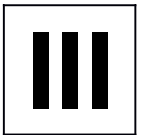


[Pure] Physics O Level Exam Paper
Preliminary Examination Set [III]
Secondary Four Express



CANDIDATE NAME:

CLASS:

INDEX NUMBER:

(Updated 2024)

6091/01

PHYSICS

1 hour

Paper 1 Multiple Choice

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid/tape.

Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** or **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

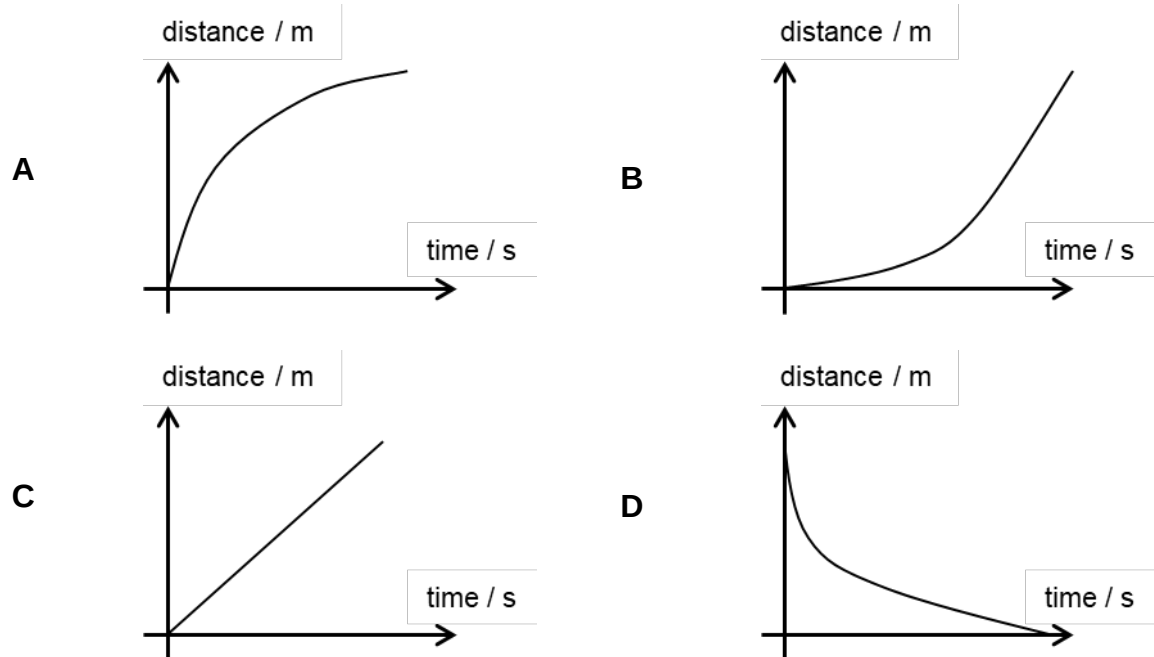
The use of an approved scientific calculator is expected, where appropriate.

1 Which measurement represents the longest length?

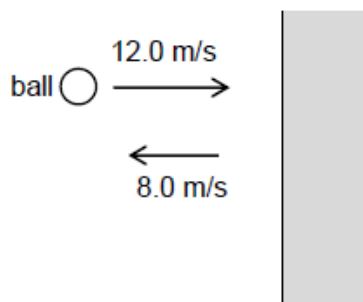
- A 1.2×10^{-4} Mm B 1.2×10^3 km C 1.2×10^5 cm D 1.2×10^7 μ m

2 A ball made of plasticine is thrown vertically upwards towards the ceiling. At the highest point of its path, it is stuck at the ceiling.

Which distance-time graph best represents the motion of the ball?



3 A squash ball hits the vertical sidewall of the court with a horizontal velocity of 12 m/s. It rebounds off the wall with a horizontal velocity of 8.0 m/s as shown in the diagram.



The collision between the ball and the wall is 0.08 s. Take leftward as positive direction.

What is the acceleration of the squash ball when it rebounds off the wall?

- A -50 m/s^2 B 50 m/s^2 C -250 m/s^2 D 250 m/s^2

- 4 A car accelerates uniformly from rest at time $t = 0$ s along a level road. The car travels 12 m in the time between $t = 1.0$ s and $t = 2.0$ s.

How far does it travel in the time between $t = 3.0$ s and $t = 4.0$ s?

- A** 28 m **B** 35 m **C** 48 m **D** 64 m

- 5 In a experiment, a student jumps upward off a common bathroom scale as the laboratory partner records the scale reading.



What does the laboratory partner observe during the instant the student pushes off?

- A** The scale reading will remain unchanged during the entire time the student is in contact with the scale.
- B** The scale reading will increase momentarily then will decrease during the entire time the student is in contact with the scale.
- C** The scale reading will decrease then increase during the entire time the student is in contact with the scale.
- D** The scale reading will decrease during the entire time the student is in contact with the scale.
- 6 A 1000 kg mass was placed 2 m directly above a 1 kg mass and both were dropped from a tower at the same time. Assuming air resistance is negligible.

Which statement is correct about the time of landing?

- A** The 1000 kg mass would land on the ground at same time as the 1 kg mass.
- B** The 1000 kg mass would land on the ground faster than the 1 kg mass.
- C** The 1000 kg mass would land on the ground later than the 1 kg mass.
- D** Not possible to predict.
- 7 An elevator of mass 500 kg is travelling downwards with a constant acceleration of 2.0 m/s^2 .

What is the tension in the elevator cable?

- A** 2500 N **B** 4000 N **C** 5000 N **D** 6000 N

- 8 5000 kg of iron is melted and mixed with 2.0 m^3 of molten copper. The density of molten iron and molten copper are 7500 kg/m^3 and 9000 kg/m^3 respectively.

What is the approximate density of the mixture?

- A 8000 kg/m^3 B 8200 kg/m^3 C 8400 kg/m^3 D 8600 kg/m^3

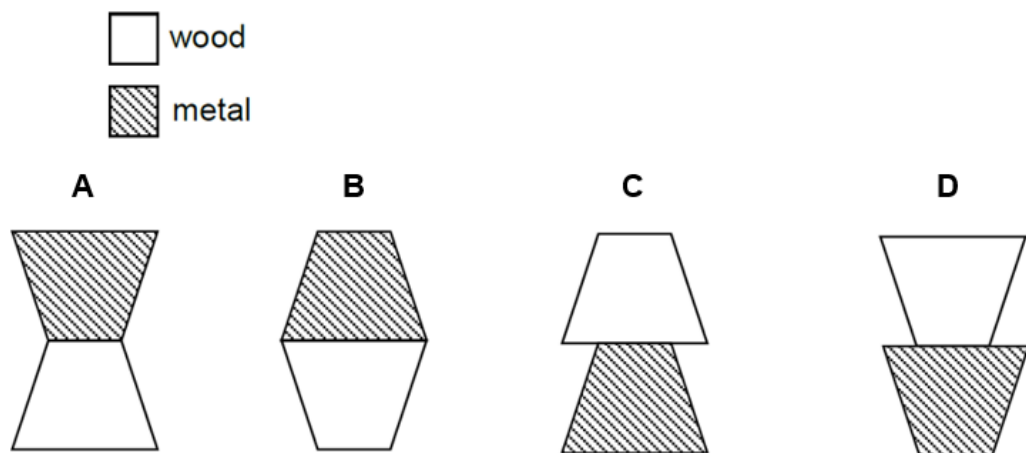
- 9 A granite rock at the surface of the Earth has density ρ . The rock is transported to the surface of another planet. The acceleration of free fall on the surface of the other planet is twice that on the surface of the Earth.

What is the density of the rock on the other planet?

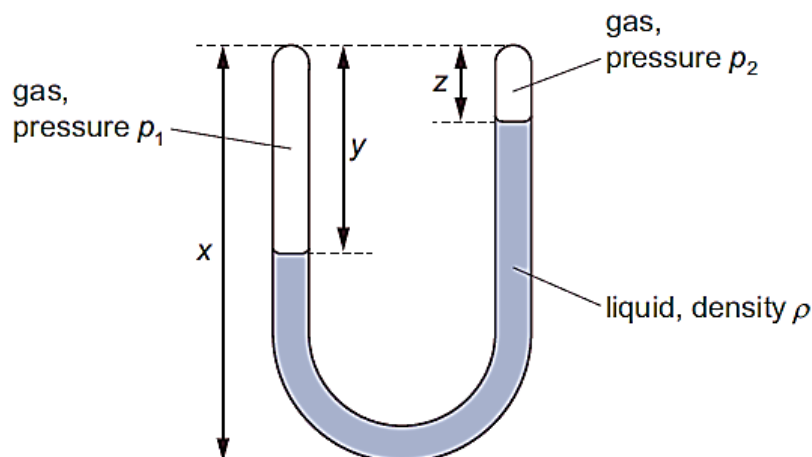
- A 0.5ρ B ρ C 2ρ D 4ρ

- 10 A student tries out different ways of stacking two containers. One container is made of wood, and the other is made of metal. The dimensions of the containers are identical.

Which arrangement has the greatest stability?



