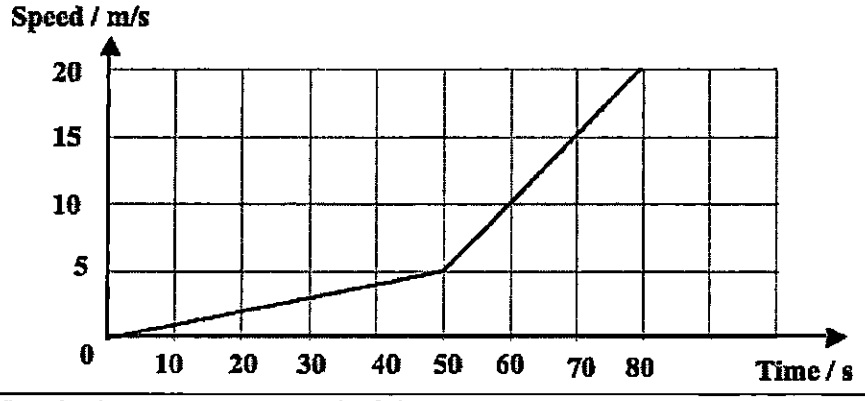
≈ End of Paper ≈

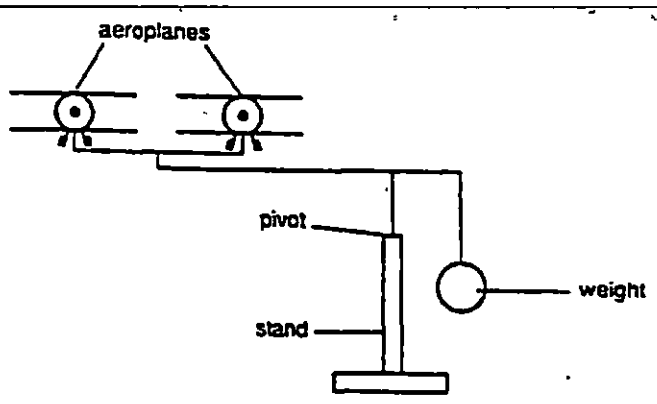
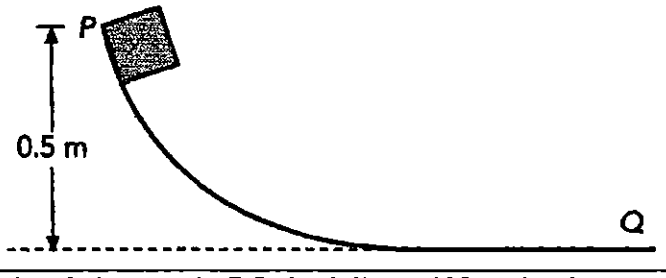
For Examiner's Use

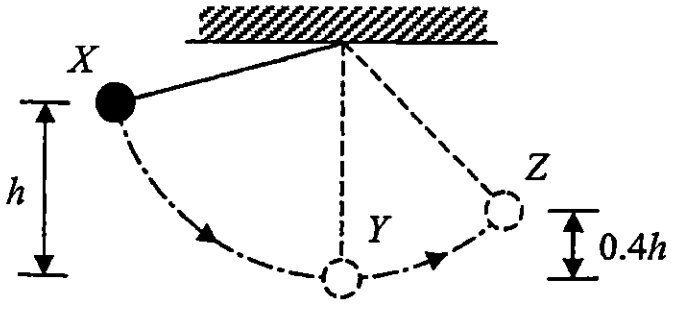
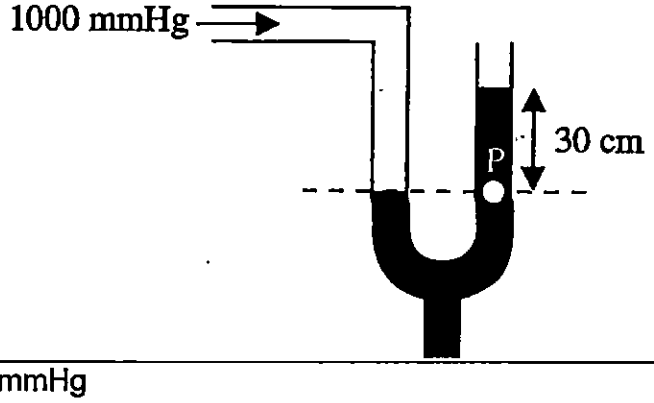
MCQ (Answer All Questions)

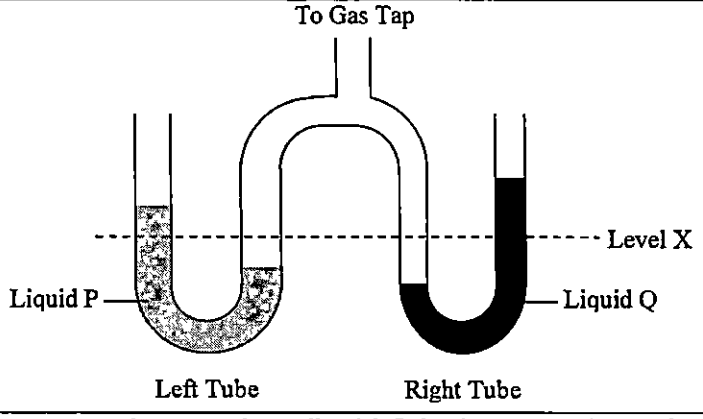
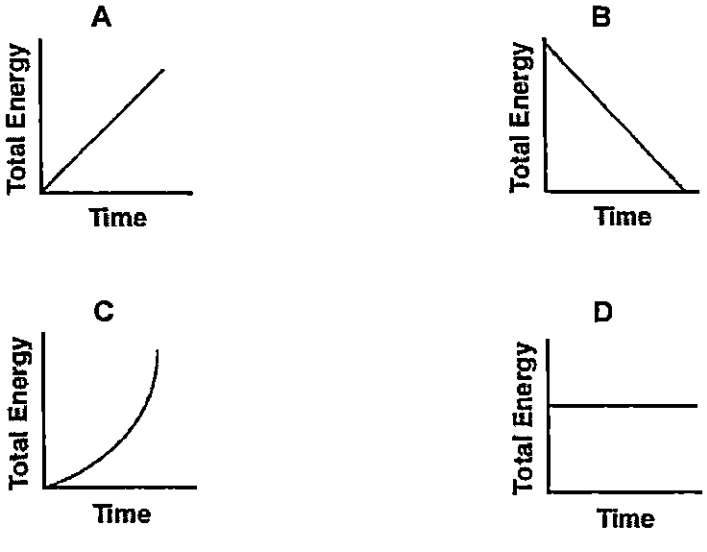
1	The diameter of a ball is measured using a micrometer screw gauge. A student takes an intial zero error reading and then a reading of the diameter. The diagrams show an enlargment of the screw gauge readings.	
	zero reading  diameter reading 	
	What is the diameter of the ball?	
	A 1.42 mm **B** 1.92 mm **C** 1.98 mm **D** 2.04 mm	B
2	It takes 36.5 s for a pendulum to swing from X to Y and back again twenty times.	
		B
	What is the frequency of the pendulum?	
	A 0.274 Hz **B** 0.548 Hz **C** 1.830 Hz **D** 2.740 Hz	
3	A stone is thrown vertically upwards with a velocity of 5.0 m/s. After time ***t***, it reaches the original position. Neglecting air resistance, the time required for the ball to reach the highest position is	
	A 10.0 t **B** 5.0 t **C** 2.5 t **D** 0.5 t	D

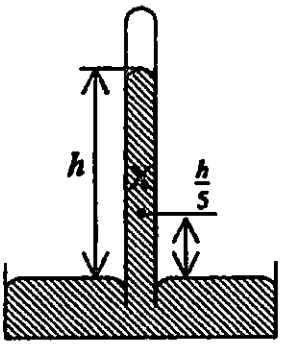
4	A student throws a baseball vertically upward and then catches it. If vertically upward is considered to be the positive direction, which graph best represents the relationship between velocity and time for the baseball? [Assume air resistance is negligible.]	
		D
5	Which of the following statements concerning the motion of a body is/are correct?	
	(I) A body can have zero acceleration but still in motion. (II) A body can have zero velocity but is also accelerating. (III) A body can have constant speed but varying velocity.	
	A (I) and (II) only **B** (I) and (III) only **C** (II) and (III) only **D** (I), (II) and (III)	D
6	A wooden block of mass 3.0 kg moves with uniform speed when it is pulled by a constant horizontal force of 6.0 N on a horizontal surface. What will happen to the motion of the wooden block if the horizontal force is increased to 12.0 N?	
	A Moves at a constant speed of 2.0 m/s. **B** Moves at a constant speed of 4.0 m/s. **C** Moves with an acceleration of 2.0 m/s^2. **D** Moves with an acceleration of 4.0 m/s^2.	C

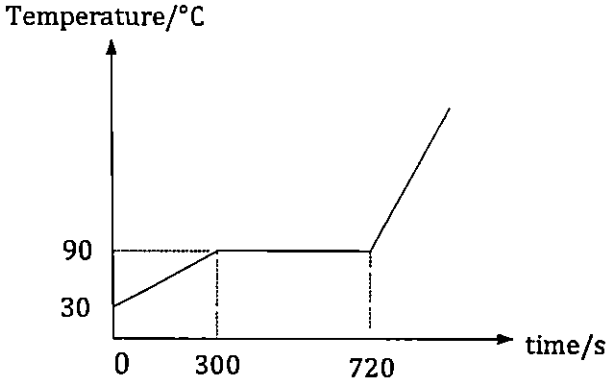
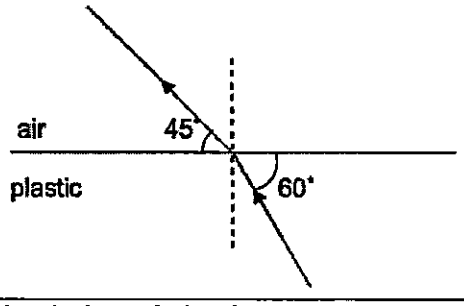
7	A bullet of mass 0.010 kg travelling horizontally at 100 m/s is stopped after penetrating through 0.20 m of wood. Find the average retarding force applied to the bullet by the wood.	
	A 10 N **B** 250 N **C** 500 N **D** 1000 N	B
8	The graph below shows how the speed of a car varies over a 80 s period.	
		
