ICSE 2025 EXAMINATION

Sample Question Paper - 7

Physics

Time: 2 Hours. **Total Marks: 80**

General Instructions:

1. *Attempt **all** questions from **Section A** and **any four** questions from **Section B**.*
2. *The intended marks of questions or parts of questions are given in brackets [ ].*

Section A

Attempt *all* questions from this section

Question 1 **[15]**

(i) When a bus suddenly starts, the standing passengers fall backwards in the bus. This can be explained by: -

(a) Newton's first law
(b) Newton's second law
(c) Newton's third law
(d) None of the above

(ii) If A and B are two bodies of masses 20 kg and 40 kg respectively, then

(a) A has more inertia than B
(b) B has more inertia than A
(c) A and B have same inertia
(d) They will not have any inertia

(iii) The series of energy inter-conversions in a steam engine is

(a) Chemical energy > Heat energy > Potential Energy
(b) Chemical energy > Heat energy
(c) Chemical energy > Heat energy > Kinetic Energy
(d) Chemical energy > Kinetic Energy

(iv) A lamp consumes 1000 J of energy in 10s, what is its power?

(a) 100 W
(b) 1000 W
(c) 100 kW
(d) 1 kW

(v) **Assertion (A):** Nuclear bomb works on the principle of nuclear fission.
Reason (R): The rate of energy released in nuclear fission used in nuclear bombs is fast and uncontrolled.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A
(c) Assertion is false but reason is true
(d) Assertion is true reason is false

(vi) A beam of light enters from air to glass. The property of the light that does not change with a change in medium is
(a) Wavelength
(b) Velocity
(c) Frequency
(d) Amplitude

(vii) The size of the image formed by concave lens is
(a) Always smaller than the size of the object
(b) Always greater than the size of the object
(c) Same as the size of the object
(d) It depends on the position of the object

(viii) A real object is placed in front of a concave lens of focal length 'f' at its principal focus. Then the image is formed at:
(a) Optical centre
(b) Infinity
(c) A distance 2f
(d) A distance f/2

(ix) Twinkling of stars is due to
(a) Refraction
(b) Atmospheric dispersion
(c) Scattering of light
(d) Atmospheric refraction

(x) Moving two like poles together usually causes a magnet resting on a table to repel and rotate. This occurs because:
(a) Like magnetic poles repel
(b) Unlike magnetic poles attract
(c) Both A and B
(d) None of these

(xi) The characteristic of the sound that is impacted by the distance of the observer from the source of the sound is

(a) Frequency
(b) Loudness
(c) Pitch
(d) Oscillation

(xii) The colour which deviates least in the formation of spectrum of white light by a prism is

(a) Red
(b) Yellow
(c) Green
(d) Violet

(xiii) The resistivity of a wire

(a) varies with its length
(b) Varies with its mass
(c) is independent of length, cross section and mass of the wire
(d) Varies with its mass

(xiv) When water solidifies to ice,

(a) Heat is absorbed
(b) Heat is released
(c) Temperature increases
(d) Temperature decrease

(xv) Which of the following is not a unit of specific latent heat of vaporization?

(a) kJ/g
(b) kcal/g
(c) cal/kg
(d) J/kg

Question 2

(i) [3]

(a) Wires leading the current to an electric bulb are thick, while the wire inside a bulb is very fine. Explain why.
(b) Why are stringed instruments provided with a sound box?
(c) The specific latent heat of fusion of water is 3.36×10^5 J kg^{-1}. What information does this convey?

(ii) What is the effect on the kinetic energy of a moving car if [2]

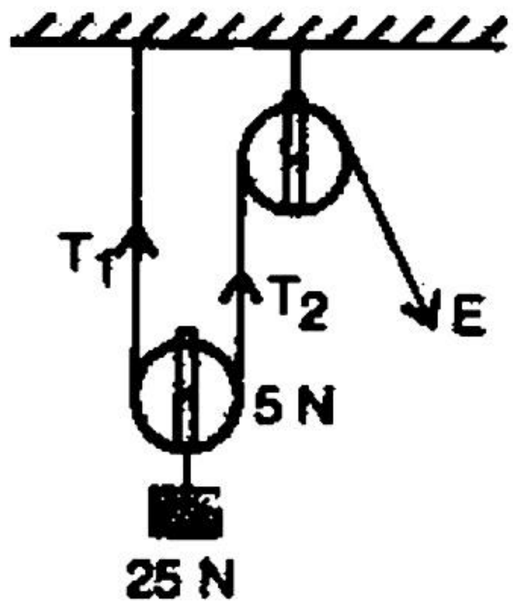
(a) Its mass is doubled
(b) Its velocity is halved

(iii) [2]

(a) In a storm, air exerts force on us. Is it a contact force or a non-contact force?

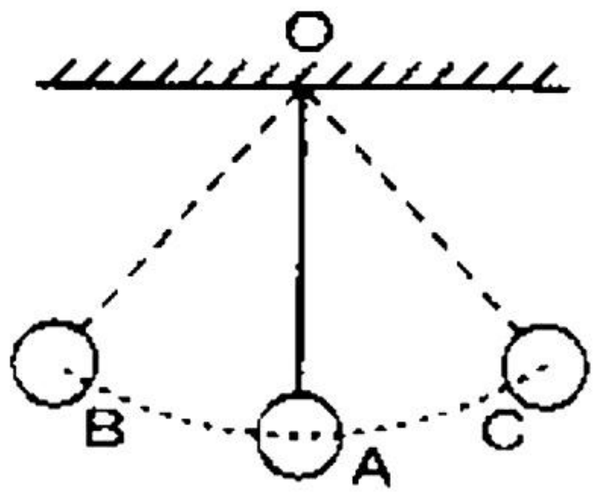
(b) In what conditions does a spring exert force on objects attached to its ends?