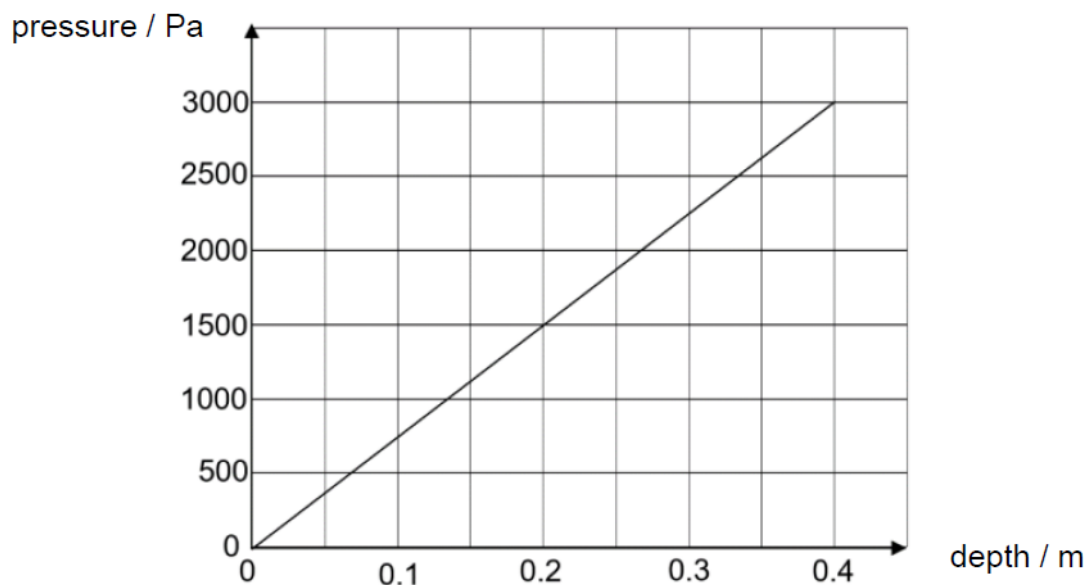
11 A closed U-shaped tube contains a stationary liquid of density ρ . One side of the tube contains a gas at pressure p_1 and the other side contains a gas at pressure p_2 , as shown. (The acceleration of free fall is g .)



Which equation is correct?

- A** $p_1 = \rho g y$ **B** $p_2 = \rho g (y - z)$
C $p_1 - p_2 = \rho g (y - z)$ **D** $p_1 - p_2 = \rho g (x - y)$

- 12** The graph shows how the pressure exerted by a liquid varies with depth below the surface.



What is the density of the liquid if the gravitational field strength is 10 N/kg ?

- A** 600 kg/m³ **B** 750 kg/m³ **C** 1200 kg/m³ **D** 7500 kg/m³

- 13** A car of mass 1500 kg is initially travelling at a speed of 15 m/s. 3.0×10^5 J of energy is transferred to its kinetic store by mechanical work while undergoing a constant acceleration.

What is the new speed of the car?

- A** 20 m/s **B** 25 m/s **C** 30 m/s **D** 35 m/s

- 14** An electric motor is required to lift an object of weight 600 N up a vertical height of 100 m in 2 minutes.

What will be the electrical power required if the overall efficiency of the motor is 80%?

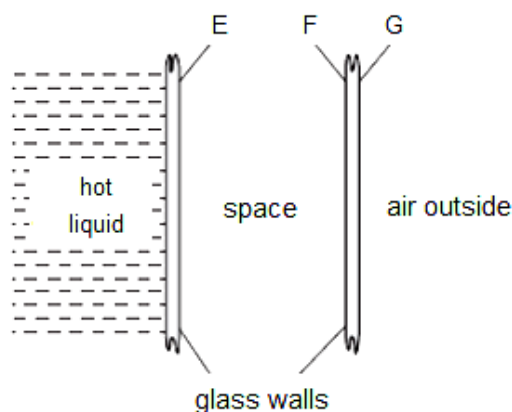
- A** 400 W **B** 625 W **C** 24 000 W **D** 37 500 W

- 15** A gas in a **sealed** cylinder is heated.

Which quantity does not increase as the gas is heated?

- A** the average number of gas molecules hitting the cylinder walls per second
B the average kinetic energy of the gas molecules
C the average speed of the gas molecules
D the average distance between the gas molecules

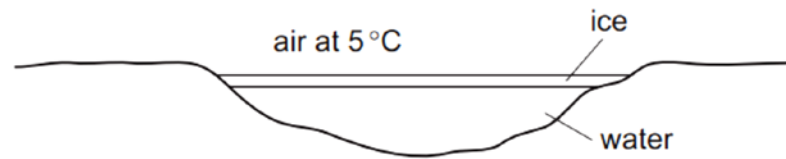
- 16** A student uses a double-walled glass vessel to contain a hot liquid.



Which reduces the energy transfer by radiation?

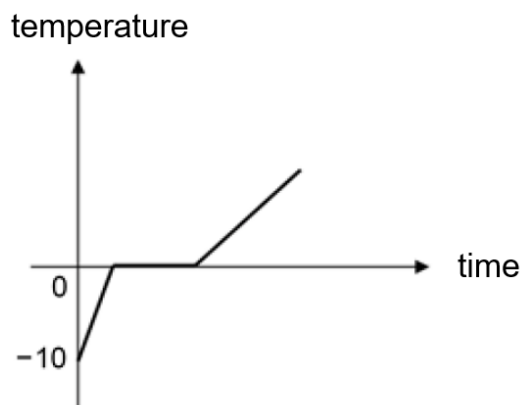
- A** vacuum in the space between the walls
B painting surface E black
C painting surface F silver
D painting surface G black

- 17 The diagram shows a frozen pond with the surface of the ice slowly melting as energy is transferred by heating from the warmer air above it.



By which processes is the energy transferred from the air to the ice?

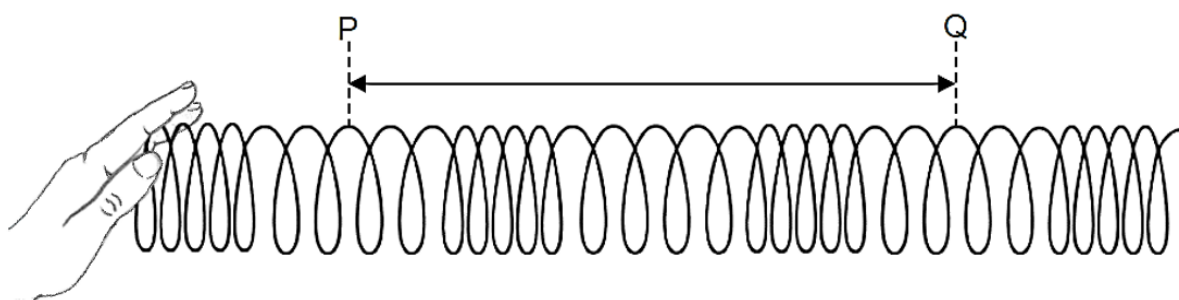
- A conduction, convection and radiation
 - B conduction and convection only
 - C conduction and radiation only
 - D convection and radiation only
- 18 A solid substance is heated. Its temperature variation with time is shown in the graph.



Which of the following statements is true?

- A The total internal energy of the substance remains constant throughout.
 - B The substance does not gain thermal energy when temperature is constant.
 - C The substance has a greater specific heat capacity in its solid state, than in its liquid state.
 - D The substance has an overall increase in internal potential energy and internal kinetic energy.
- 19 Which source generates longitudinal waves?
- A a lamp
 - B a wireless microphone
 - C a loudspeaker
 - D a noise level detector in the library

- 20** The diagram shows a wave travelling in a slinky spring after being pushed by a hand.



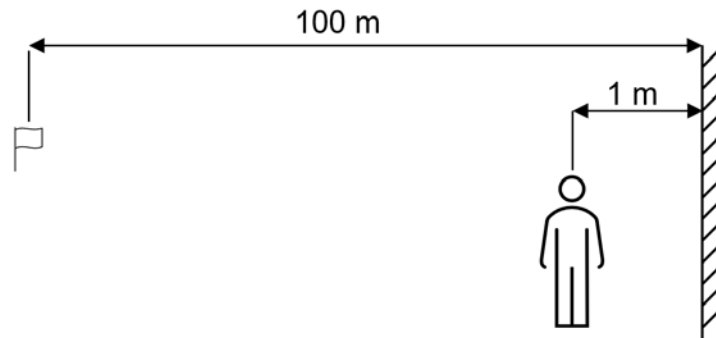
If a compression takes 1.0 s to travel from point P to Q, what is the frequency of this wave?

- A** 0.33 Hz **B** 0.5 Hz **C** 2.0 Hz **D** 3.0 Hz
- 21** Ultrasound is used to map the ocean floor. During one survey, the depth of water is 1200 m. An ultrasound pulse is sent from the surface and when it returns to the ship, another pulse is sent immediately. In any period of 8.0 s, five pulses are sent down from the surface.
- What is the speed of the ultrasound in water?
- A** 600 m/s **B** 750 m/s **C** 1200 m/s **D** 1500 m/s
- 22** An experimenter standing at one end of a long solid steel pipe hits one end of the steel pipe with a hammer. A detector on the other end detects two sounds with an interval of 2.0 s between the two sounds. The speed of sound in steel is 5100 m/s and speed of sound in air is 300 m/s.

What is the length of the steel pipe?