	What is the average speed of the car?	
	A 3.25 m/s **B** 6.25 m/s **C** 7.25 m/s **D** 12.5 m/s	B
9	The density of a metal bar is 12.0 g cm^{-3}. When a hole of volume 1.0 cm^3 is drilled into the bar, what will be its density be?	
	A 11.0 g cm^{-3} **B** 12.0 g cm^{-3} **C** 12.5 g cm^{-3} **D** 13.0 g cm^{-3}	B

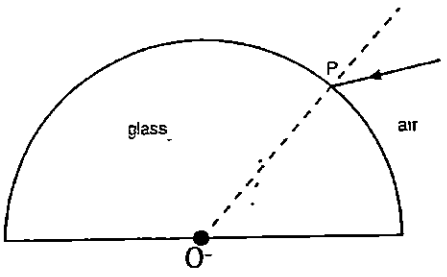
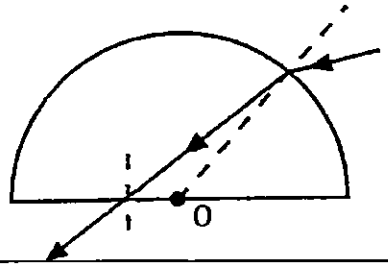
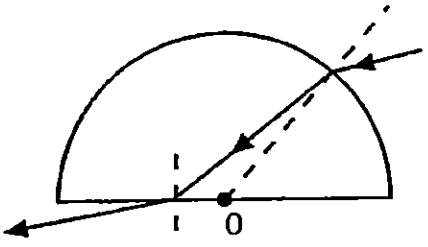
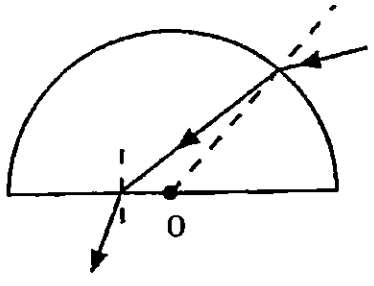
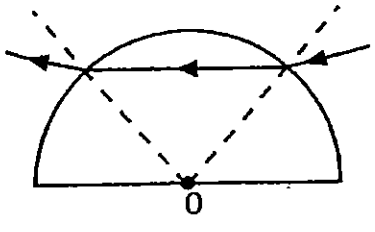
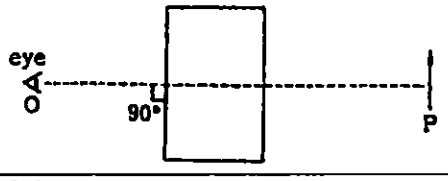
10	The diagram shows a balancing toy pivoted on a stand.If the toy is tilted slightly, it does not overbalance but returns to its original position. This is because the centre of gravity of the toy is	
		
	A between the aeroplanes. **B** below the pivot. **C** exactly at the pivot. **D** inside the weight.	B
11	A block of mass 2.0 kg is released from rest at point P as shown in the figure below. It is found that the block finally comes to rest at point Q.	
		
	Length of the track PQ is 2.5 m. What is the average value of frictional force acting on the block when it is moving from P to Q?	
	A 2.0 N **B** 2.5 N **C** 3.0 N **D** 4.0 N	D

12	A pendulum bob is released from rest at position **X** which is at a height ***h*** above its lowest position **Y** and then passes through position **Z**. Position **Z** is 0.4***h*** above **Y**. Assuming air resistance is negligible, find the ratio of the speed of the bob at position **Y** to that at position **Z**.	
		
	A 1.29 : 1 **B** 1.58 : 1 **C** 1.67 : 1 **D** 2.50 : 1	A
13	A manometer is connected to a 1000 mmHg air pressure at one end and the other end is left open as shown below. Given that the manometer is filled with mercury, what is the pressure at point **P**?	
		
	A 300 mmHg **B** 700 mmHg **C** 1000 mmHg **D** 1300 mmHg	C

14	The apparatus shown is connected to a gas tap in order to measure the pressure of the gas. The left tube contains liquid P whereas the right tube contains liquid Q. The levels in the tube were originally at X.	
		
	When the gas tap is turned on, liquid Q in the open limb of the right tube rises to a higher level than liquid P in the open limb of the left tube as shown. Why is this so?	
	A Liquid P has a higher density than liquid Q. **B** The right tube has a smaller cross-sectional area than the left tube. **C** There is more liquid Q in the right tube than liquid P in the left tube. **D** The gas exerts a greater pressure on the right tube as it is nearer to the gas inlet.	A
15	A ball is dropped from the top of a cliff. Which graph best represents the relationship between the ball's total energy and elapsed time as the ball falls to the ground? (Assume air resistance is negligible.)	
		D

16	In the Brownian motion experiment involving smoke particles in the air, heavy particles settle quickly but very small particles remain suspended for long periods of time. This is because	
	A air pressure has a greater effect on smaller particles. **B** the small smoke particles have the same density as air. **C** the Earth's gravitational field has a negligible effect on very small particles. **D** smaller particles are more easily affected by the bombardments of the air molecules.	C
17	The height of a mercury barometer is ***h*** when the atmospheric pressure is 100 000 Pa. What is the pressure at **X**?	
	A 20 000 Pa **B** 80 000 Pa **C** 120 000 Pa **D** 180 000 Pa 	B
18	A piece of aluminium of mass *m* has a specific heat capacity of ***c***. A piece of copper of mass ***2m*** has a specific heat capacity of ***2c***. Both of these metals receive the same quantity of heat and the temperature of the copper rises by 10°C. By how much did the temperature of the aluminium rise?	
	A 5°C **B** 10°C **C** 20°C **D** 40°C	D

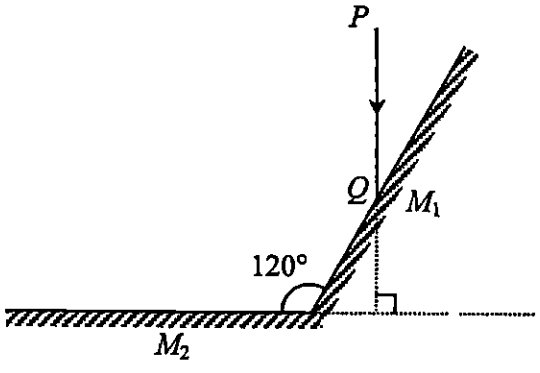
19	The diagram shows a graph of temperature against time when 0.5 kg of salt is being heated.	
		
	If heat energy is supplied to the salt at a rate of 100 W, what is the specific latent heat of fusion of the salt?	
	A 1.4×10^3 J/kg **B** 2.1×10^4 J/kg **C** 8.4×10^4 J/kg **D** 1.4×10^5 J/kg	C
20	The diagram shows a ray of light moving from plastic to air.	
		
	What is the refractive index of plastic?	
	A 0.707 **B** 0.816 **C** 1.22 **D** 1.41	D

21		
	A ray of light in air is incident on a semicircular block of glass at point **P**, as shown in the diagram above. **OP** is a radius of the semicircle. Which of the following ray diagrams shows how the ray will pass through the block and into the air again?	
	A  **B** 	B
	C  **D** 	
22	An observer looks straight through a rectangular glass block at an object **P**, as shown below. How does the object appear to the observer?	
		
	A Moved to the right **B** In its true position **C** Laterally inverted **D** Nearer	D

23 When an object is placed 20 cm from a thin converging lens, a real image equal in size to the object is formed. The object is then moved 5 cm towards the lens. Which of the following describes the new image formed?

	Image Distance	Image Size	
A	more than 20 cm	magnified	A
B	more than 20 cm	diminished	
C	less than 20 cm	magnified	
D	less than 20 cm	diminished	

24 The following diagram shows two mirrors inclined at 120 °.

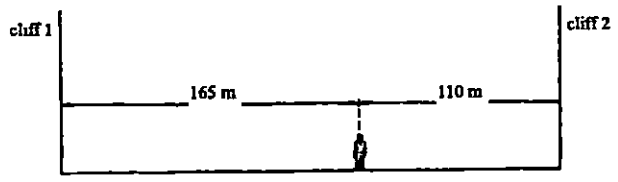
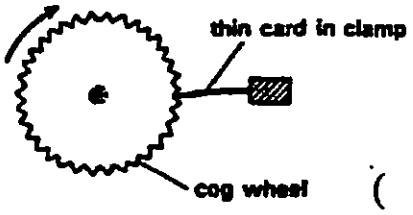
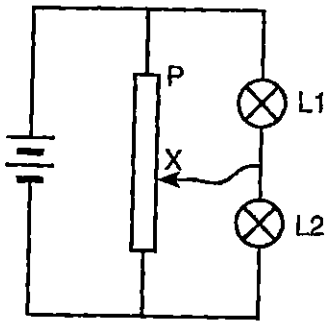


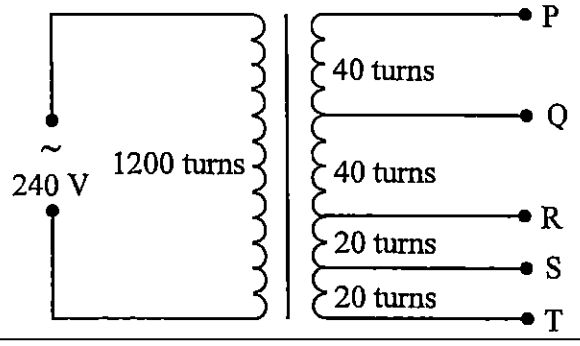
An incident ray **PQ**, whose direction of propagation is perpendicular to M_2, is reflected by M_1. What is the angle of reflection at M_2 ?