(iv) Look at the figure drawn below and calculate the magnitude of effort E and the value of the tensions T_1 and T_2 in the strings. [2]

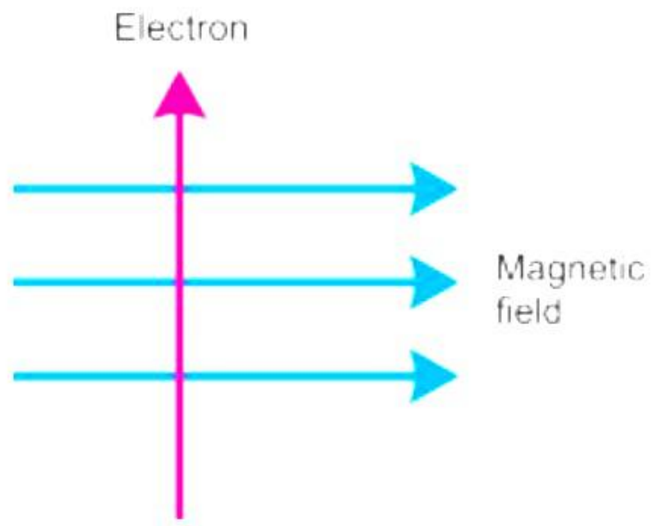


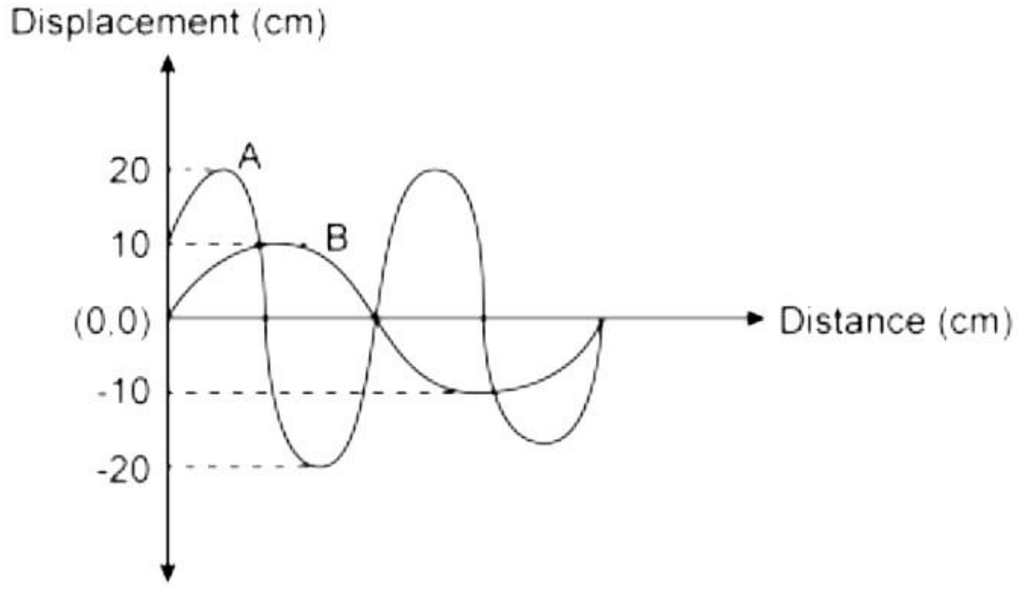
(v) How can we improve the efficiency of the pulleys in combination? [2]

(vi) A pendulum is suspended from Point O and oscillates about its mean position OA. At which points do the bob have maximum potential energy and maximum kinetic energy? [2]



(vii) A beam of electrons is passing a magnetic field at right angles as shown in figure. What would be the direction of force and which rule would you apply to find direction of force? [2]





(viii) Displacement distance graph of two sound waves A and B, travelling in a medium, are as shown in the diagram below. [2]

Study the two sound waves and compare their:

1) Amplitudes
2) Wavelengths

Question 3

(i)

(a) At the city sub-station the voltage is stepped down from 11 kV to _____ [12/220/110] Volts.

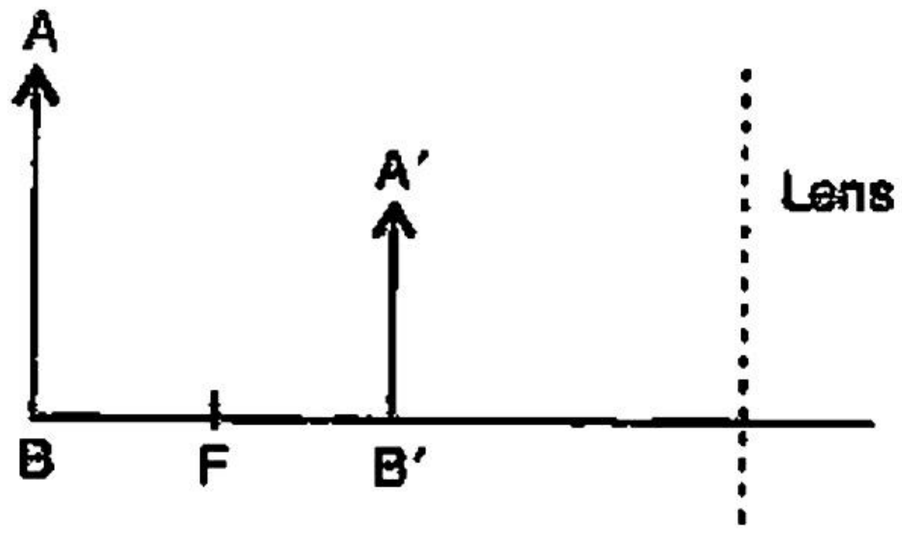
(b) In case of _____ [series/parallel/both series and parallel] combination of cell, equivalent resistance is equal to algebraic sum of individual resistances.

(c) A simple microscope employs a _____ [convex/concave/both convex and concave] lens.

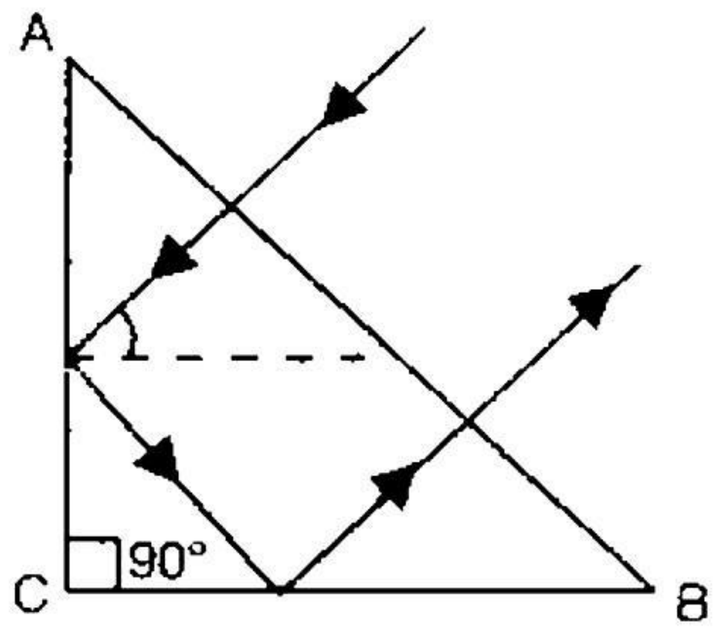
(d) A body moves along a circular path of constant radius. The magnitude of its acceleration is _____ [constant/negative/always less than zero].