- A** 600 m **B** 638 m **C** 9600 m **D** 10200 m

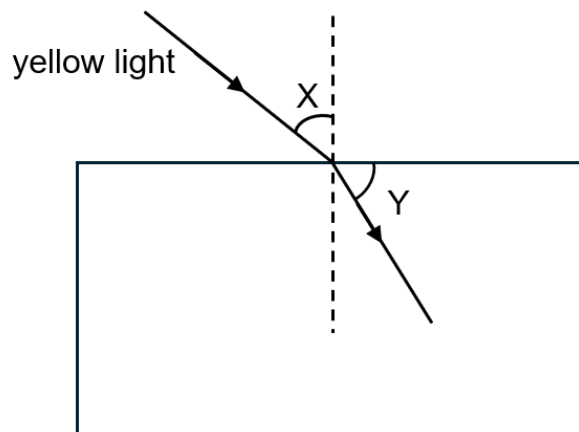
- 23** An object is placed at 100 m in front of a plane mirror, while an observer stands 1 m in front of the mirror.



Which of the following correctly describes the characteristics of the image compared to the object?

	orientation	size
A	inverted	same size
B	laterally inverted	diminished
C	upright	diminished
D	laterally inverted	same size

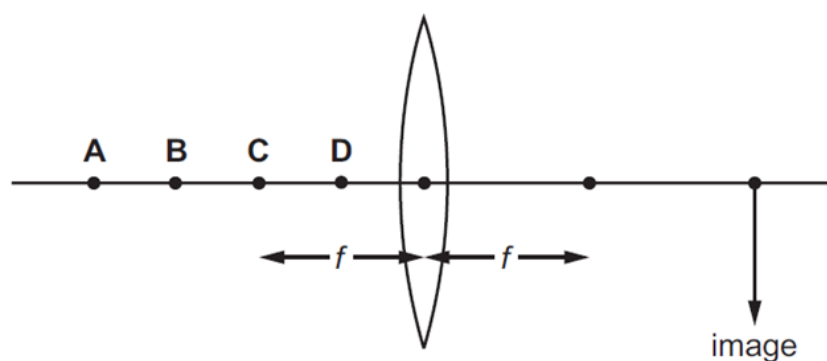
- 24** Elly shone a yellow light through a glass block and it refracted in the glass block as shown.



Which of the following correctly describes the path indigo light will travel as it is shone at the same angle of incidence, X through the glass block?

- A** Angle Y will decrease as indigo light travels slower than yellow light in glass block.
- B** Angle Y will decrease as indigo light travels faster than yellow light in glass block.
- C** Angle Y will increase as indigo light travels faster than yellow light in glass block.
- D** Angle Y will increase as indigo light travels slower than yellow light in glass block.

- 25 The diagram shows a thin converging lens of focal length f and an image.

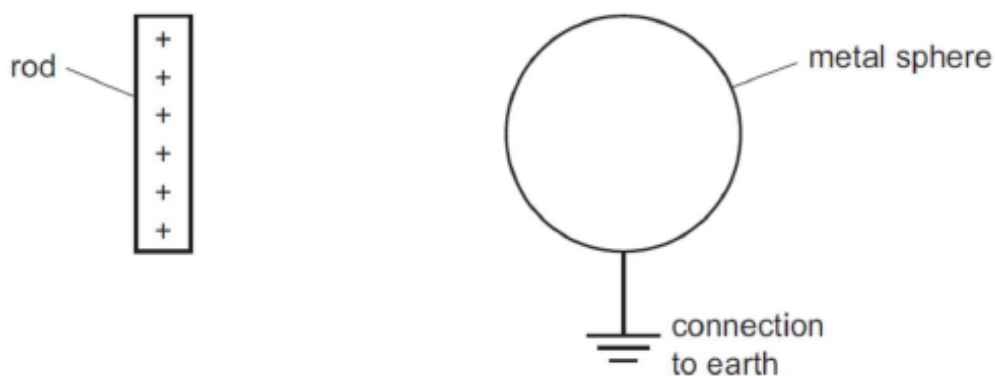


Where should the object be placed in order to produce an image as shown?

- 26 Many devices produce electromagnetic waves when operating.

Which device produces electromagnetic waves of the highest frequency?

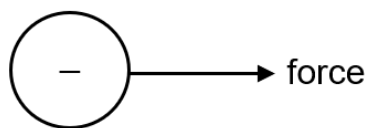
- A sunbed
 - B mobile phone
 - C television remote controller
 - D toaster
- 27 A metal sphere is connected to earth. A positively charged rod approaches the sphere and stops before touching it.



Which of the following describes the charge on the metal sphere?

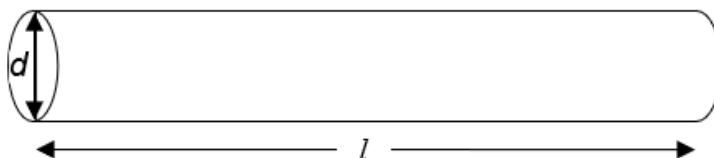
- A It is negative because electrons are attracted towards the rod.
- B It is neutral because it is earthed.
- C It is positive because protons are repelled by the rod.
- D It is neutral because electrons are attracted towards the rod and protons are repelled.

- 28 A stationary negative charge in an electric field experiences an electric force in the direction shown.



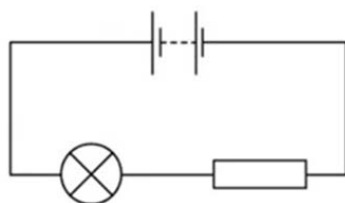
What is the direction of the electric field?

- A horizontally to the left
 - B horizontally to the right
 - C vertically down
 - D into the page
- 29 The diagram shows a segment of a uniform copper wire with length l and diameter d .



Which one of the following changes will cause the resistance of the wire to increase by four times?

- A increase the diameter to $2d$ and increase the length to $4l$
 - B increase the diameter to $2d$ and decrease the length to $l/2$
 - C decrease the diameter to $d/2$ and decrease the length to $l/2$
 - D decrease the diameter to $d/2$ and keep the length unchanged
- 30 Peter sets up the circuit below, but he noticed that the lamp is too dim.



What change can be made to the circuit to increase the brightness of the lamp?

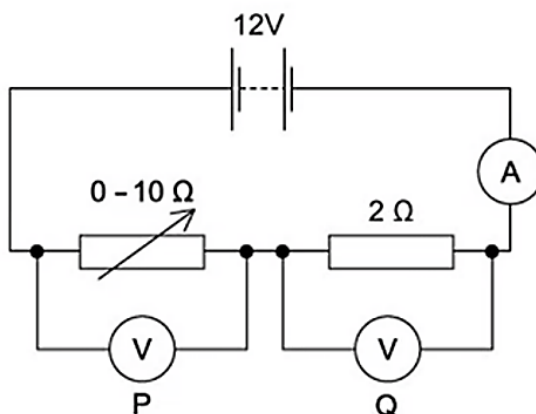
- A Putting another resistor in parallel with the battery.
- B Putting a resistor in parallel with the lamp.
- C Putting another resistor in series with the resistor.
- D Putting another resistor in parallel with the resistor.

- 31** A 12 V battery is charged for 20 minutes by connecting it to a source of electromotive force (e.m.f). The battery is supplied with 7.2×10^4 J of energy in this time.

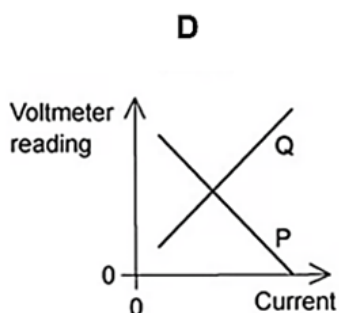
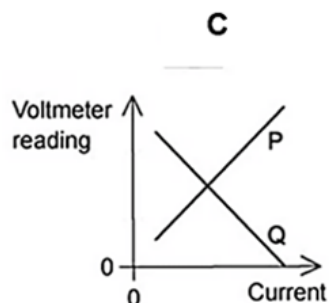
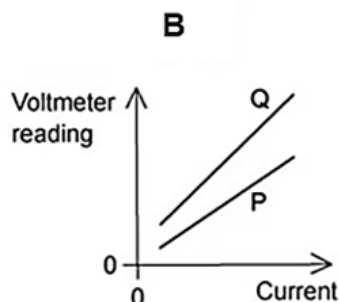
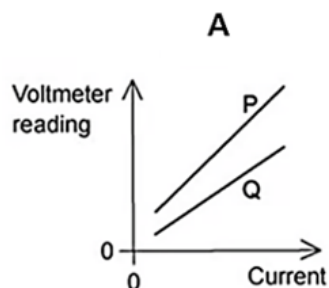
How much charge flows into the battery?

- A** 5.0 C **B** 60 C **C** 100 C **D** 6000 C

- 32** A 12 V battery is in series with an ammeter, a $2\ \Omega$ fixed resistor and a $0 - 10\ \Omega$ variable resistor. High-resistance voltmeters P and Q are connected across the variable resistor and the fixed resistor, respectively, as shown.



Which graph shows the variation with current of the voltmeter readings?



- 33** In the three-pin plug of a heater, a fuse is connected at the live wire but not at the neutral wire.

Which statement correctly explains the above statement?