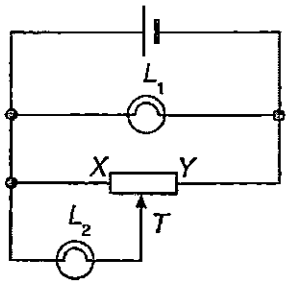
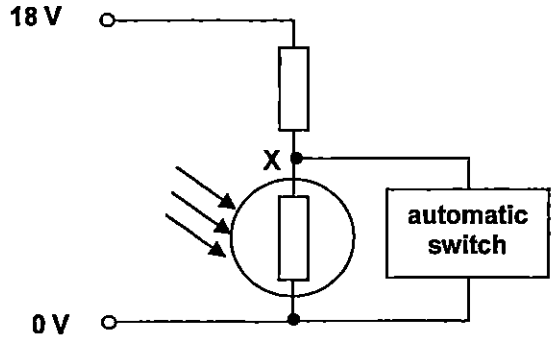
A	30°	C
B	45 °	
C	60 °	
D	75 °	

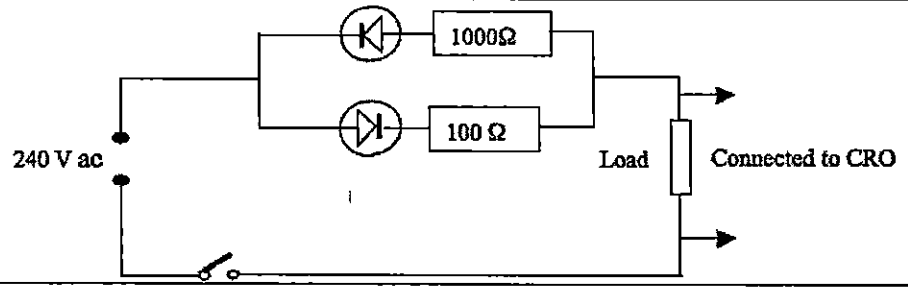
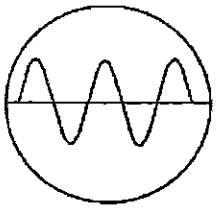
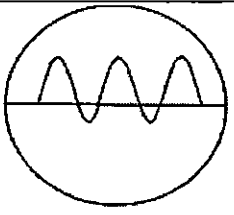
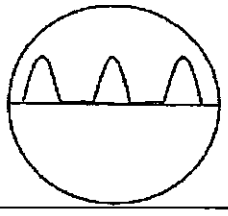
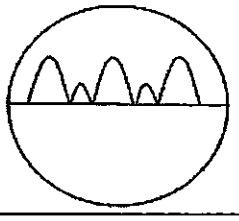
25 Which is one practical application of infra-red radiation?

A	Used to produce vitamin E	C
B	Used to check for flaws in metals	
C	Used in the remote controls for various electrical appliances	
D	Used in mobile phones.	

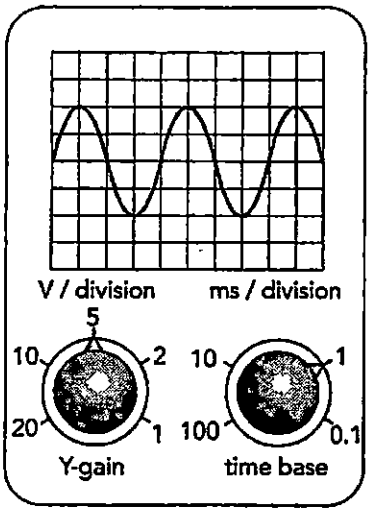
26	A man stands between two cliffs as shown in the diagram and claps his hand once. Assuming that the velocity of sound in air is 330 m/s, what will be the time interval between the two loudest echoes?	
		
	A 1/6 s **B** 1/3 s **C** 2/3 s **D** 5/6 s	B
27	A piece of thin card was held against the teeth of a cog wheel. When the wheel is turned at the high speed a note is heard. How may the pitch of this note be raised?	
		
	A Using a thicker card **B** Using a longer card **C** Pressing the card against the teeth with a greater force **D** Turning the wheel more quickly	D
28	The diagram shows a potential divider circuit.	
		
	What happens to the brightness of lamp **1** and lamp **2** as the contact **X** is moved away from point **P** of the potential divider?	
	lamp 1 / **lamp 2**	
	A brighter / stay the same **B** brighter / dimmer **C** dimmer / stay the same **D** dimmer / brighter	B

29	A transformer consists of one coil with 1200 turns and a second coil, with a total of 120 turns, which can be tapped at various points as shown.	
		
	Which pair of terminals should be connected to a 12 V, 24 W lamp for it to be lit normally?	
	A PS **B** QS **C** RT **D** PT	B
30	The school hall is fitted with 20 units of air-conditioner, each rated 2400 W. During the 10 days of school examination, the air-conditioners had to be switched on twice a day and each session lasted for 3 hours. If each unit of electricity costs 25 cents, how much do the school have to pay to provide air-conditioning for the students during the examination?	
	A $36.00 **B** $360.00 **C** $72.00 **D** $720.00	D

31	The figure below shows an electric circuit.	
		
	Which one of the following describes the brightness of **L_2** in the given circuit when the tab **T** of the potential divider is moved slowly from **X** to **Y**?	
	A It is originally as bright as L_1 and then dims gradually. **B** It is originally half as bright as L_1 and then dims gradually. **C** Its brightness increases gradually and is finally as bright as L_1. **D** Its brightness increases gradually and is finally half as bright as L_1.	C
32	The circuit shown below is connected to an automatic switch for the lights in the garden. The automatic switch needs a voltage at **X** of 12 V or higher for the lights to be on. The lights are to come on at sunset and the value of the fixed resistor is 400 W.	
		
	What must be the minimum resistance of the light-dependent resistor in order for the lights to come on at sunset?	
	A 400 W **B** 800 W **C** 1200 W **D** 1600 W	B

33	A circuit is set up as shown in the diagram below and a load is connected to the CRO. Which is the correct waveform on the CRO when the switch is closed?	
		
	A.  B.  C.  D. 	B
34	Two foam balls which are wrapped with aluminium foil, suspended from adjacent silk threads, attract each other. This indicates that	
	(I) the magnetism is strong (II) they are oppositely-charged. (III) only one of them is charged.	
	A (I) only B (II) only C (I) and (II) only D (II) and (III) only	D

35 An alternating voltage signal is displayed on an oscilloscope, with the settings shown in the figure below.

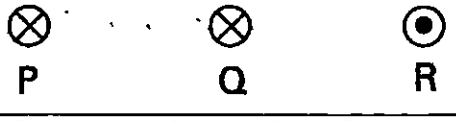


Which of the following combinations gives the correct values for the peak voltage and frequency of the signal?

B

	Peak voltage / V	Frequency / Hz
A	10	100
B	10	250
C	20	250
D	20	1000

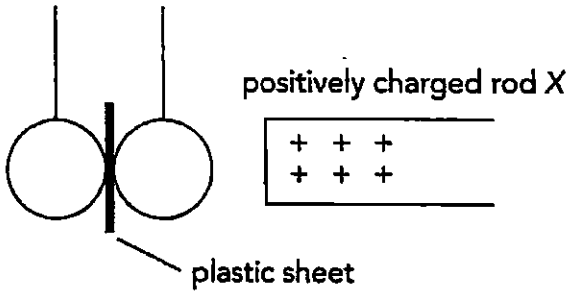
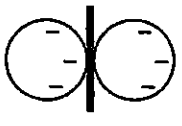
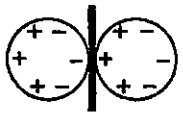
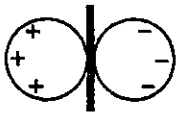
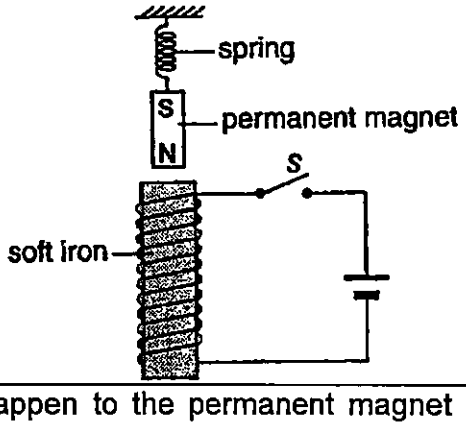
36 The figure below shows three parallel long straight wires **P**, **Q** and **R**. **P** and **Q** carry currents flowing into the paper and **R** carries a current flowing out of the paper.

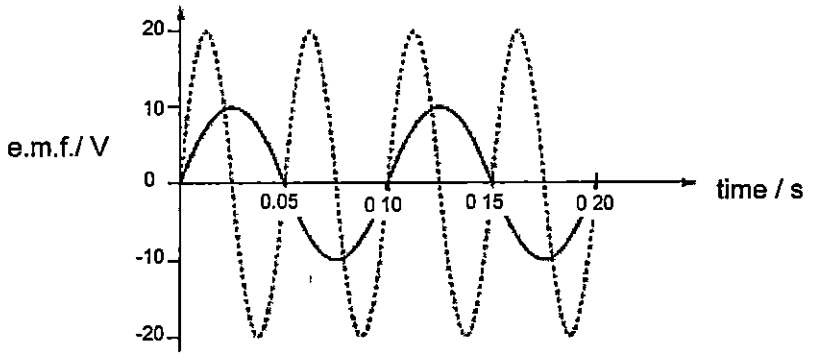
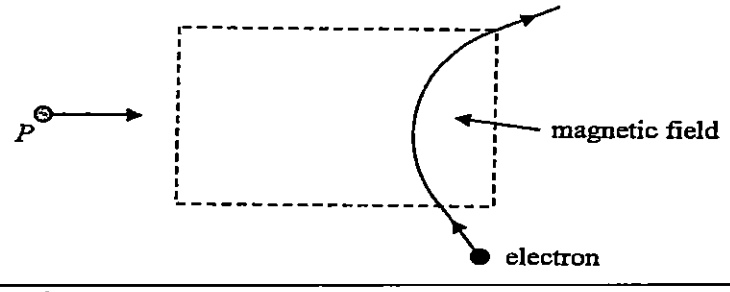


What is the direction of the resultant force acting on **Q**?