(e) Increase in pressure over ice _____ [decreases/ increases] its melting point, and a decrease in pressure _____ [decreases/ increases] its melting point.

(ii) The figure given below represents the object AB and the image A′B′. Complete the ray diagram to show the formation of the image. Also, write the nature of the lens. [2]



(iii) A ray of light incident normally on face AB of an isosceles prism travels as shown in the figure given below. What will be the value of the refractive index of the material of the prism? [2]



SECTION B

*(Attempt **any four** questions from this Section)*

Question 3

i) A block and tackle pulley system has a velocity ratio 3. [3]
   (a) Draw a labelled diagram of this system. In your diagram, indicate clearly the points of application and the directions of the load and effort.
   (b) Why should the lower block of this pulley system be negligible weight?

ii) What are free electrons? Why do they not leave the metal surface on their own [2]

iii) Draw a ray diagram to show the refraction of a monochromatic ray through a prism when it suffers minimum deviation. How is the emergence angle related to the incidence angle in this position? [2]

iv) A mechanic can open a nut by applying a force of 150 N while using a wrench handle of a length of 40 cm. How long a handle is required if he wants to open it by applying a force of only 50 N? [2]

v) Name two sources, each of infrared radiation and ultraviolet radiation. [2]

vi) How is the refractive index of a medium related to the real and apparent depths of an object in that medium? [2]

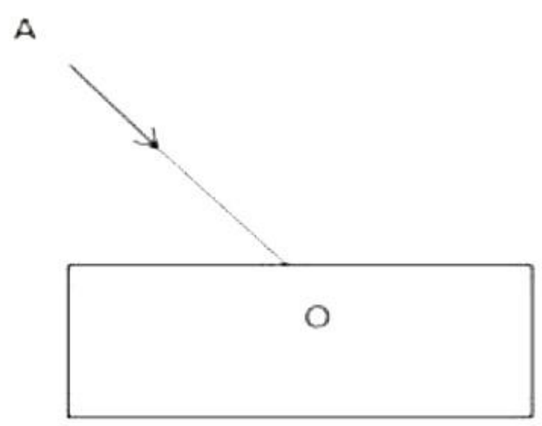
vii) An electric heater is rated 1kW, 220V. Calculate the resistance of the heating filament. [2]

Question 4

i) [3]
   (a) Why is white light considered to be polychromatic in nature?
   (b) Give the range of the wavelength of those electromagnetic waves which are visible to us.
   (c) How is a rainbow formed?

ii) [3]
   (a) State the difference in sun colours observed during sunrise/sunset and noon. Explain each.
   (b) When you travel by aeroplane flying at a high altitude, the sky appears almost dark. Why?

iii) In the adjacent diagram, AO is a ray of light incident on a rectangular glass slab. [4]



(a) Complete the path of the ray till it emerges out of the slab.
(b) In the ray diagram, mark the angle of incidence (i) and the angle of refraction (r) at the first interface. How is the refractive index of glass related to angles I and r?
(c) Mark the angle of emergence by the letter e. How are the angles i and e related?
(d) Which two rays are parallel to each other? Name them.

Question 5

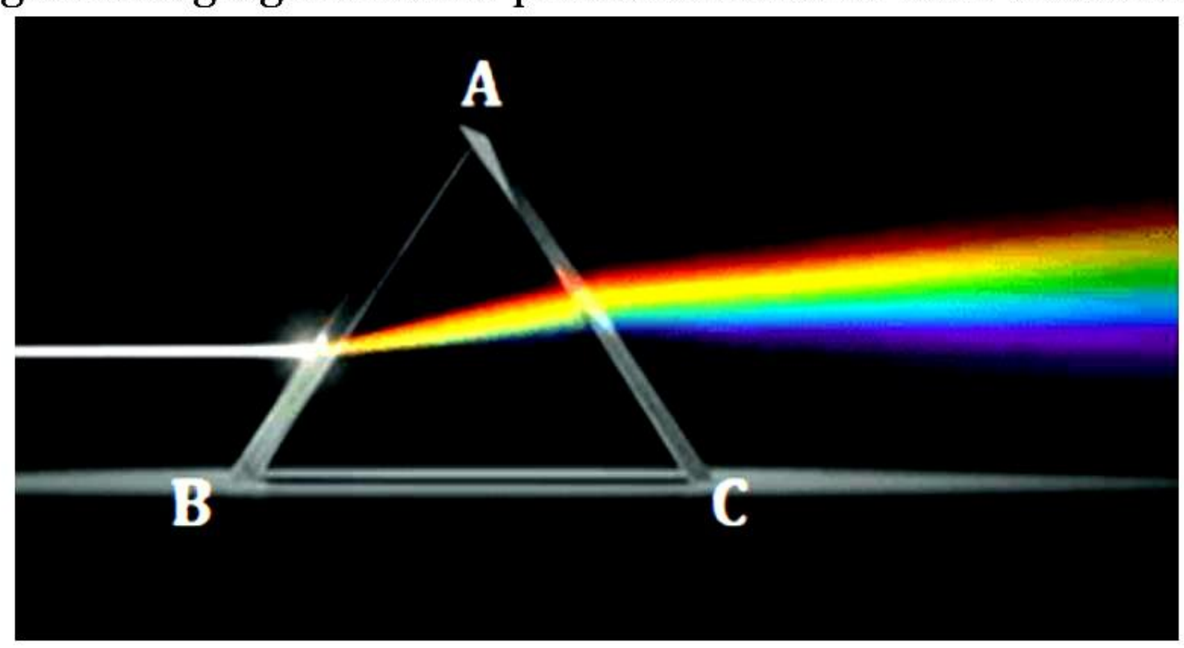
i) [3]

(a) Water in a pond appears to be only three-quarters of its actual depth. What property of light is responsible for this observation?
(b) How can you account for the brilliance of a diamond?
(c) Why do the stars show the twinkling effect, whereas the planets do not?

ii) [3]

(a) Define real and virtual focus. Explain with the help of a simple ray diagram.
(b) A doctor has prescribed a corrective lens of power -1.5 D. Find the lens's focal length. Is the lens diverging or converging?
(c) What happens to the image formed by a convex lens if its lower part is blackened?

iii) Rahul allows the spectrum of white light from a source to enter through a small aperture. The white light then passes through a glass prism placed in the path of the spectrum. The light emerging out of the prism is obtained on a white screen. [4]



(a) What is white light comprised of?
(b) On which surface does the dispersion of light occur?
(c) On which surface does the deviation take place?
(d) Which constituent colour of white light deviates most towards the base of the prism?