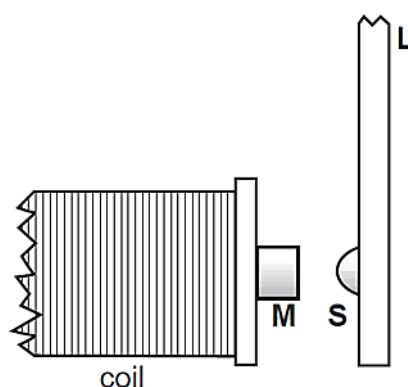
- A** The neutral wire is always at a voltage lower than that of the live wire.
- B** The live wire carries a larger current than the neutral wire.
- C** If the fuse in the neutral wire 'blew', the heater still works.
- D** None of the above.

- 34** An electric hotplate is rated at 1500 W and an oven is rated at 2000 W. Over the duration of one day, the hotplate is switched on for a total of 1.0 hour and the oven is switched on for 4.0 hours. The cost of electricity is 29 cents per kWh.

What is the cost of using the electric hotplate and oven in one day?

- A** \$2.32 **B** \$2.54 **C** \$2.76 **D** \$5.08

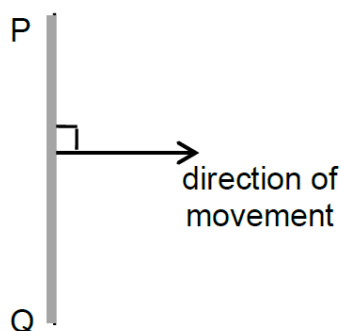
- 35** The diagram shows part of a magnetic relay. M is part of the core of the magnet. L is part of the armature which is attracted to the core when a current flows through the coil. S is a stud which stops the armature being attracted too strongly.



Which line of the table gives the best materials for M, L and S?

	M	L	S
A	copper	iron	steel
B	iron	iron	copper
C	steel	copper	iron
D	iron	copper	iron

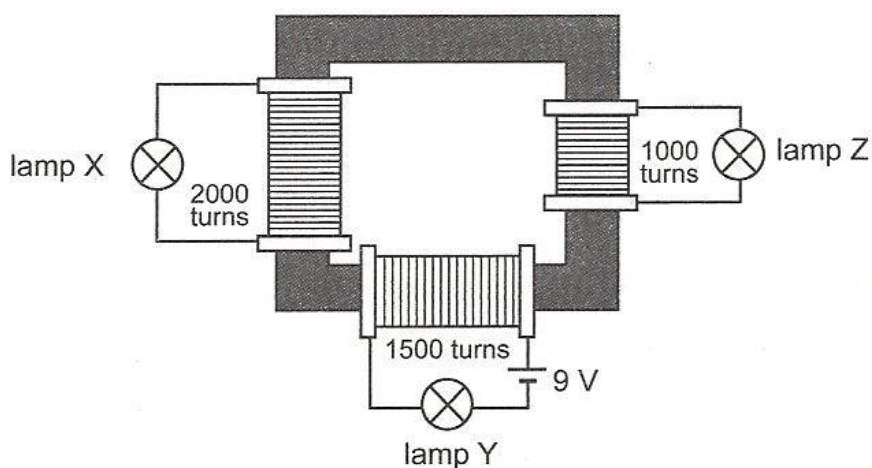
- 36** A beam of electrons travels along wire PQ. The wire starts to move in the direction shown.



Which of the following combinations will give the induced force as shown?

	electrons flow from	magnetic field lines
A	P to Q	to the bottom of page
B	P to Q	into the page
C	Q to P	into the page
D	Q to P	out of the page

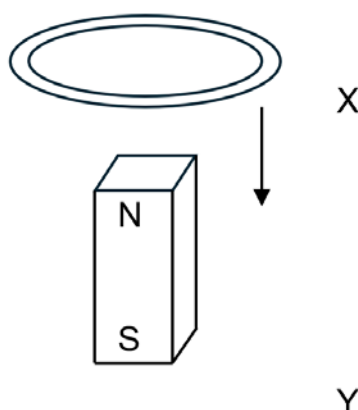
- 37** Three identical filament lamps, X, Y and Z, are connected to an iron core with multiple coils of different number of turns as shown. The resistance of each lamp is $4.5\ \Omega$ and each requires a minimum current of $2.0\ \text{A}$ to light up normally. Lamp Y is connected to the coil with a direct current supply of $9.0\ \text{V}$.



What can be observed about the brightness of the three lamps after a few seconds?

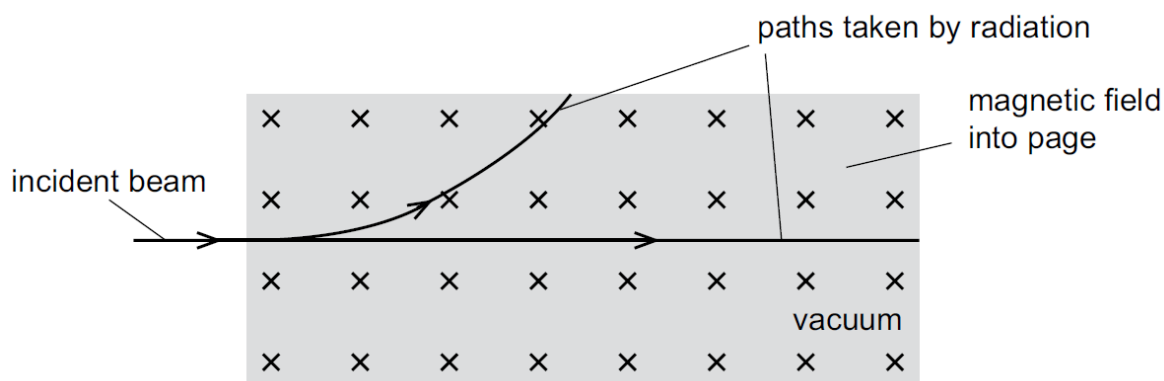
	lamp X	lamp Y	lamp Z
A	brighter than normal	normal brightness	dimmer than normal
B	dimmer than normal	normal brightness	brighter than normal
C	not light up	normal brightness	not light up
D	not light up	not light up	not light up

- 38** A copper ring is dropped over a bar magnet from point X to Y as shown below.



As seen from the top, which statement about the induced current in the ring at point X and Y is correct?

- A** It flows in a clockwise direction at both X and Y.
 - B** It flows in an anti-clockwise direction at X and then a clockwise direction at Y.
 - C** It flows in a clockwise direction at X and then an anti-clockwise direction at Y.
 - D** It flows in an anti-clockwise direction at both X and Y.
- 39** A beam of radiation enters a region in which there is a very strong, uniform magnetic field directed into the page. All the equipment is in a vacuum.

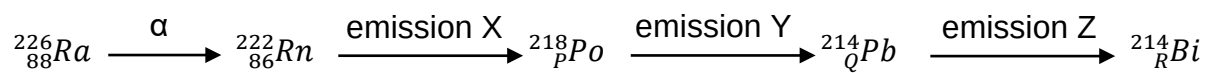


The beam splits and the curved path and the straight path taken by the radiation in the magnetic field are shown on the diagram.

What types of radiation are in the incident beam?

- A** α -particles and β -particles only
- B** α -particles and γ -rays only
- C** β -particles and γ -rays only
- D** α -particles, β -particles and γ -rays

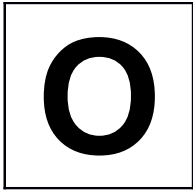
40 Consider the radioactive decay of $^{226}_{88}\text{Ra}$.



Which of the following correctly describes the radioactive decay of $^{226}_{88}\text{Ra}$?

	type of emission			proton number		
	X	Y	Z	P	Q	R
A	α	α	β	84	82	83
B	α	β	α	84	85	83
C	β	α	β	86	84	85
D	β	β	α	86	87	85

End of Paper



[Pure] Physics O Level Exam Paper
Preliminary Examination Set [III]
Secondary Four Express



CANDIDATE NAME:

CLASS:

INDEX NUMBER:

(Updated 2024)

5059/02

Physics

1 hour 45 minutes

Paper 2 Theory

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid/tape.

Section A

Answer **all** questions.

Section B

Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

Section A	
Section B	
Total	

Section A

Answer **all** questions.

- 1** Fig. 1.1 shows the velocity-time graph for the first 80 s after an object is dropped from rest at a height of 2000 m above the ground.

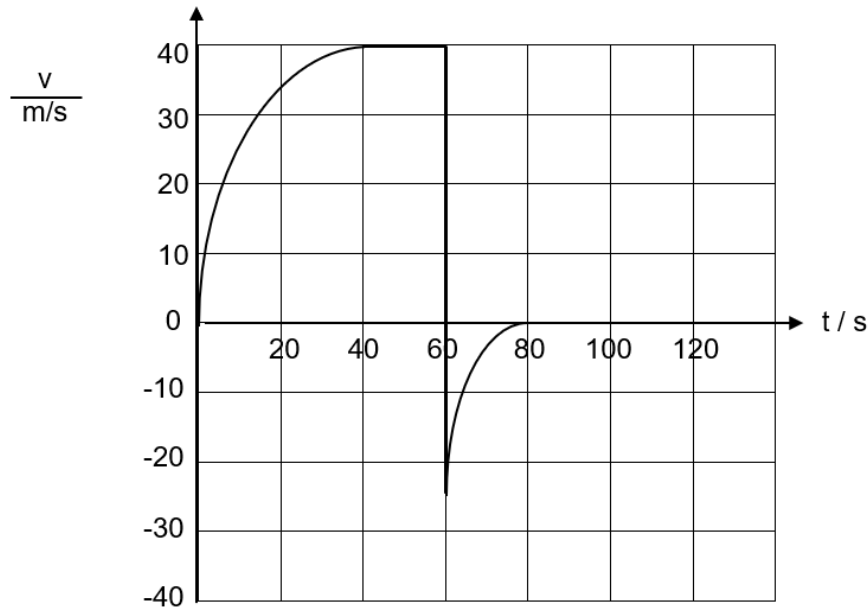


Fig. 1.1

The object has a mass of 9.0 kg.