A ↑ B ↓ C ← D →

C

37	The figure below shows two uncharged metal spheres suspended by insulating threads and separated by a plastic sheet. A positively charged rod **X** is brought near them as shown.	
		
	Which of the following diagrams shows the resulting charge distribution on the spheres?	
	A.  B.  C.  D. 	C
38	The figure below shows a permanent magnet suspended from a spring placed right on top of an electromagnet.	
		
	What will happen to the permanent magnet once the switch **S** is turned on?	
	A The magnet is pulled downwards. **B** The magnet is pushed upwards. **C** The magnet is stationary. **D** The magnet starts to swing from left to right.	A

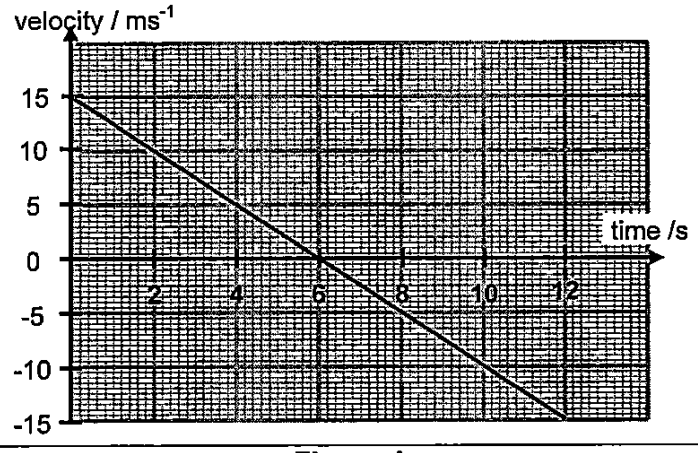
39	In the graph shown, the solid curve shows how the e.m.f. produced by a simple generator varies with time. The dashed curve is the output from the same generator after a modification has been made to the generator.	
		
	Which modification was made to produce the result shown?	
	A The area of the coil was doubled. **B** A split-ring commutator was added. **C** The number of turns in the coil was doubled. **D** The speed of rotation of the coil was doubled.	D
40	When an electron enters a magnetic field, it is deflected in the direction as shown below. When a positively-charged particle **P** enters the magnetic field from the left, it will be deflected	
		
	A to the top **B** to the bottom **C** out of the paper **D** into the paper	A

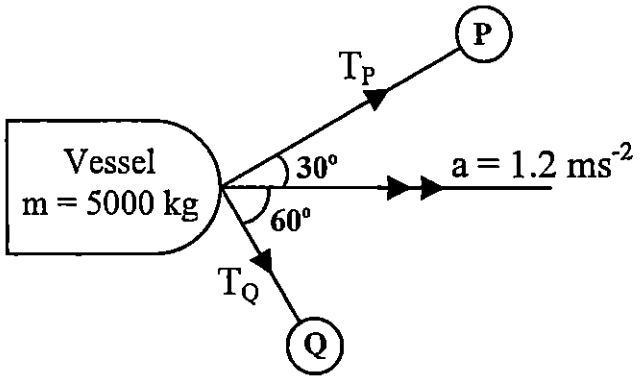
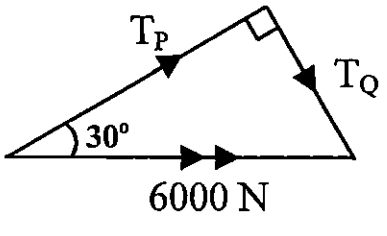
Answers for Paper 1 MCQ (Prelim 2 2015)

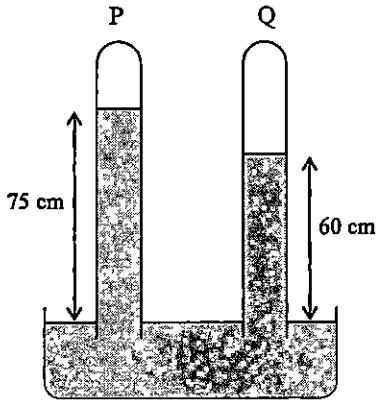
Qn No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans	B	B	D	D	D	C	B	B	B	B	D	A	C	A	D	C	B	D	C	D
Qn No	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans	B	D	A	C	C	B	D	B	B	D	C	B	B	D	B	C	C	A	D	A

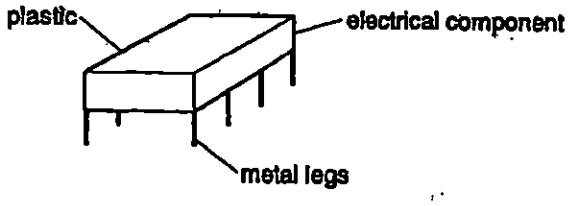
For Examine Use

Section A (50 marks)
Answer all Questions

1	A ball was given a push and it rolled up a smooth slope. **Figure 1** below describes the motion of the ball.	
		
	Figure 1	
(a)	Describe the motion of the ball for the **first half of the journey.**	[1]
	For the first 6.0s the velocity decreases at a constant rate . **[1/2] It has a constant deceleration of 2.5 ms^{-2}. [1/2]**	
(b)	Find the displacement of the ball for the first 8.0 s.	[2]
	Displacement = Area under the graph **Displacement = ½ (15 x 6) + ½ (-5x 2) [1]** **= 45 – 5** **= 40 m [1]**	
(c)	Define the term ***velocity.***	[1]
	Velocity is the rate of change of displacement. [1]	
(d)	Define Newton's First Law of Motion	[1]
	Newton's First Law of Motion states that every object will continue in its state of rest or uniform motion in a straight line [1/2] unless a resultant force acts on it. [1/2]	

2	A large vessel is towed by two tug boats P and Q as shown in **Figure 2.** The vessel of mass 5000 kg moves forward with an acceleration of 1.2 ms^{-2}. By drawing a suitable scaled diagram, determine the tension in the two ropes T_P and T_Q.	[4]
		
	Figure 2	
	Scale: 1 cm to 500 N [1/2 mark] F = ma F=5000×1.2 F=6000N [1/2 mark] T_P=5150N to 5250N [1 mark] T_Q=2950N–3050N [1 mark] ½ mark – correct diagram ½ mark – arrows drawn correctly 	
3	Figure 3 below shows two vertical tubes **P** and **Q**, each closed at	

	the upper end. The space above the mercury meniscus of tube **P** is a vacuum but not that of tube **Q**. The density of mercury is 1.36×10^4 kg/m^3.	
		
(a)	Determine the pressure, in Pa, exerted by the air in the space above the mercury meniscus of tube **Q**.	[2]
	$P=\varrho gh$ $P = 13600 \times 10 \times (0.75 - 0.60)$ [1 mark] $P = 20400$ Pa [1 mark]	
	Tube **Q** is pushed further into the trough such that its lower end immersed more deeply in the reservoir of mercury. How would the height of the mercury column in tube **P** and tube **Q** be affected respectively?	[1]
	The height of the mercury column is tube P remains unaffected. [1/2] The height of the mercury column is tube Q is shortened. [1/2]	
(b)	Explain in terms of molecular properties,	
(i)	how the air inside a car tyre exerts a pressure on the walls of the	[2]

	tyre,	
	The air molecules in the car tyre is **moving about randomly[1/2]** and continuously and **will hit/bombard on the interior wall[1]** of the tyre. The **average force per unit area** [1/2] of the tyre is the pressure of the tire	
(ii)	why the air pressure in the car tyre increases after a long journey.	[2]
	Friction [1/2] between the tyre and the road produces heat. **Kinetic energy** of the air molecules **increases**.[1/2] The **velocity of the molecules is higher** [1/2] and they bombard the walls of the tire. This **increases** the **force per unit area[1/2]** exerted onto the walls of tyre. So, air pressure in the car tyre increases.	
4	Some electrical components are easily damaged if electric charge is placed on them.They are often stored by placing them in contact with a conductor.	
(a)	When the component shown in **Figure 4.1** is rubbed with a cloth, the metal legs become negatively charged. Explain how this happens.	[1]
	 **Figure 4.1**	
	When the component is rubbed with cloth, its metal legs are **negatively charged** [1/2] because the **electrons moves from the cloth onto the component. [1/2]**	
(b)	Figure 4.2 shows the negatively charged metal legs placed near a piece of aluminium foil which rests on an insulator.	

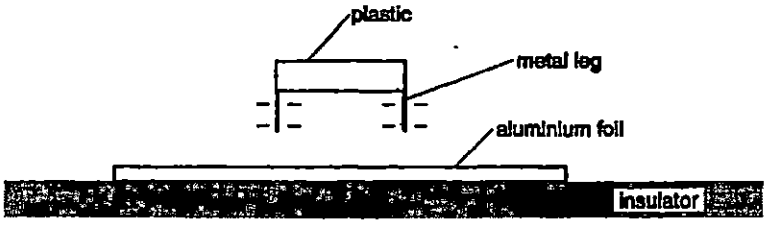


Figure 4.2

(i) On **Figure 4.2**, draw the induced charges that form on the aluminium foil. [1]

(ii) The metal legs are placed in contact with the aluminium foil. Describe what happens to the charges on the foil and on the legs. [2]

When metal legs are placed in contact with the aluminium foil, the **negative charges on the legs move to the aluminium foil [1/2]. There will be no more excess positive charges [1/2]** on the top surfaces of the aluminium foil. Unlike charges attract each other. There is now **excess negative charges in the foil**. [1/2] Hence, **the aluminium foil becomes negatively charged.[1/2]** The metal legs will still have excess negative charges on it and remains negatively charged.