Question 6

i) [3]

(a) When we burst a cracker, is it correct to say that the chemical energy of crackers gets used up or destroyed as we are left with just ashes after bursting it?
(b) How many joules is equal to 1 kilowatt hour?
(c) Why are kilowatt hours used instead of joules in the bill?

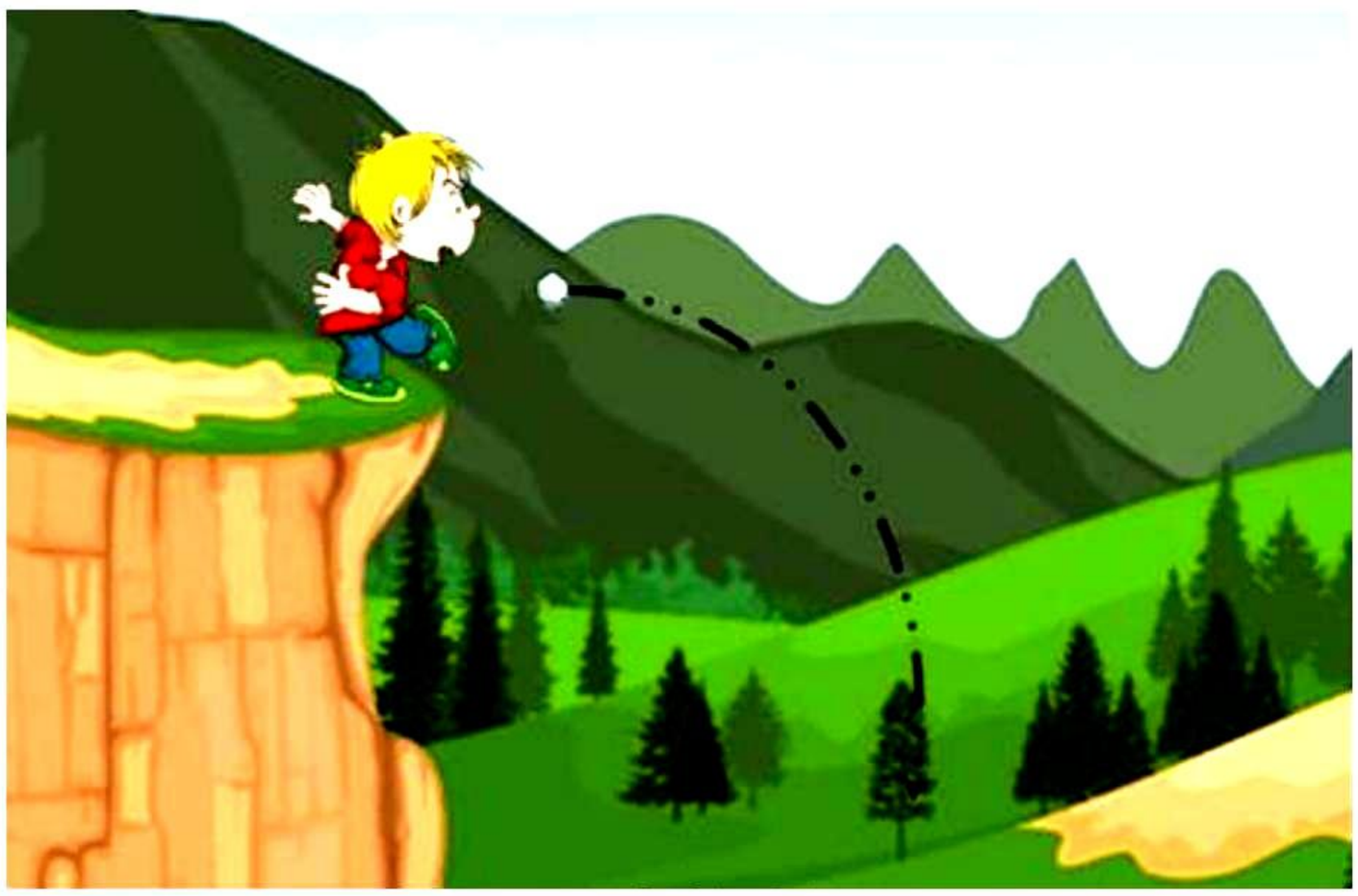
ii) [3]

(a) State the principle of moments.

(b) Give the expression for mechanical advantage.

(c) To pull open a heavy gate using minimum force, where and in what direction should the force be applied? Why?

iii) Sham drops a stone of 100 g while standing on the cliff's edge. Assume the cliff's height is 200 meters, acceleration due to gravity is 9.8 m/s^2 and the stone was initially at rest. [4]



(a) Define work. When is work said to be done by a force?

(b) Find the total work done by the force of gravity when the stone hits the ground.

(c) What will be the direction of force and displacement? Also find the angle between displacement and force for the given case.

(d) Find the total energy possessed by the stone at any instance. At which point potential energy will be highest and lowest? Explain why?