- (a)** State the acceleration of the object at 0 s.

acceleration = [1]

- (b)** Describe the motion from 0 to 80 s.

.....

.....

.....

.....

.....

.....[4]

- (c)** Describe the energy transfer when the object is travelling at terminal velocity.

.....

.....

.....[2]

- (d) Calculate the maximum possible air resistance acting on the object when the object is falling at terminal velocity.

maximum air resistance =[1]

- 2 A 7.0 kg picture frame is being suspended from a nail by a string. The string forms two segments L_1 and L_2 , as shown in the Fig. 2.1. L_1 and L_2 make an angle of 35° and 60° with the vertical respectively.

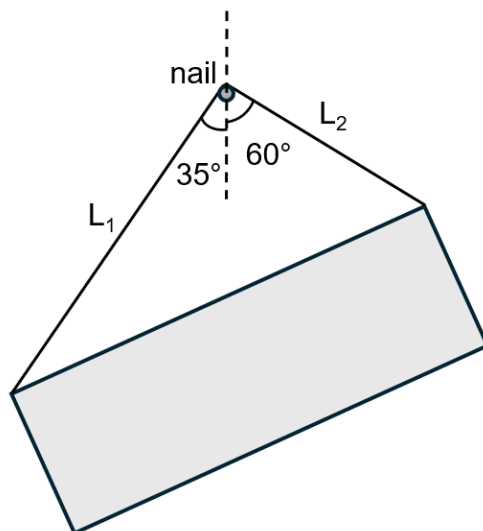


Fig. 2.1

- (a) In the space below, draw a vector diagram to determine the tensions in segments L_1 and L_2 . Specify the scale used.

scale = , tension in L_1 = , tension in L_2 =
[4]

- (b) State the magnitude and direction of the force by the nail, on the string.

.....

[2]

- (c) The picture frame was adjusted such that both segments of the string make an **equal** angle with the vertical.

State the changes to the tensions in segment L_1 and L_2 and how their magnitudes compare.

.....
[2]

- 3 Fig. 3.1 shows a man holding a 0.20 N object in his hand with his forearm in a horizontal position. He can support the object in this position because the flexor muscle exerts a force, F_M vertically upward on the forearm. The man's forearm weighs 22 N and its centre of gravity (C.G.) is indicated in the diagram. The forearm can rotate about the elbow joint.

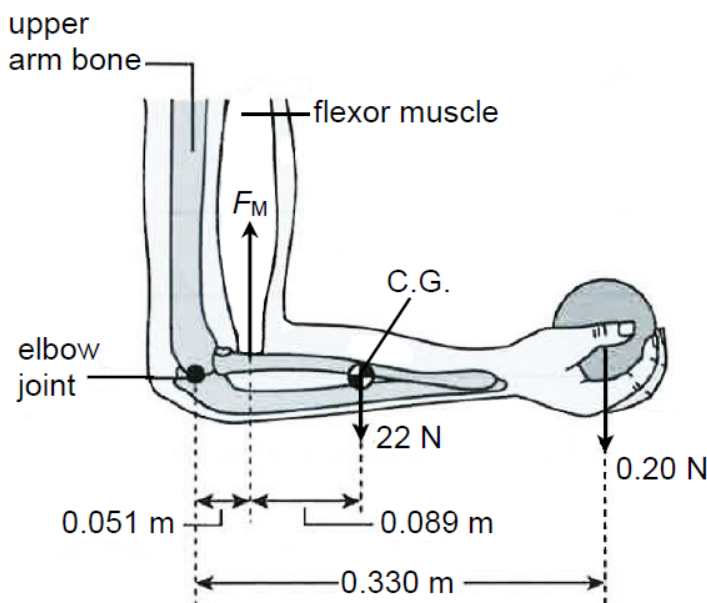


Fig. 3.1

- (a) Calculate the value of F_M .

$F_M = \dots\dots\dots$ [2]

- (b) To keep the forearm in the horizontal equilibrium position, the upper arm bone exerts a force at the elbow joint.

Determine the magnitude and direction of this force.

magnitude =

direction is[3]

- (c) Explain why the force in (b) is not considered in the calculation in (a).

.....
[1]

- 4 Fig. 4.1 shows two vertical tubes P and Q, each closed at the upper end. The pressure in the space above the mercury meniscus in tube P is 16800 Pa. The pressure in the space above the mercury meniscus in tube Q is unknown.

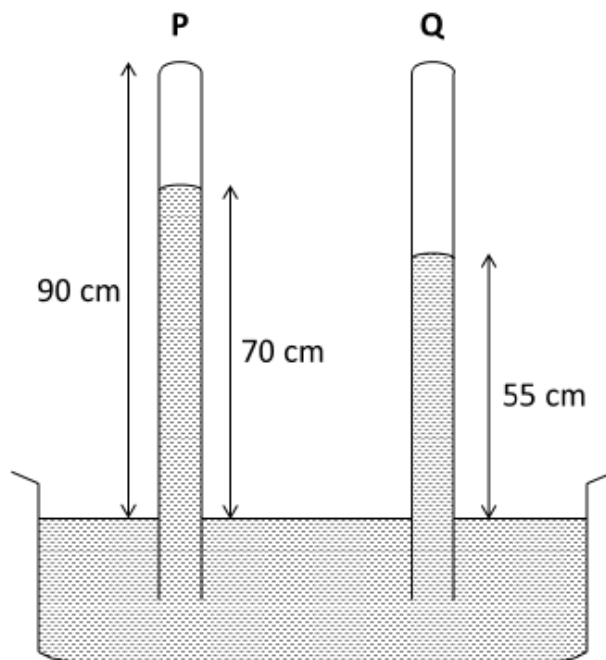


Fig. 4.1

Take the density of mercury to be 13600 kg/m^3

(a) Using the information provided, calculate

(i) the atmospheric pressure;

atmospheric pressure = [2]

(ii) the pressure in the space above the mercury meniscus in tube Q.

pressure = [2]

(b) Due to a small knock, tube Q is slightly shifted and ends up at an angle 15° to the vertical, as shown in Fig. 4.2.

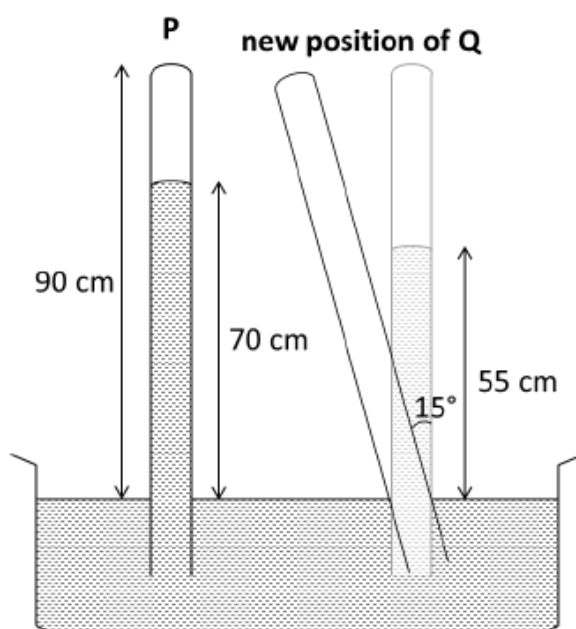


Fig. 4.2

On Fig. 4.2, draw the new level of the mercury meniscus in tube Q, and explain your answer.

.....
.....
.....[2]

5 Fig. 5.1 shows the structure of a water cooler that supplies cold water.

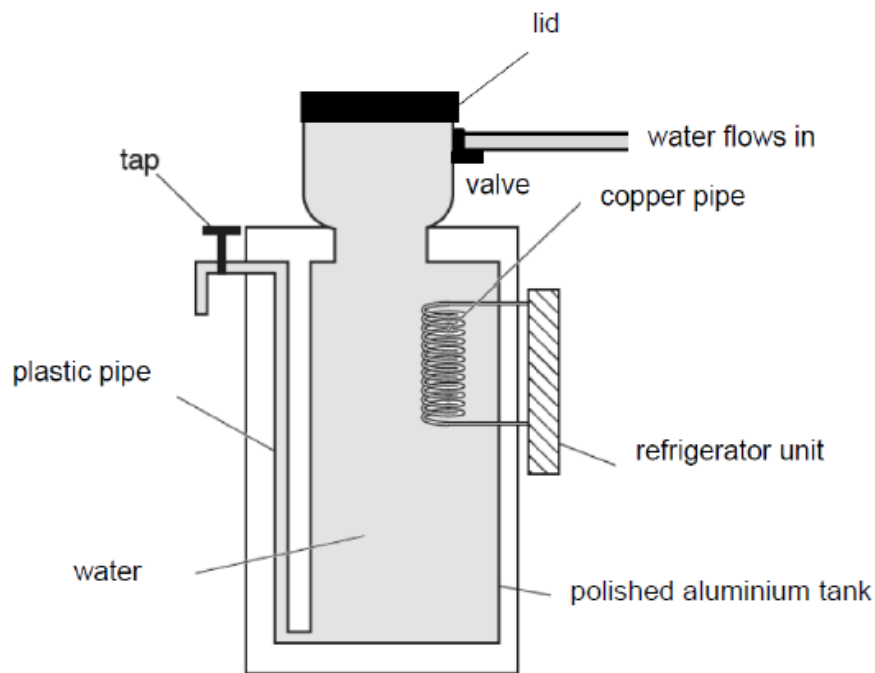


Fig. 5.1

- (a) In the refrigerator unit, a coolant is pumped through the copper pipe.
Explain how energy is transferred from the water to the coolant in the pipe.