5 **Figure 5** shows a simple setup used to study the flow of current from terminal **X** to terminal **Y** through the solenoid.

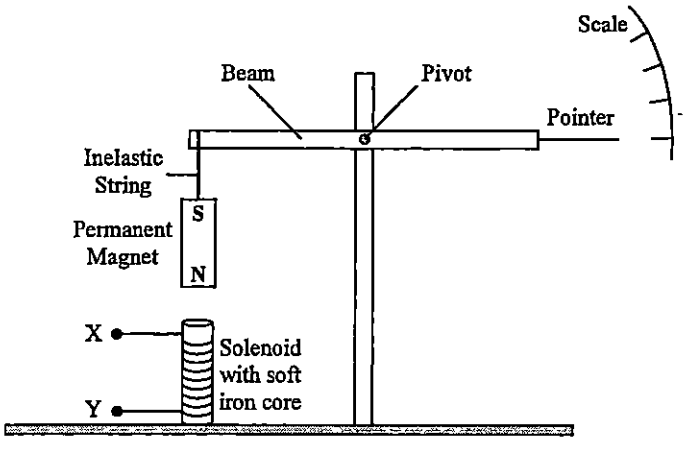
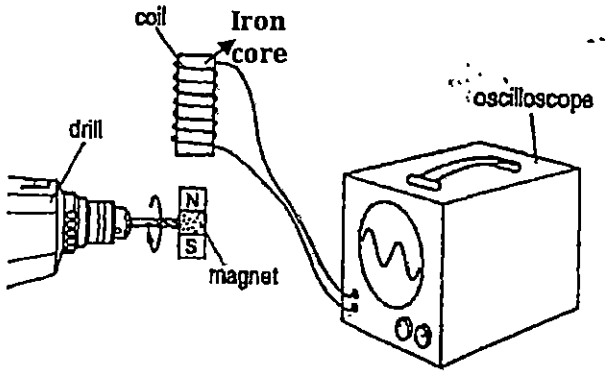
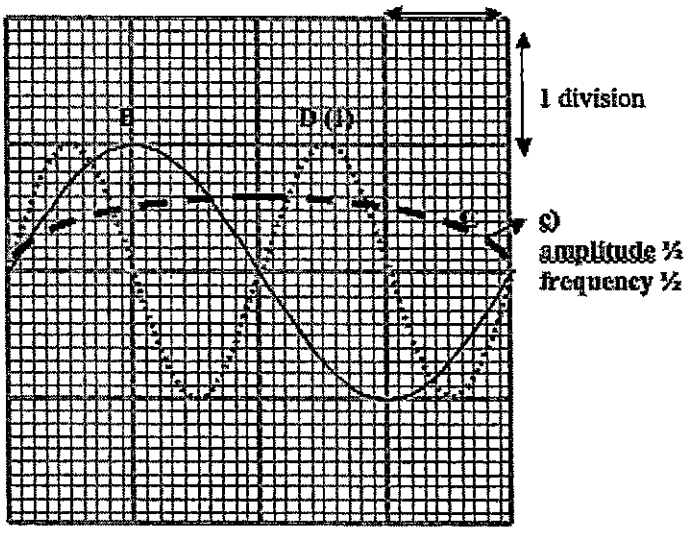


	Figure 5	
(a)	Describe how the setup works to measure the magnitude of current flow.	[3]
	As the current flow from terminal X to terminal Y through the solenoid, **a magnetic field is produced**. [1/2] Using right hand grip rule, it can be determined that **the top end is south pole[1/2]** and the bottom end is north pole. This cause the **solenoid to attract the permanent magnet.[1/2]** When the permanent magnet is pulled down due to the attraction, it causes **the horizontal beam to rotate anticlockwise about the pivot** [1/2] and the pointer will move up the scale according. An **increase in the magnitude of current flow will result in stronger magnetic attraction** [1/2] and **hence a greater deflection** [1/2] as displayed by the pointer on the scale.	
(b)	Suggest two ways to increase the sensitivity of this setup.	[1]
	Any two of these: [1/2 mark each] 1. Increase the number of turns of the solenoid 2. Use a stronger permanent magnet 3. Shift the pivot of the horizontal beam to the left, nearer the permanent magnet	
(c)	The setup will not work if the polarity of the current flow is reversed (i.e. current flows from terminal Y to terminal X through the solenoid).	
(i)	Why is that so?	[2]
	If the polarity of the current flow is reversed, then the **top end of the solenoid will be north pole**.[1/2] Since like poles repel, the permanent **magnet will be repelled away from the solenoid**. [1/2] The permanent magnet is **suspended on an inelastic string**.[1/2] The repelled magnet will still be hanging down (to the left or right side of the solenoid) due to its weight/gravitational force. Hence the horizontal beam will **remain unaffected by the repulsive push upward. [1/2]**	

(ii)	How can we modify the setup to correct this problem? Explain your answer.	[2]
	The permanent magnet is **replaced by a soft iron bar**. [1/2] The solenoid will be able **to induce magnetism in the soft iron bar** [1/2]. The polarity of the induced magnetic field in the soft iron bar will be such that **the bottom end of it will have an unlike pole** [1/2] to the solenoid polarity. The electromagnet formed by the solenoid is able to **attract the soft iron bar regardless of its polarity** [1/2] due to the current flow and the magnetic field.	
6	**Figure 6A** shows a drill that is being spun with a magnet attached to the drillbit. A coil of wire around an iron core is placed above the rotating magnet. The ends of the coil are connected to the y-input of the cathode ray oscilloscope(CRO).	
	 **Figure 6A**	
(a)	Explain why there is a current induced in the coil when the drillbit rotates.	[1]
	When the drillbit rotates, the magnet rotates with it and this produces a change in the magnetic flux linked to the coil [1/2]. This induces an emf and therefore a current [1/2] in the coil.	

(b)	Draw on Figure 6A the direction of the current in the coil as the N-pole of the magnet approaches the coil.	[1]
(c)	The following display B is seen on the CRO screen in Figure 6B. Draw on the figure, the display when the speed of the drill bit is halved. Label it as **curve C**.	[2]
	c), d)  Figure 6B	
	c) amplitude -1/2 [1 mark], frequency-1/2 [1 mark]	
(d)	The time-base of the CRO is currently 6 ms/division. Draw also on Figure 6B what happens to curve B when only the time-base is doubled to 12 ms/division. Label it as **curve D.**	[1]
(e)	State the effects on the amplitude and frequency of the display if the soft iron core is replaced by a copper core.	[1]
	Amplitude _**decreases [1/2]** _Frequency **remains unchanged** [1/2]	
7	The graph in **Figure 7.1** shows the relationship between temperature, **θ** , and time, **t** , of two objects **Y** and **Z** of the same material and **water**. The masses of **Y**, **Z** and **water** are m_1 kg and $3m_1$ kg and **1.5** kg respectively. They are heated with the same heater for the same period of time. The specific heat capacity of water is 4200 J/kg.	

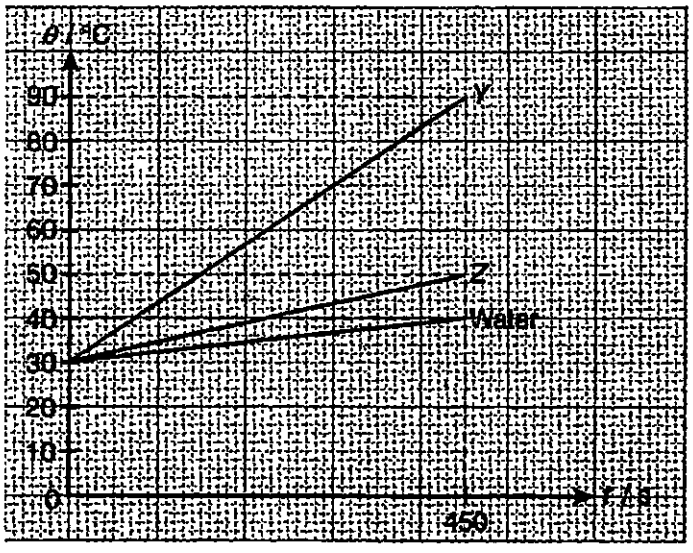


Figure 7.1

(a) From the graph, find the heat capacity of Y and Z. [2]

From the graph of water, the heat energy supplied by the heater in 450 s

$= m c_w \theta$

$= 1.5 \times 4200 \times (40 - 30)$

$= 63\,000$ J

For Y: $63\,000 = c_y \times (90 - 30)$ [1/2]

$c_y = 1050$ J/°C [1/2]

For Z: $63\,000 = c_z \times (50 - 30)$ [1/2]

$C_z = 3150$ J/°C [1/2]

(b) If $m_1 = 2$, what is the specific heat capacity of objects Y and Z? [2]

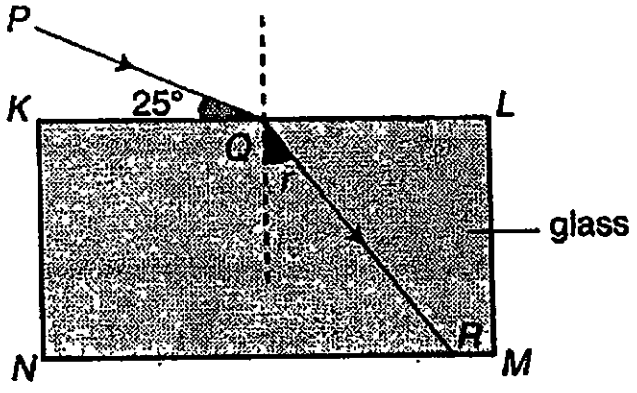
For Y: $c_y = mc$

$1050 = 2 \times c$ [1/2]

$c = 525$ J /kg °C [1/2]

Since Y and Z are of the same material, their specific heat capacity is the same i.e.