Question 7

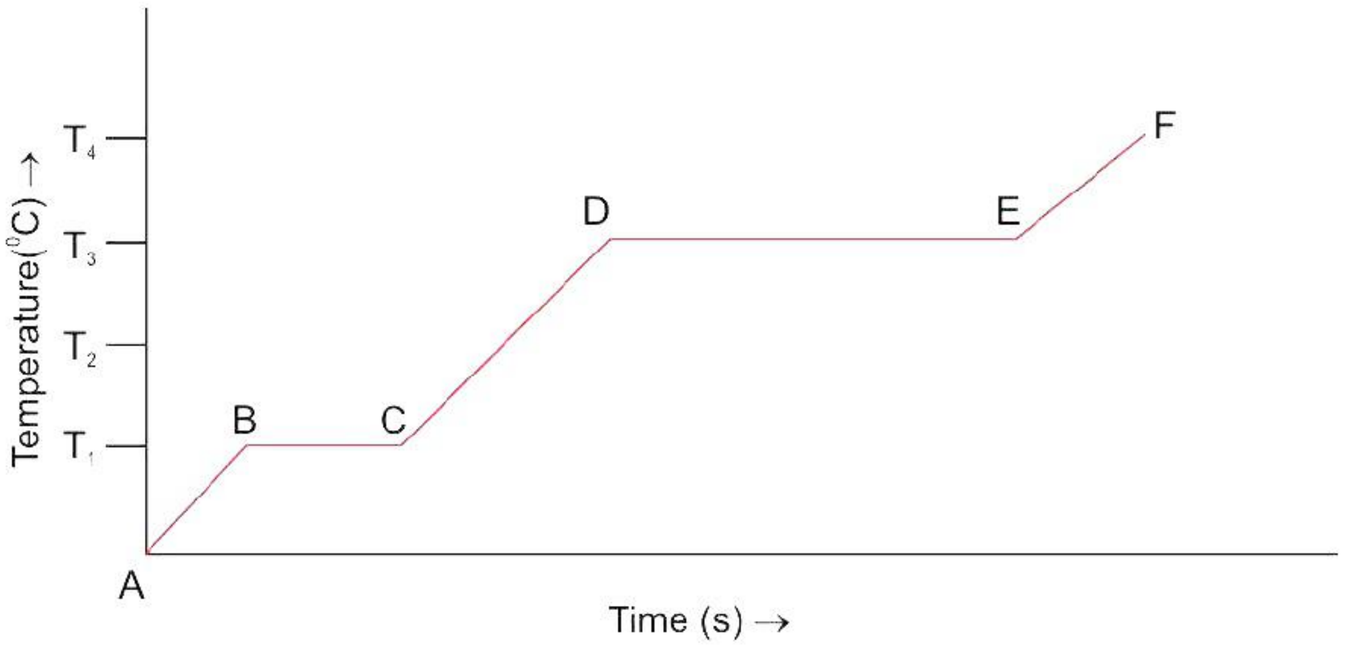
i) An electric heater of power 150 W is immersed in 0.75 kg of ice at 0 °C in a lagged container of negligible heat capacity. The temperature remains constant for 27.5 minutes and then rises to 40 °C in a further 14 minutes. [3]

(a) Explain why the temperature remains constant.

(b) Calculate:

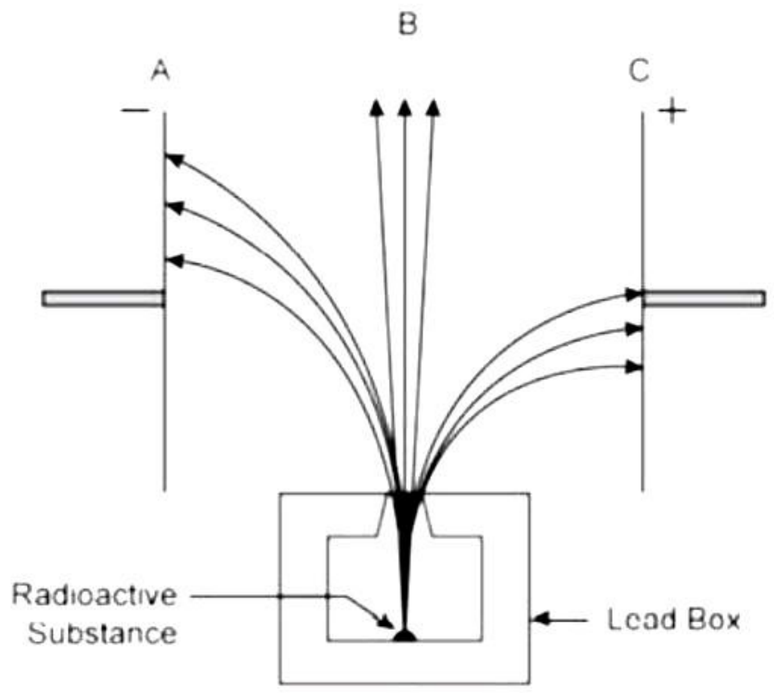
1. the specific latent heat of ice
2. the specific heat capacity of water.

ii) The diagram above shows the change of phases of a substance on a temperature-time graph. [3]



(a) What do the parts AB, BC, CD, and DE represent?
(b) What is the melting point of the substance?
(c) What is the boiling point of the substance?

iii) When a radioactive sample is enclosed in a lead box, radiation is emitted through a narrow opening. When placed between two charged metallic plates, the arrows show the path of the radiation A, B, and C traces, respectively. Answer the following questions in terms of A, B and C. [4]

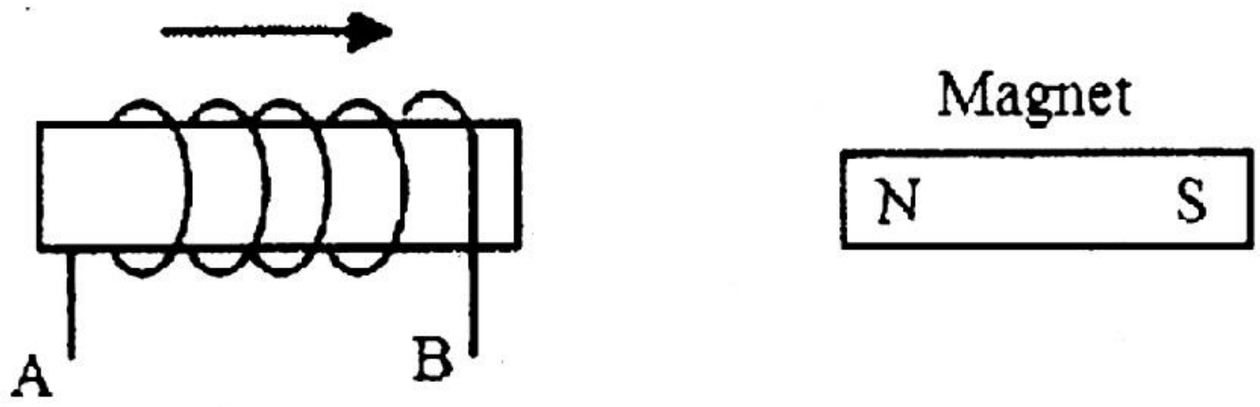


(a) Name all three radiations: A, B and C
(b) Explain why radiation B is unaffected by the electrostatic field.
(c) Why does the radiation C deflect more than A?
(d) Which among the three causes the most minor biological damage externally?