.....
.....
.....[2]

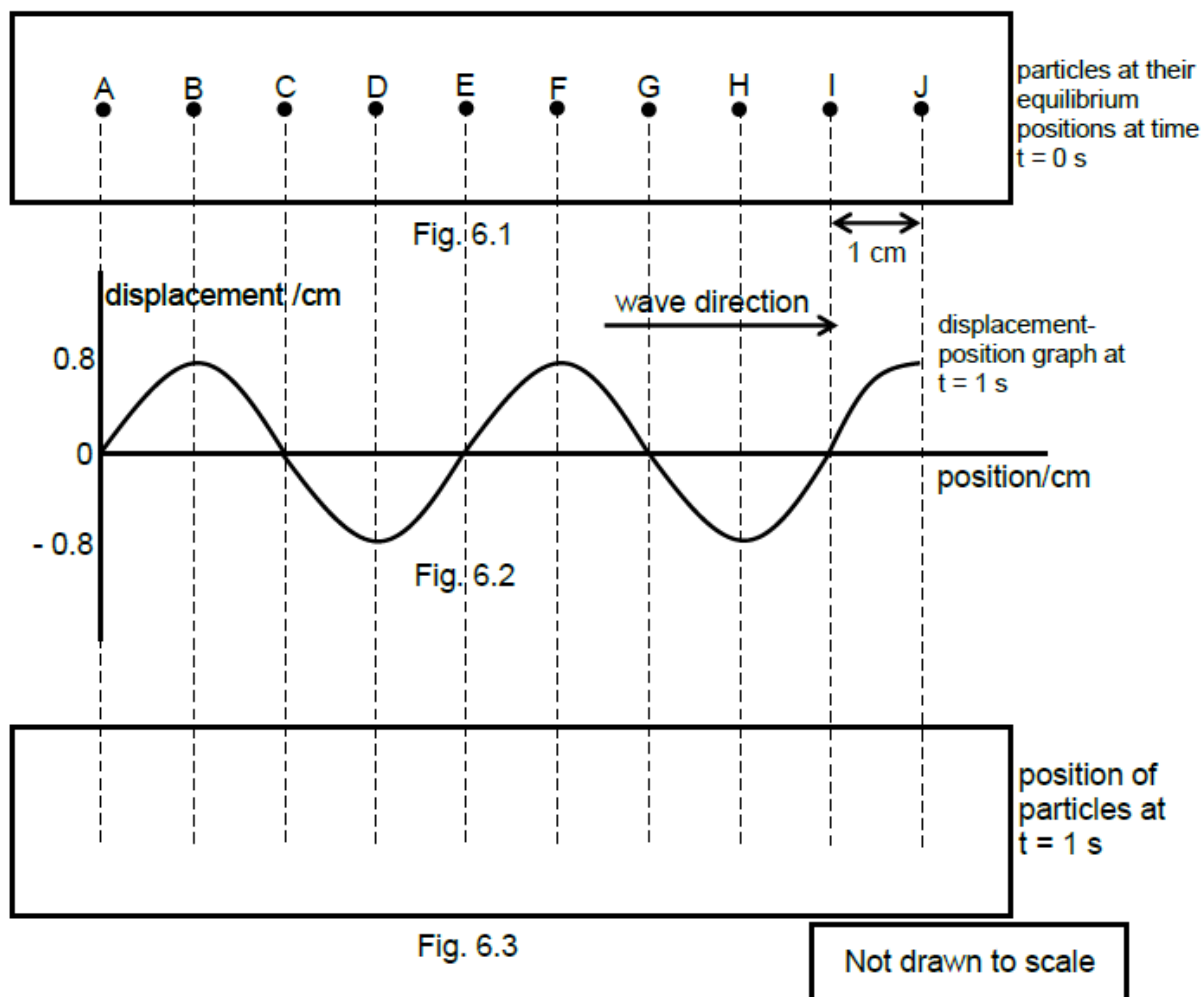
- (b) Describe how the entire tank of water is cooled.

.....
.....
.....
.....[2]

- (c) Explain how the polished aluminium tank helps to keep the water cold.

.....
.....[1]

- 6 Fig. 6.1 shows the equilibrium positions of some particles in a medium at time $t = 0$ s. When a longitudinal wave travels through this medium, the displacements of these particles at time $t = 1$ s are shown in the displacement - position graph (Fig. 6.2).



- (a) Mark the positions of the particles A – J at the time $t = 1$ s in the space provided in Fig. 6.3 with reference to the displacement - position graph shown in Fig. 6.2. [1]
- (b) With reference to your answer to (a) which particle(s) is/are at the
- (i) centre of compression, particle(s) [1]
- (ii) centre of rarefaction. particle(s) [1]
- (c) If the speed of the wave is 340 m s^{-1} , find the period of the wave.

period = [2]

- 7 Fig. 7.1 shows a converging lens. Parallel rays of light from point A which is from the top of a distant building is brought to a focus at I . Parallel rays of light from another point B which is from the bottom of the same building is incident on the lens as shown. One of the ray from A is refracted as shown.

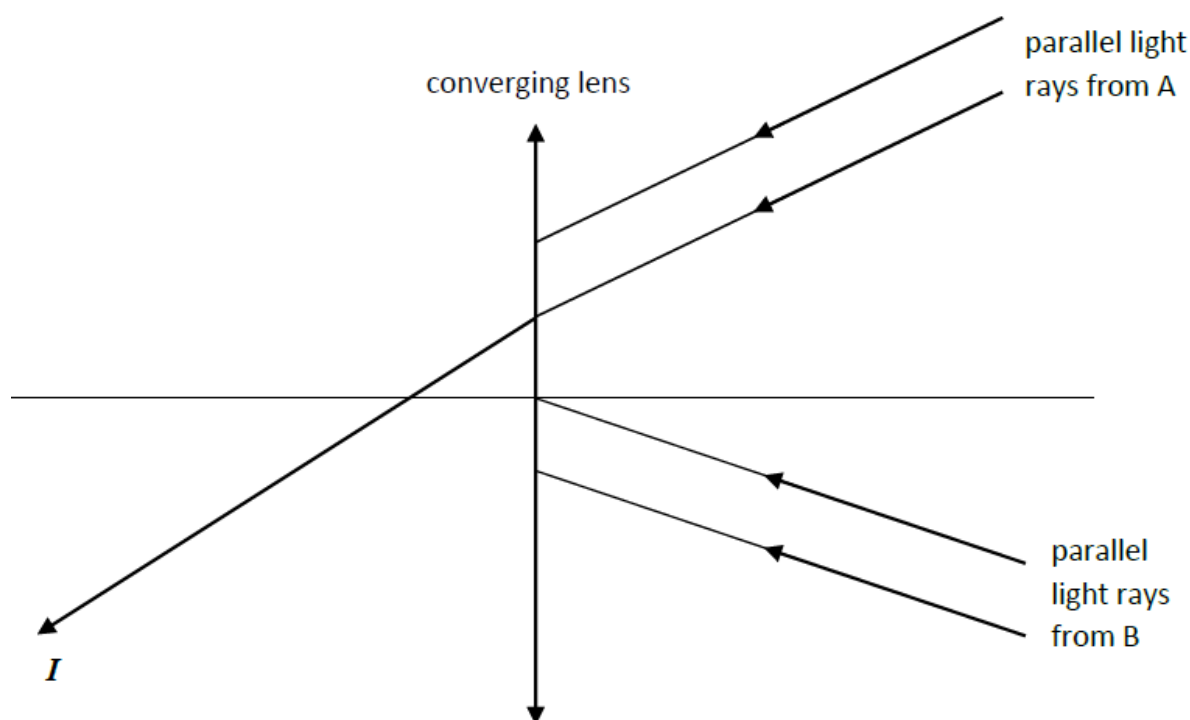


Fig. 7.1

- (a) Complete the rays from A and B on Fig. 7.1 to show how the image is formed. [2]
- (b) Indicate on Fig 7.1 the height of the image with letter h and principal focal point with the letter F . [2]

- 8 LASER is the acronym for Light Amplification by Simulated Emission of Radiation.

Table 8.1 shows different brands of laser guns for industrial use and their specific wavelengths. All laser guns emit electromagnetic waves.

An enthusiastic laser user sorts out the different brands of laser guns into Types I, II and III. He also discovers that the Red Beam laser gun emits a bright, red light.