Specific heat capacity of Z is also equals to 525 J /kg °C [1]

8	Figure 8.1 shows a rectangular glass block **KLMN**.	
		
	Figure 8.1	
	The refractive index of the glass is 1.50. The ray of light **PQ** is refracted when passing through the rectangular glass block.	
(a)	Explain why the ray is refracted.	[1]
	There is a **change of speed of light** [1/2] as the ray travels from a medium (air) to another (glass) of **different optical density**. [1/2]	
(b)	Calculate angle of refraction, **r** of the ray **PQ** passing through the surface **KL**.	[1]
	$n = \sin i / \sin r$ $\sin r = \sin i / n$ $= \sin 65^\circ / 1.50$ [1/2] $= 0.6042$ $r = 37^\circ$ [1/2]	
(c)	The rectangular glass block is displaced slightly to the left, as shown in **Figure 8.2**.	

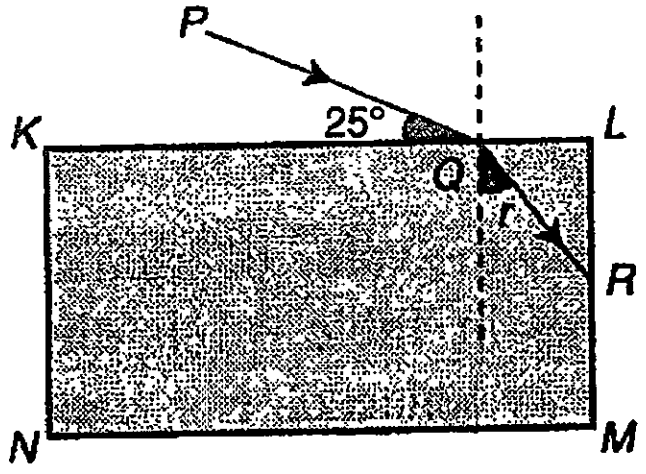


Figure 8.2

(i) Using a pen, complete the diagram in **Figure 8.2** to show the path of the ray immediately after it strikes the surface **LM** till it emerges from the glass block. [1]

drawing shows total internal reflection at surface LM
[1/2 mark for total internal reflection and side LM;
½ mark for refraction on emerging and side MN]

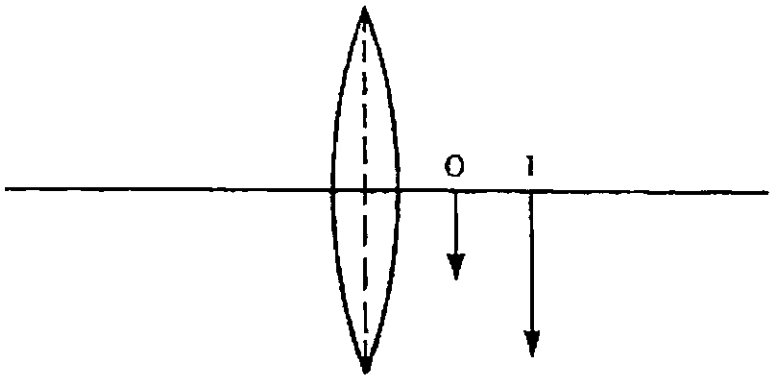
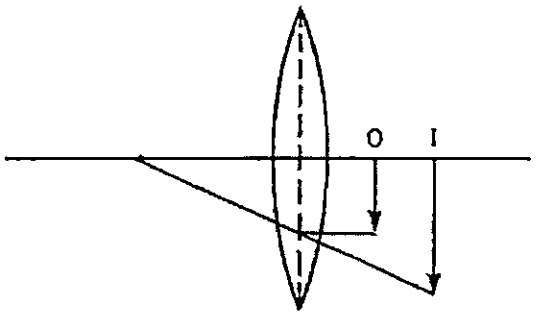
(ii) Explain your answer in **(c)(i).** [2]

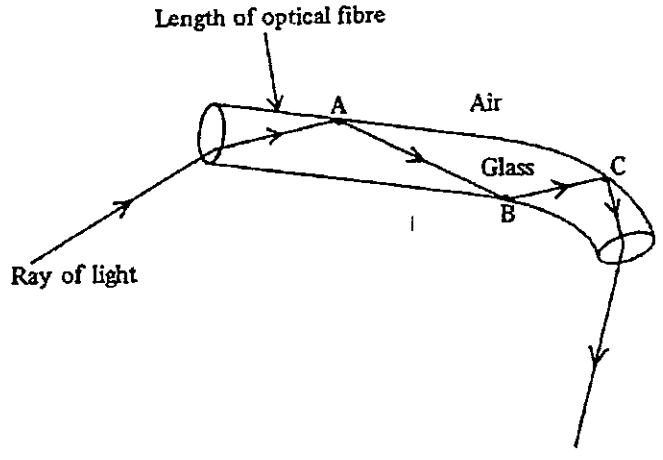
$\sin c = 1 / n$
$= 1 / 1.50$
$= 0.6667$
critical angle , $c = 42°$ [1/2]

angle of incidence at the surface LM,
$r_1 = 90° - 37°$
$= 53°$ [1/2]
since r_1 at the surface LM is more than the critical angle, the ray will undergo total internal reflection. [1/2]
At the surface MN, the ray of light hits the interface at an incident angle of 37° which is less than the critical angle. Therefore, it can emerge from the side MN. [1/2]

(d) What are the two conditions required for total internal reflection to take place? [1]

Total internal reflection will take place when:
1) a ray of light travels from an optically denser medium to an optically less dense medium, and [1/2]
2) the angle of incidence in the optically denser medium is greater than the critical angle of the denser medium. [1/2]

9	The diagram shows a converging lens producing an image I of an object O.	
		
(i)	By adding rays to the diagram, find the position of the principal focus and label it **F**. Hence, determine the focal length of the lens.	[2]
	Ray from top of object, parallel to principal axis to centre of lens [1/2] Ray from top of image through centre of lens to principal axis [1/2] **F** labelled 28 ± 2 mm from centre of lens [1/2] **Answer: Focal length = 28 ± 2 mm** from centre of lens [1/2] 	
(ii)	Name one use of this arrangement.	[1]

	Magnifying glass [1]	
(b)	Optical fibres have taken the place of wires in telecommunications. A length of a glass optical fibre carrying a ray of light is shown below. In this situation the glass has a refractive index of 1.5.	
		
(i)	Calculate the size of the largest angle that the light ray can make with the walls so that it does not escape through them.	[1]
	Sin c = 1/1.5 c = 41.8° [1/2] largest angle = 90° − 41.8° = **48.2°** [1/2] (NB: The critical angle is the largest angle of incidence that the light can make with the *normal*. The question asks for the largest angle with the *walls*.)	
(ii)	State two advantages of the use of optical fibre in telecommunications as compared to using copper wires.	[2]
	Advantages (Any two from the following): [1 each] A fibre can carry much more information over long distances than a copper wire. Optical Fibres experience much less signal loss as compared to wires. Optical wires are lighter and cheaper to manufacture than copper wires.	

For
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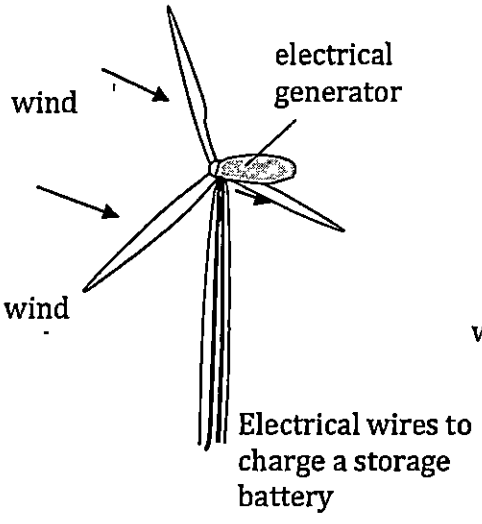
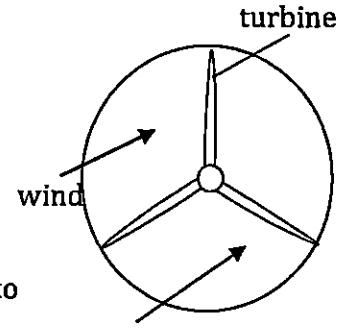
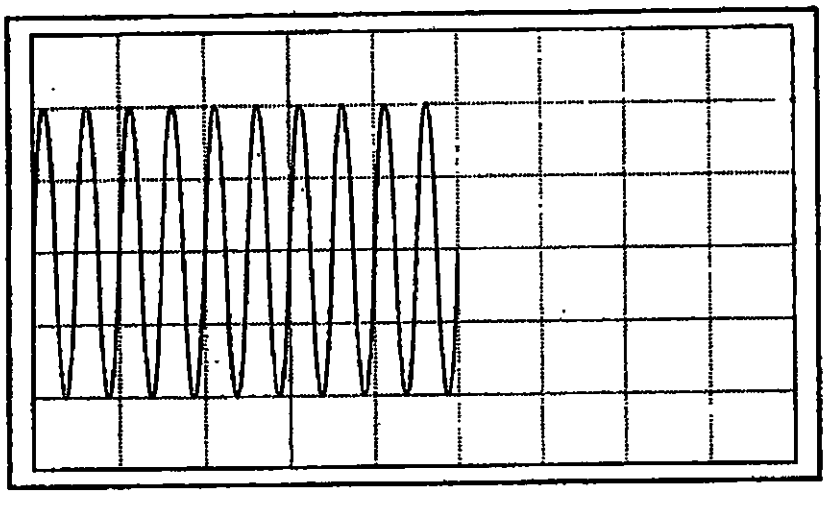
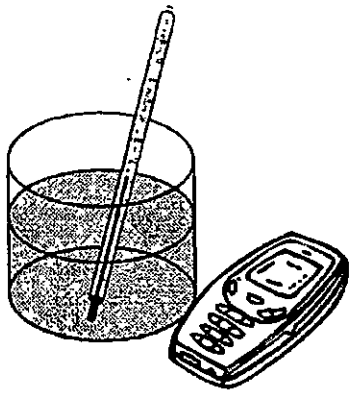
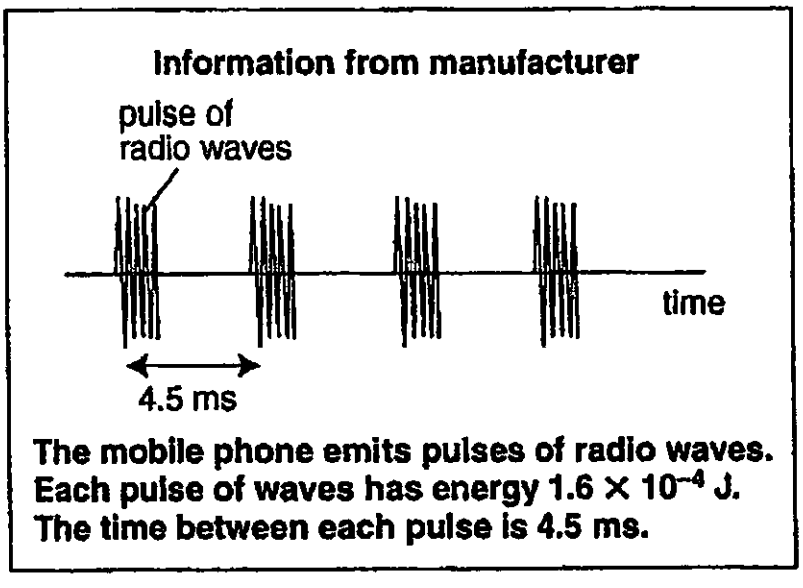
Section B (30 marks)