Question 8

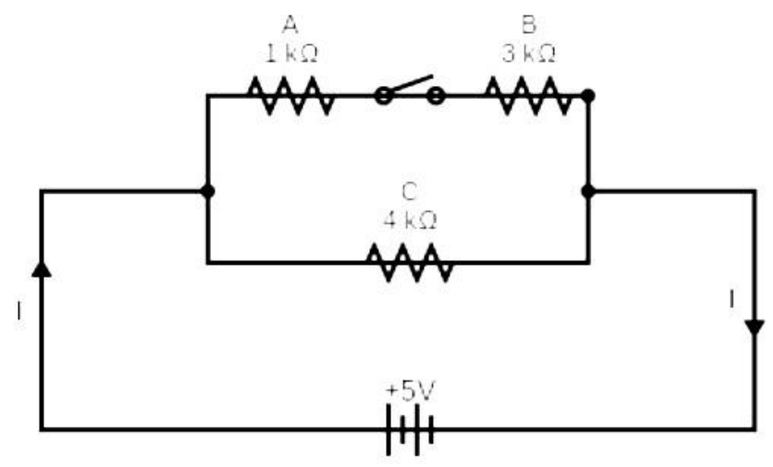
i) A 1.5 V cell of internal resistance 1 Ω is connected to resistors 4 Ω and 20 Ω in series. Calculate: [3]
(a) Current in the circuit
(b) PD across each resistor
(c) PD across the cell

ii) In the following diagram, an arrow shows the motion of the coil towards the bar magnet. [3]



(a) State in which direction does the current flow, A to B or B to A?
(b) Name the law used to conclude.
(c) Name any one factor on which the magnitude of an induced e.m.f. in the secondary coil depends.

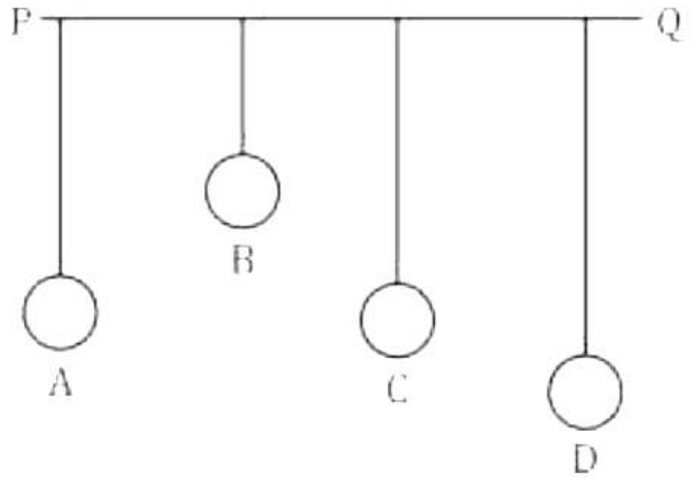
iii) [4]



The diagram above shows a circuit for a combination of three resistances, A, B and C, connected across a battery of 5 V and 0.3 kΩ internal resistance, with the key 'k' open. Calculate:
(a) The resistance of the circuit when the key k is open.
(b) The current is drawn from the cell when the key k is open.
(c) The resistance of the circuit when the key k is closed.
(d) The current is drawn from the cell when the key k is closed.

Question 9

i) In the diagram below, A, B, C, and D are four pendulums suspended from the same elastic string PQ. The length of A and C are equal, while the length of pendulum B is smaller than that of D. Pendulum A is set into a mode of vibrations [3]



(a) Name the type of vibrations taking place in pendulums B and D.

(b) What is the state of pendulum C?

(c) State the reason for the type of vibrations in pendulums B and C.

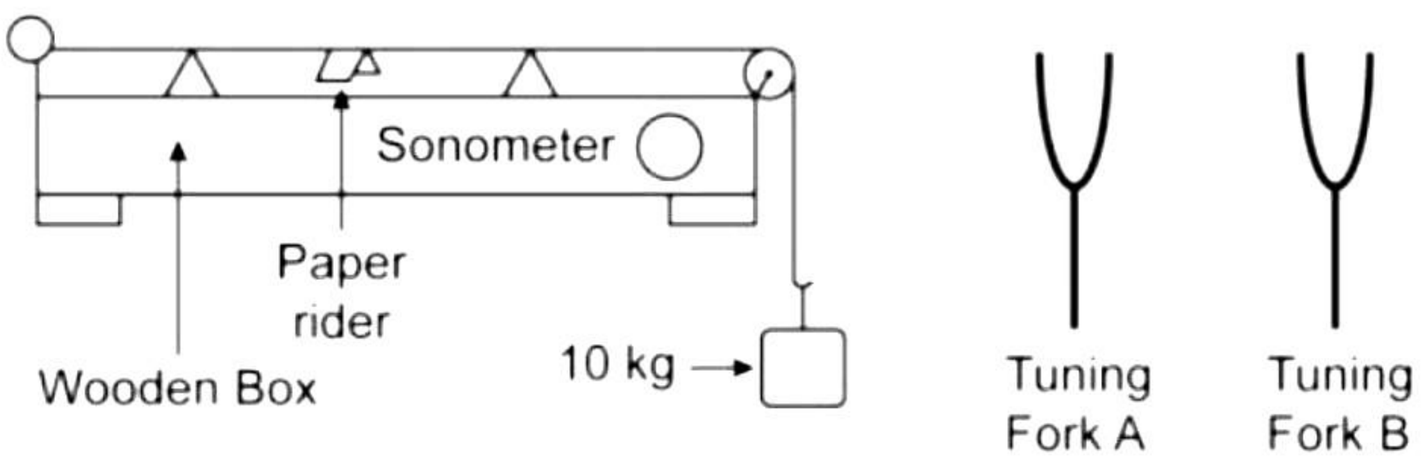
ii) An atomic nucleus A is composed of 84 protons and 128 neutrons. The nucleus A emits an alpha particle and is transformed into a nucleus B. [3]

(a) What is the composition of B?

(b) The nucleus B emits a beta particle and is transformed into a nucleus C. What is the composition of C?

(c) What is the mass number of the nucleus A?

iii) A wire is stretched over a sonometer in the diagram above. The stems of two vibrating tuning forks, A and B, are touched to the sonometer's wooden box. When the stem of a vibrating tuning fork B is pressed to the wooden box, the paper rider (a small piece of paper folded at the centre) on the wire files off, but the paper only vibrates when the stem of a vibrating tuning fork A is touched to the wooden box. [4]



(a) Name the phenomenon when the paper rider vibrates.

(b) Describe the phenomena that occur as the paper rider flies away.

(c) When the stem of tuning fork B is touched to the box, why does the paper rider fly away?

(d) Differentiate between forced vibrations and resonance.

Solution

Section A

Solution 1

(i) Correct option – a: Newton's first law

The given example can be explained by newton's first law.

(ii) Correct option – b: B has more inertia than A

The inertia of body depends on its mass. A heavier body has greater inertia than a lighter one.