Table . 8.1

Type	brand of laser gun	wavelength / $\times 10^{-7}$ m
I	Trace	3.2
II	Eagle Eye	4.9
	Fire Fly	5.5
	Red Beam	6.3
III	Sparrow Beak	9.8

- (a) State the type of electromagnetic waves emitted by Type I, Type II and Type III laser guns in the electromagnetic spectrum respectively.

Type I :

Type II :

Type III : [2]

- (b) State and explain which brand(s) of the laser guns listed in Table 8.1 can be used in a vacuum environment?

.....

.....

..... [2]

- 9 Fig. 9.1 shows a coil of wire wound on a soft iron core. A current is passed through the coil in the direction indicated by the arrows.

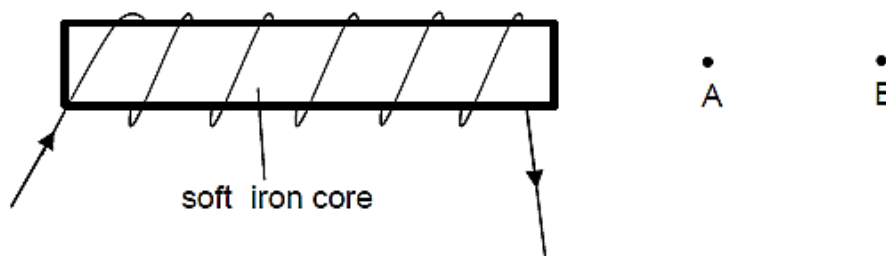


Fig. 9.1

- (a) Show by drawing an arrow, the direction in which the north end of a compass needle would point when placed at position A in Fig. 9.1. Label the arrow C. [1]

- (b) A beam of electrons flows through the point B in a direction that is perpendicularly downwards into the paper.

Show clearly by an arrow labelled F, the direction of the force exerted by the magnetic field on the electron beam. [1]

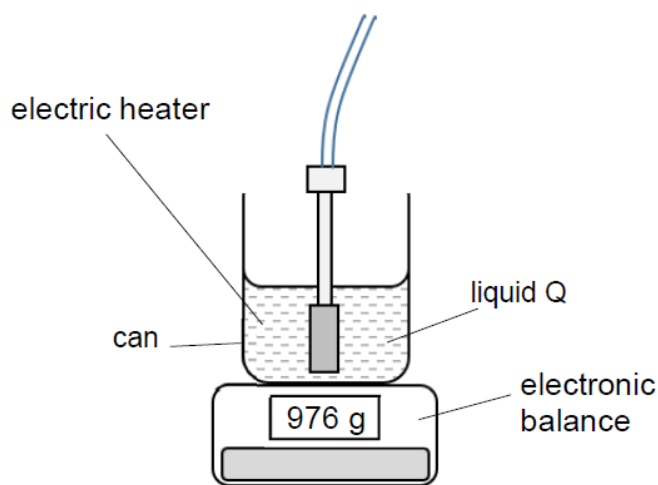
- (c) Explain how you determine the direction indicated in (b).

.....

.....

..... [2]

- 10 Fig. 10.1 shows an experimental set up that can be used to calculate the specific heat capacity and specific latent heat of vaporisation of a liquid Q. Energy is continuously provided by a 100 W electric heater to liquid Q. The temperature and electronic balance readings are recorded at regular intervals of time.



power of electric heater = 100 W

mass of empty can = 100 g

mass of liquid Q and can = 976 g

specific latent heat of vaporisation of liquid Q = 330 kJ/kg

Fig. 10.1

Fig. 10.2 shows how the total mass (mass of can + mass of liquid Q) changes with time. Fig. 10.3 shows how temperature of liquid Q changes with time.

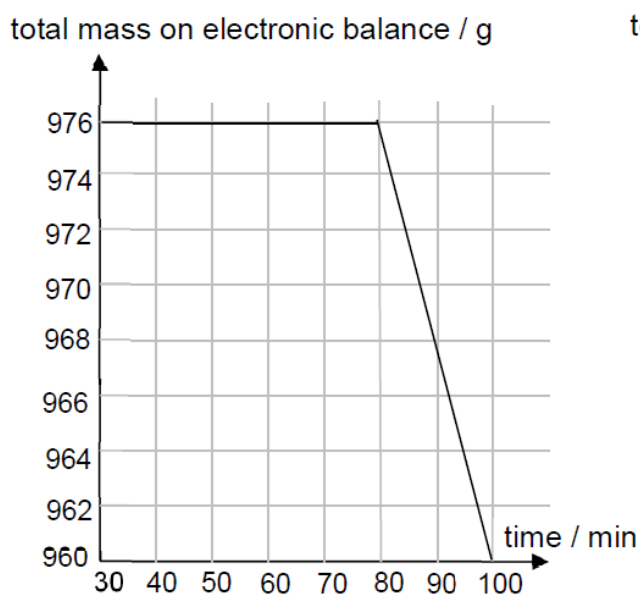


Fig. 10.2

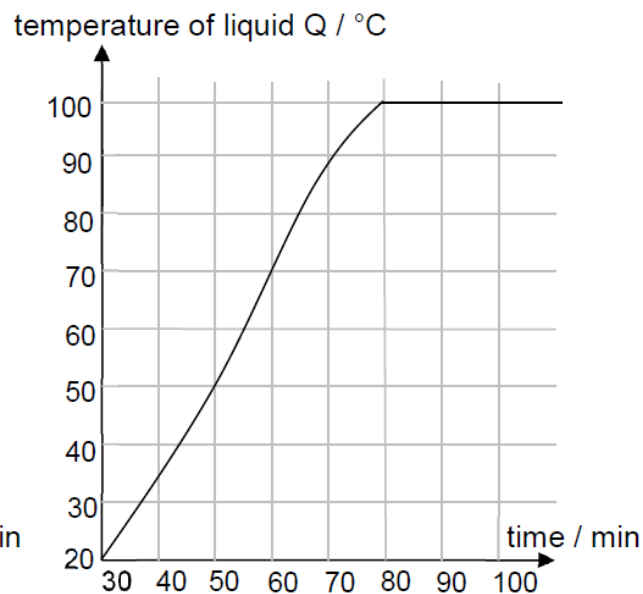


Fig. 10.3

- (a) Define *specific latent heat of vaporisation*.

.....
[1]

- (b) (i) Calculate the amount of energy supplied by the heater from 30 minutes to 80 minutes.

energy supplied = [2]

- (ii) Given that 60 000 J of energy is transferred from the experimental set up to the surroundings from 30 minutes to 80 minutes, calculate the specific heat capacity of the liquid Q. Assume the can has negligible specific heat capacity.

specific heat capacity of liquid Q = [3]

- (iii) With reference to your calculation in (b)(ii), explain whether the value of the specific heat capacity of liquid Q calculated is higher or lower than the actual specific heat capacity of the liquid if specific heat capacity of the can is not negligible.

.....
.....
.....
.....[2]

- (c) (i) Calculate the amount of energy needed to boil off liquid Q from 80 minutes to 100 minutes.

energy = [1]

- (ii) The mass of the liquid remains relatively constant from 0 minutes to 80 minutes. The rate of evaporation is hence insignificant.

Suggest why the rate of evaporation is insignificant.

.....
.....[1]

- 11** Fig. 11.1 shows a radioactive source used to measure and control the thickness of cardboard during manufacture.

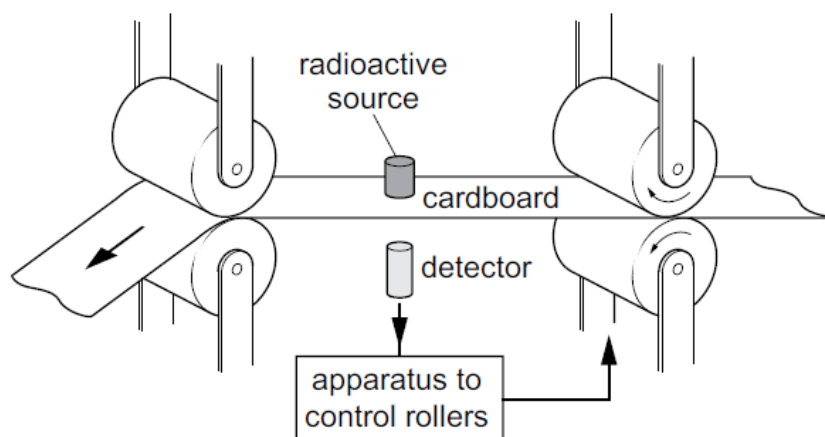


Fig. 11.1

- (a)** Some radioactive sources emit alpha-particles, some beta-particles and some gamma radiation.

Explain why emission count of alpha-particles and gamma radiation are not suitable for the application shown in Fig. 11.1.

.....

[2]

- (b)** Strontium-90 is an isotope used in the radioactive source in Fig. 11.1.

A nucleus of strontium-90 emits a beta-particle as it decays.

- (i)** The radioactive decay of a nucleus is a random and spontaneous process.

Explain what is meant by a random decay.

.....
[1]

- (ii) In nuclide notation, strontium-90 is written as ${}^{90}_{38}\text{Sr}$.
When a nucleus of strontium-90 emits a beta-particle (β), it decays to an isotope of yttrium (Y).

Complete the decay equation below for this decay.



- (iii) Beta decay can be considered as the decay of a neutron to a proton and an electron.

Explain how the composition of the nuclei of the strontium and yttrium isotopes illustrates this statement.