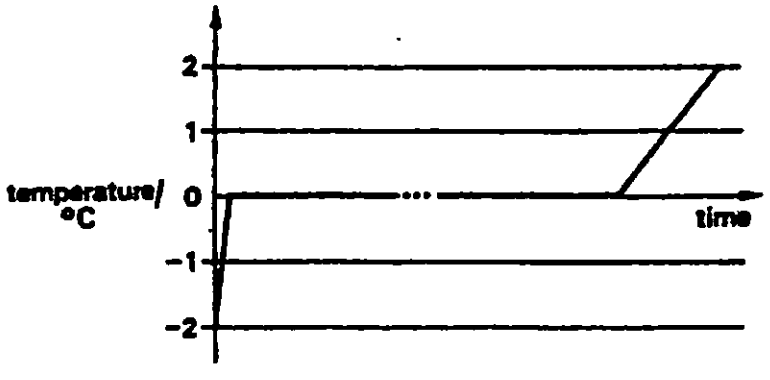
Answer all the Questions in this section. **Question 12** has a choice of parts to answer.

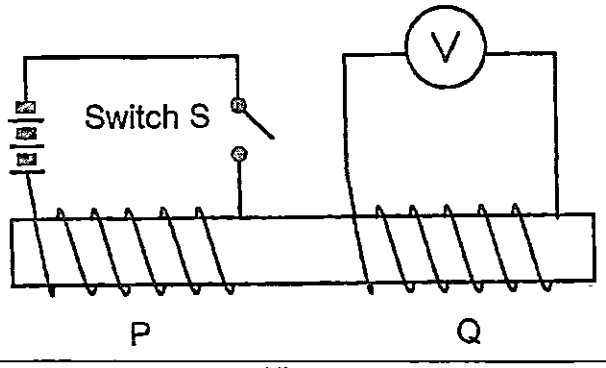
10	**Figure 10A** shows a wind turbine used to produce electricity. The turbine blades are turned by the wind and are connected to a d.c. electrical generator which then charges a battery.	
		
	Figure 10A	
		
	Figure 10B	
	In one revolution the blades sweep out a circle as shown in **Figure 10B**. In 60 s, a mass of 54,000 kg of air traveling at a speed of 6.0 m/s is incident on that circle. 25% of this moving air hits the blades and leaves the turbine at a speed of 2.0 m/s. The rest of the moving air passes straight through the circle with the original speed of 6.0 m/s.	
(a)	Calculate	
(i)	the loss of kinetic energy of air in 60 s.	[2]
	Loss of KE= Initial KE – Final KE **Loss of k.e. = ½ x 25% x 54,000 x 6^2 - ½ x 25% x 54,000 x 2^2** [1] **= 216,000 J** **= 2.2 x 10^5 J** [1]	

(ii)	the power of the turbine that is available to charge a storage battery.	[2]
	Power= Energy available / time = 216,000 J / 60 s [1] ecf for E=216000J[-1/2 mark] = 3600 W = 3.6 x 10^2 W [1]	
(b)	The storage battery is used to light up street lamps, each having a power of 240 W. Each street lamp is to be switched on 8 hours per day.	
(i)	Calculate the number of kWh used by each lamp.	[1]
	Energy used = P x t = (240/1000) kW x 8 h [1/2] = 1.96 kWh = 2.0 kWh [1/2]	
(ii)	Estimate the maximum number of street lamps that can be operated if the wind is available for 10 hours per day.	[2]
	Max. energy produced by turbine = p x t = (3600/1000) kW x 10 h ecf for available E=3600 W [-1/2 mark] = 36 kWh [1] Thus, max. number of lamps = 36 kWh / 1.96 kWh = 18.4 Ecf for energy used by each lamp= 2 kWh [-1/2 mark] The max. number of lamps to be operated is 18 [1]	
(c)	Explain briefly why more energy is produced per second if	
(i)	the wind blows faster,	[1]
	When the wind blows faster, the turbine will move faster at a **higher velocity**. There will be **more k.e. per unit mass of air** [1/2] available as **k.e. is related to square of speed as in ½mv^2.** In a generator, the **higher rate of change of the magnetic flux linked to the coil induces a larger current** [1/2] and therefore, more energy is produced.	
(ii)	the turbine blades are longer	[1]
	Longer blades: A longer blade enables more air to hit against it. The energy of the moving air can then be converted to the Kinetic energy of the moving blade. A **great mass of moving air will impinge on the blades**. [1/2] This also makes more k.e. available because **k.e. is also related to mass [1/2]** of moving air as in ½mv^2	
(iii)	the turbine is more efficient.	[1]
	Higher efficiency means that **less energy is wasted in**	

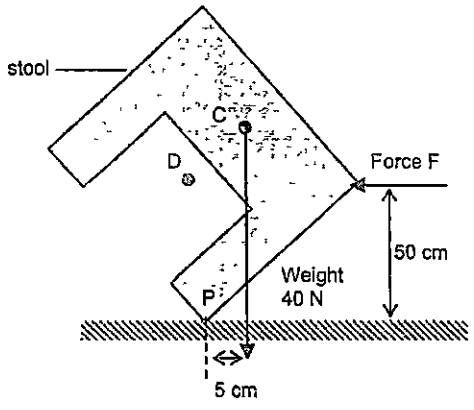
	overcoming friction[1/2] of the moving parts of the turbine. More energy will be converted to the useful form (which is electrical energy in this case).[1/2] [Alternative answer to (iii): Higher efficiency means that a **higher % of moving air is captured by the blades**. [1/2] This results in greater amount of energy being harnessed per unit time.[1/2]	
11	Ruth uses a mobile phone.	
(a)	She sets the ring tone of her mobile phone to produce a sound consisting of two notes, one after another. **Figure 11.1** shows the trace on a cathode-ray oscilloscope (CRO) screen produced by the first of the notes.	
		
	Figure 11.1	
	The second note is softer and has lower pitch. On **Figure 11.1**, continue the trace to show what happens when the second note is played.	[2]
	smaller amplitude [1] lower frequency (longer period) [1] minus 1 m if the drawing is not accurate e.g. amplitude or frequency is not uniform.	
(b)	Ruth wonders if the energy from the radio waves of her mobile may cause a significant temperature rise in her brain. To	

	investigate this effect, she calculates the heating effect of the mobile phone on a beaker of water placed next to it, as shown in **Figure 11.2**.	
		
	Figure 11.2	
	Figure 11.3 shows the relevant information about the mobile phone taken from the manual.	
		
	Figure 11.3	
	The mobile phone is used for 5 minutes next to a beaker containing 40 g of water.	
(i)	Determine the number of pulses of radio waves produced during the mobile phone call.	[1]
	Number of pulses = $(5 \times 60) / 4.5 \times 10^{-3}$ [1/2] $= 6.7 \times 10^{4}$ [1/2[	
(ii)	Determine the total energy of the radio waves emitted during the	[1]

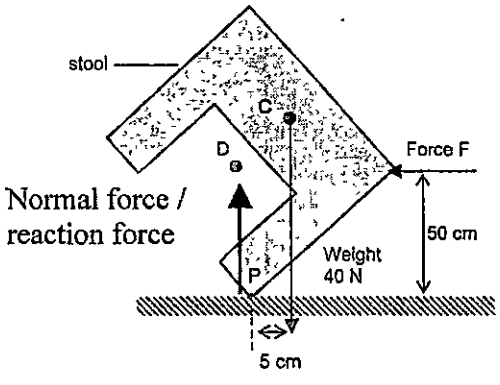
	mobile phone call.	
	Total energy = $(1.6 \times 10^{-4}) \times (6.7 \times 10^{4})$ [1/2] ecf no of pulses=$6.7*10^4$ [-1/2 mark] = 10.7 J [1/2]	
(iii)	Determine the maximum temperature rise produced in 40 g of water if all the energy calculated in **(b)(ii)** is absorbed by the water. (The specific heat capacity of water is 4.2 J/gK).	[1]
	$Q = mc\theta$ $\theta = Q / mc = 10.7 / (40 \times 4.2)$ [1] ecf for Q= 10.7 J [-1/2 mark] = 0.064 °C [1]	
(iv)	Why do motorists choose to use water as the liquid in the car radiator?	[1]
	Water has a high specific heat capacity.	
(v)	Define the specific latent heat of fusion of a substance.	[1]
	The specific latent heat of a substance is the amount of thermal energy required to change unit mass of the substance from solid state to liquid state, [1/2] without a change in temperature.[1/2]	
(c)	A small quantity of crushed ice was allowed to warm up from a temperature of -2°C. The graph in the figure below shows how the temperature of the ice varied with time.	
		