(iii) Correct option - c: Chemical energy > Heat energy > Kinetic Energy

The series of inter-conversion of energy in a steam engine is as follows: Chemical energy (of coal) > Heat energy (on burning coal) > Kinetic Energy (of steam engine when it moves)

(iv) Correct option – a: 100 W

Power = Energy/ time

= 1000/10 = 100 W

(v) Correct option – a: Both A and R are true and R is the correct explanation of A.

A tremendous amount of energy is released in the process of the fission reaction. The nuclear fission process can be used in two ways i.e., destructive use (nuclear bomb) and constructive use (nuclear reactor).

(vi) Correct option – c: Frequency

With the change in medium, the frequency of light remain same but the velocity and wavelength changes.

(vii) Correct option – a: Always smaller than the size of the object

The size of the image formed by concave lens is always smaller than the size of the object.

(viii) Correct option – d: a distance f/2

A real object is placed in front of a concave lens of focal length 'f' at its principal focus. Then the image is formed at a distance f/2.

(ix) Correct option – d: Atmospheric refraction

When the light coming from stars enter the earth atmosphere, it undergoes refraction due to carrying optical density of air at various altitudes.

(x) Correct option – c: Both A and B
This occurs because like magnetic poles repel and unlike attract each other.

(xi) Correct option – b: Loudness
Loudness is a characteristic that depends on the distance of the observer from the source of the sound.

(xii) Correct option – a: red
The colour which deviates least in the formation of spectrum of white light by a prism is red.

(xiii) Correct option – c: is independent of length, cross section and mass of the wire
The resistivity of a wire is independent of length, cross section and mass of the wire.

(xiv) Correct option – b: heat is released
When water solidifies to ice, heat is released.

(xv) Correct option – c : cal/kg
cal/kg is not a unit of specific latent heat of vaporization.

Solution 2

(i)

(a) The wires leading to an electric bulb are thick to ensure low resistance and prevent overheating, while the wire inside the bulb, known as the filament, is thin because it needs to have a high resistance to heat up and emit light when electric current passes through it.

(b) Vibrating strings of stringed instruments produce a very weak sound which cannot be heard. Therefore, these instruments are provided with a sound box (or chamber). When the strings are set into vibration, forced vibrations are produced in the sound box. The large area of the sound box sets a large volume of air into vibrations which a produces large sound of the same frequency as that of the string.

(c) The specific latent heat of fusion is 3.36×10^5 J kg^{-1} means that 3.36×10^5 J heat is required to convert 1 kg of ice at 0°C to water at 0°C or 3.36×10^5 J of heat is to be withdrawn to convert 1 kg of water at 0°C to ice at 0°C.

(ii) We know that kinetic energy = $1/2\ mv^2$

(a) If mass m is doubled, the kinetic energy gets doubled.

(b) If velocity is halved, the kinetic energy becomes one fourth.

(iii)

(a) When air exerts force on us, it is a type of contact force.

(b) A spring exerts force on objects attached to its ends when it is stretched or compressed.

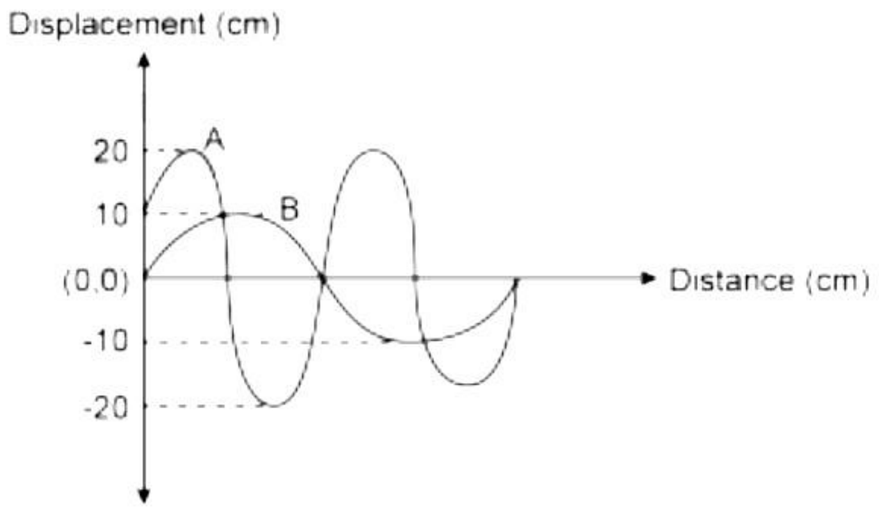
(iv) According to the principle of a machine, work done by the machine will be at the most equal to the work done on the machine, i.e. for a perfect machine (whose parts are weightless and frictionless) work done on the machine (input) is equal to work done by the machine (output).

(v) The efficiency of the pulleys can be improved by using lubricants to minimize the friction in the bearings of pulleys and the pulleys in the lower block should be as light as possible because the efficiency is reduced due to the weight of the lower block of pulleys.

(vi) The bob has maximum potential energy at points B and C, and maximum kinetic energy at point A.

(vii) As the direction of current is taken as opposite of direction of flow of electrons, applying Fleming's left hand rule we find that the direction of force would be perpendicularly outwards from the page.

(viii)



1) Amplitude of Wave A is 20 cm. Amplitude of Wave B is 10 cm.
2) Wavelength of B is twice the wavelength of A.

Solution 3

(i)

(a) At the city sub-station the voltage is stepped down from 11 kV to **220** Volts.

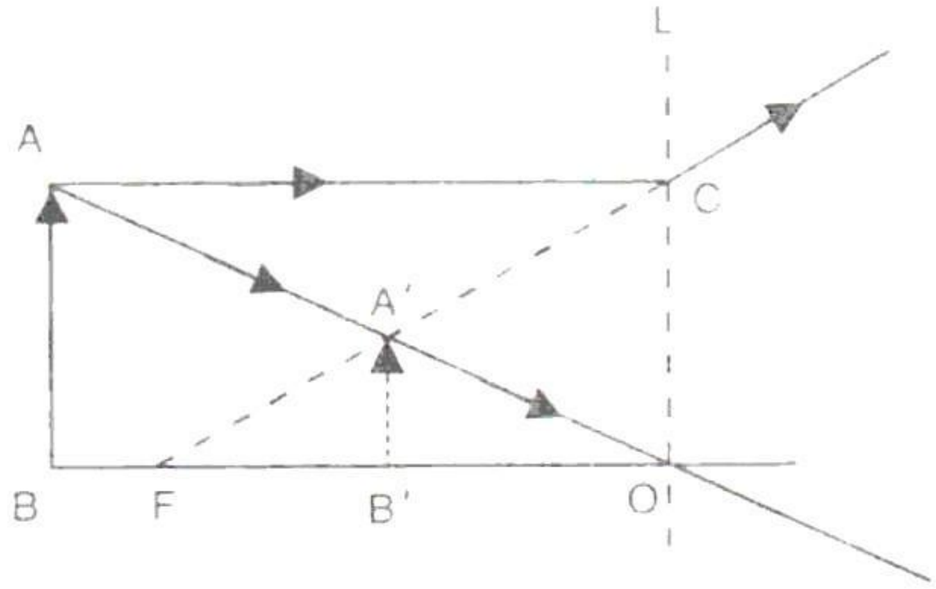
(b) In case of **series** combination of cell, equivalent resistance is equal to algebraic sum of individual resistances.