.....
.....
.....[2]

- (c) The half-life of strontium-90 is 29 years.

- (i) Suggest why a radioactive source with a half-life of millions of years is unsuitable for use in the apparatus shown in Fig. 11.1.

.....
.....[1]

- (ii) A pure source of strontium-90 emits 1.6×10^5 beta-particles per second.

Calculate the number of beta-particles emitted per second by the source after 87 years.

number of particles per second =[2]

End of Section A

Section B

Answer **one** question from this section.

- 12** Two light bulbs (A and B) are at their normal brightness when each is connected to a 3 V battery. The graph in Fig. 12.1 shows how the current varies with the applied voltage (potential difference) for each bulb.

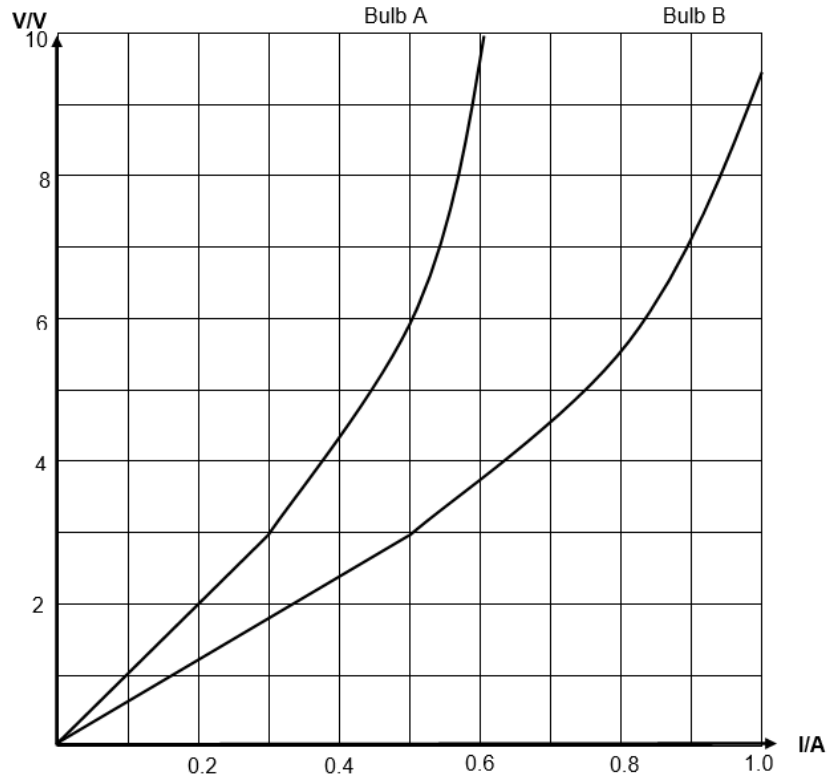


Fig. 12.1

- (a) (i)** Explain the shape of the V-I graph of bulb A.

.....

.....

.....

.....[2]

- (ii)** Determine the resistance of each bulb when they are operating at normal brightness.

resistance of bulb A = , resistance of bulb B =[2]

- (b) A pupil studying potential dividers sets up the circuit as shown in Fig. 12.2 using bulb A.

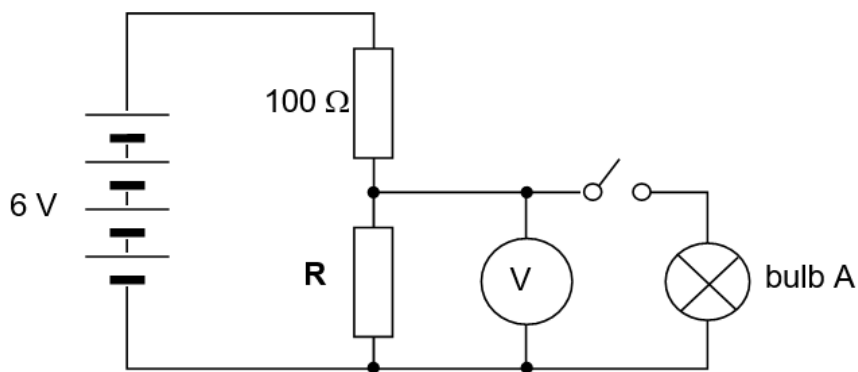


Fig. 12.2

When the switch is open the voltmeter shows a reading of 3.5 V.

- (i) Calculate the value of R.

R = [2]

- (ii) Explain why the reading shown on the voltmeter decreases.

.....

[2]

- (iii) Suggest and explain how the circuit can be modified so that it can be used in a temperature sensor which lights up when placed in a very hot environment.

.....

[2]

- 13** Fig 13.1 represents a typical transformer. When a primary voltage V_P is applied across the primary coil, a secondary voltage V_S occurs in the secondary coil.

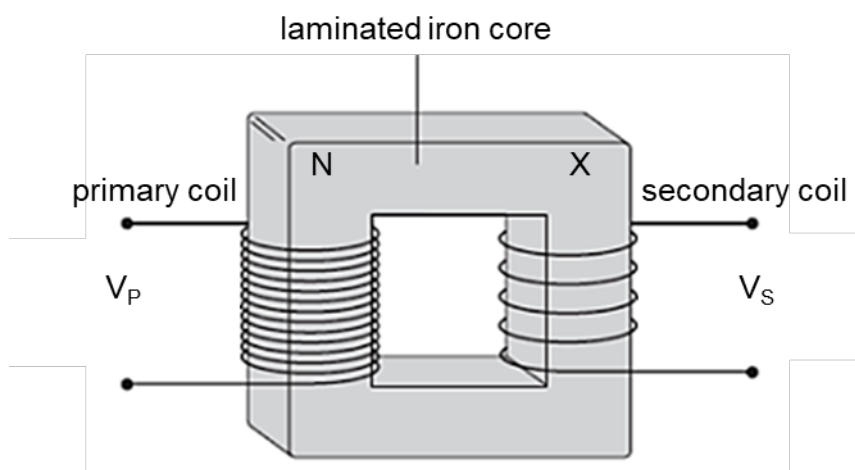


Fig. 13.1

- (a) (i)** Explain how current can flow in the secondary coil when V_P is applied even though there is no electrical contact between the primary and secondary coil.

.....

[1]

- (ii)** Explain why the secondary voltage V_S is reduced when the number of turns in its secondary coil is reduced.

.....

[1]

- (iii)** Fig 13.1 shows an instant when the current in the primary coil produces a north pole above the coil.

State the pole that is formed at X above the secondary coil at this instant.
 Explain how you obtained your answer.

.....

[2]

- (b) A remote village is supplied with electrical energy from a power station some distance away by power cables as shown in Fig. 13.2 below. At the village, a transformer steps down the potential difference from 10,000 V to 250 V. R represents the net resistance of the electrical circuits in the village. The mean rate of supply of electrical energy to the village is 400 kW.

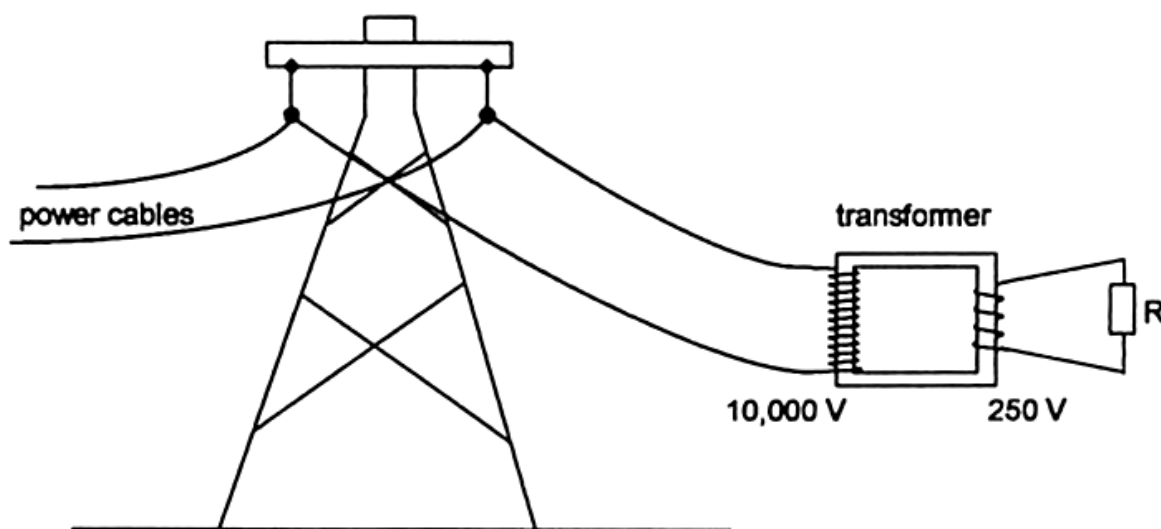


Fig. 13.2

- (i) Explain why a high voltage of 10,000 V is used to transmit the electrical power.

.....

[2]

- (ii) Calculate the current flowing in the secondary coil of the transformer.

Hence, calculate the current in the primary coil assuming that the transformer is 100% efficient.

current in secondary coil = , current in primary coil =[2]

- (iii) If the power cables have a resistance of $25\ \Omega$, calculate the rate at which energy is lost in the power cables.

Hence, deduce the power the cables must draw from the power station, in order to deliver 400 kW of electrical power to the village.

rate = , power =[2]

End of Paper 2