(i)	Explain why, after an initial rise to 0°C, the temperature of the body remained constant.	[2]
	Ice melts at 0°C. The energy supplied to the ice is used to **overcome the attractive intermolecular forces[1/2]** between the molecules. The **potential energy of the molecules increases** [1/2]but the **average kinetic energy of the molecules remains the same**. [1/2] Since the **average KE does not increase**, the temperature of the substance does not increase. [1/2] The energy supplied is the	

	latent heat of fusion. When all the solid ice has melted into a liquid, the temperature will then start rising.	
(ii)	Suggest why the slope of the graph between -2°C and 0°C is greater than that between 0°C and +2"C.	[1]
	Specific heat capacity of ice is less than that of water. Thus, the rate of rise in temperature is greater for ice.	
12	Answer only **one** of the following choice questions.	
	EITHER	
12 (a)	**Figure 12** shows two insulated copper coils, P and Q mounted close together on a wooden rod. Coil P is connected to switch S and a battery. Coil Q is connected to a sensitive voltmeter V.	
		
	Figure 12	
	When the switch S is closed a deflection is seen on the meter. This deflection lasts for a very short time.	
(i)	Does the current flow through the meter from left to right or from right to left? Justify your answer.	[2]
	The current flow through the meter from left to right. [1/2]According to **Lenz's Law of electromagnetic induction states that the direction of induced current is always such hat its magnetic effect always oppose the change producing it. [1/2]** Since the **current flows from the positive terminal and back to negative terminal of battery in coil P**,[1/2] the **induced current flows in coil Q in the opposite direction [1/2]**to oppose the increase in the magnetic flux linkage in coil P.	

(ii)	Give two ways in which the efficiency of a transformer can be improved.	[1]
	Any two – ½ mark each (a) Use low-resistance copper wires for the coil to avoid losing energy in the form of thermal energy (b) Use a laminated core to reduce eddy currents (c) Use a soft magnetic material for the core to reduce energy losses when the magnetic field changes direction (d) Use a special core design to ensure minimal leakage of magnetic field lines	
(iii)	In a step-down transformer, why is the primary coil made of thin wire and the secondary coil made of thick wire?	[1]
	The **current flowing in the secondary coil is higher** than that flowing in the primary coil, thus the secondary coil has to be made of thicker wire.	
(iii)	Define Faraday's Law of Electromagnetic Induction.	[1]
	Faraday's Law of Electromagnetic Induction states that the magnitude of the induced emf [1/2] in a circuit is directly proportional to the rate of change of magnetic flux in the circuit.[1/2]	
(b)	The figure below shows a stool. A horizontal force F keeps the stool balanced. C is the centre of gravity of the stool and the weight of the stool is 40 N.	



(i) On the figure above, draw and label an arrow to show the vertical force that acts on the stool. [1]

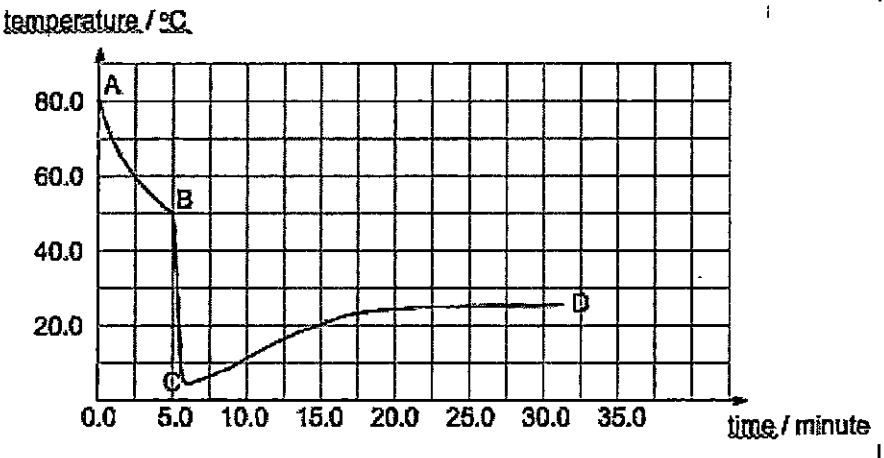


(ii) Explain why a stool is more stable with a centre of gravity at D rather than at C. [2]

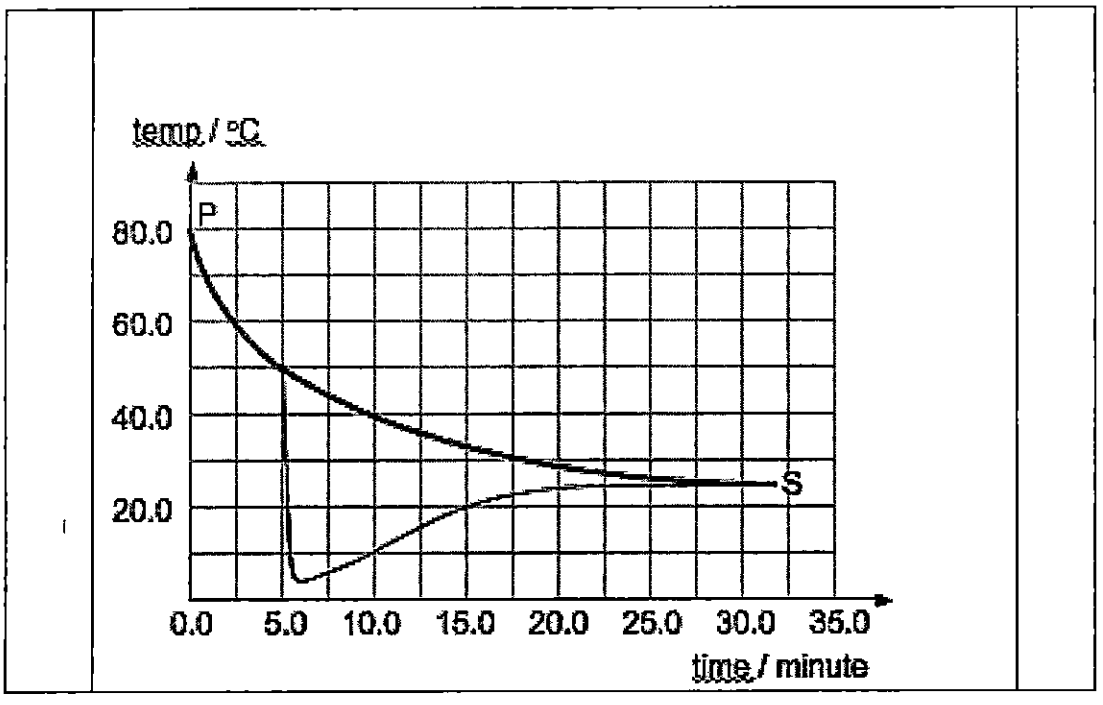
If the stool has **lower centre of gravity at D** , it can be **tilted at a greater angle [1/2] before the line of action of weight lies outside its base area /pivot point [1] and topple as compared to a higher centre of gravity at C,** so the stool will be more stable when the centre of gravity is at D.[1/2]

(iii) What are the two ways in which you can make a double-decker bus stable? [1]

1. Make the centre of gravity lower.
2. Make the base larger.

(iv)	Define the centre of gravity of an object.	[1]
	The centre of gravity of an object is defined as the point through which its whole weight appears to act, for any orientation of the object.	
	OR	
12 (a)	Jonah poured 250 g of hot tea into a container. He placed a temperature sensor into the tea and started measuring the temperature with respect to time. After a while, he added some ice cubes into the tea.	
	The figure below shows the temperature-time graph obtained.	
	 Figure 12.1	
	The following information is provided : *specific latent heat of fusion of ice* = 3.36×10^5 J kg^{-1} *specific latent heat of vaporisation of water* or *tea* = 2.26×10^6 J kg^{-1} *specific heat capacity of ice* = 2.10×10^3 J kg^{-1} °C^{-1} *specific heat capacity of water* or *tea* = 4.20×10^3 J kg^{-1} °C^{-1}	
	Assume there is no loss of thermal energy to the surrounding and the temperature of the ice cubes before being added into the hot tea is 0 °C.	
(a)	At what time did Jonah add the ice cubes into the tea? Explain your answer.	[2]
	The ice cubes were added at **5.0 minutes**. [1] This is because there is a **sudden drop in temperature** from 5.0 minutes onwards. [1]	

(b)	Calculate the loss of thermal energy in the hot tea from B to C.	[2]
	Loss in thermal energy = $mc\theta$ = 0.25 x 4200 x (50.0 – 5.0) [1] = 47,250 J = **47,300 J** (or 47,000 J) [1]	
(c)	Calculate the total mass of the ice cubes added into the hot tea.	[2]
	Heat loss from tea = heat gained by ice cubes 47,250 = (m x 3.36 x 10^5) + (m x 4200 x 5.0) [1] ecf for heat loss = 47250 J [-1/2 mark] = 336,000 m + 21,000 m m = 47,250 / 357,000 [1/2] = **0.132 kg** (or 132 g) [1/2]	
(d)	Explain why the temperature of the tea increases from C to D.	[2]
	Since there is a **temperature difference** [1] between the tea and the surrounding, **thermal energy is transferred from the surrounding to the tea**,[1] hence the temperature increase.	
(e)	Estimate the temperature of the surrounding.	[1]
	25.0 °C (or 25 °C)	
(f)	In another experiment, Jonah 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.	
	Draw the temperature-time graph for the second experiment on the same graph in Figure 12.1	[1]
	- **No mark** if graph never reach 25°C	


temp / °C
80.0
60.0
40.0
20.0
P
S
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
time / minute