(c) A simple microscope employs a **convex** lens.

(d) A body moves along a circular path of constant radius. The magnitude of its acceleration is **constant**.

(e) Increase in pressure over ice **decreases** its melting point and a decrease in pressure **increases** its melting point.

(ii) Since the image is diminished and erect, the lens is concave.



(iii) The ray is totally reflected at faces AC and CB. The angle of incidence at each face is at least $i_c = 45°$

$$\mu = \frac{1}{\sin i_c} = \frac{1}{\sin 45} = \frac{1}{\frac{1}{\sqrt{2}}} = \sqrt{2}$$

SECTION B

Solution 4

i)

(a) Polychromatic light consists of many colours, each having its characteristic wavelength. White Light is polychromatic light because white light is made up of seven colours.

(b) 780 nm-400nm (7800A^{o} -4000 A^{o})

(c) A rainbow is typically observed soon after a rain shower. It is caused by the dispersion of sunlight by raindrops suspended in the air. Water drops act like tiny prisms. The water drops refract sunlight, disperse, then reflect internally and refract it again. The eye sees different colours in a series in the sky due to the dispersion of light. This is a rainbow.

ii)

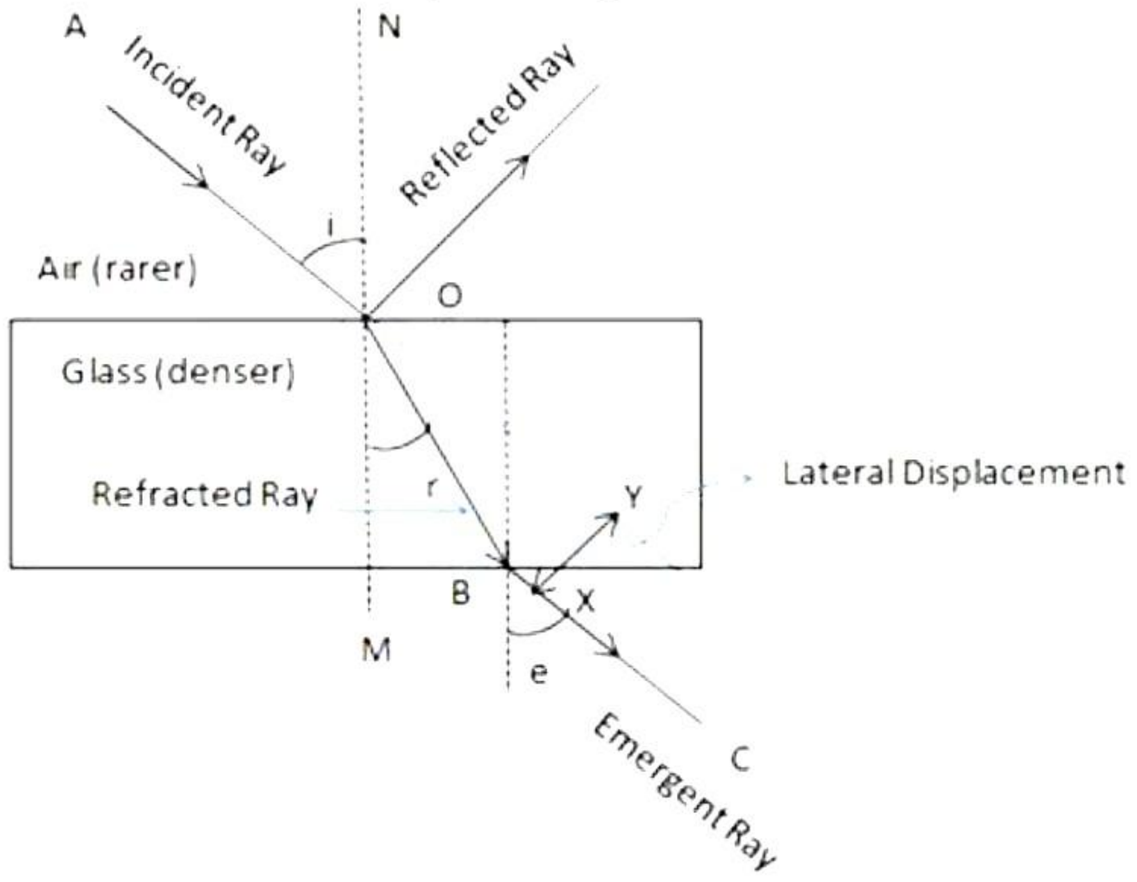
(a) The sun is red at sunrise and sunset, while at noon, the sun appears white. At sunrise and sunset, the sun is near the horizon. The rays from the sun have to travel a much larger part of the atmosphere to reach an observer on Earth. So, most of the blue light is scattered away. The red colour, which has the largest wavelength, is scattered the least and enters our eyes. Hence, the sun appears red at the time of sunrise and

sunset. At noon, the sun is nearly overhead. The sunlight has to pass through a much smaller portion of Earth's atmosphere. The scattering is much less, and the sun looks white.

(b) When we travel by aeroplane flying at high altitudes, the sky appears almost dark because there is no atmosphere at higher altitudes. Thus, there are no particles to scatter light at such an altitude. This makes the sky look black.

iii)

(a) The complete path of the incident ray in the glass block is drawn in the figure below.



(b) The angle of incidence (i) and angle of refraction (r) are marked in part (a).
The refractive index (μ) of glass is related to the angles as

$$\frac{\sin i}{\sin r} = \mu$$

(c) The angle of emergence (e) is marked in part (a)
The two angles are related to each other by the relation.

$$\angle i = \angle e$$

(d) Incident ray and emergent ray are parallel to each other.

Solution 5

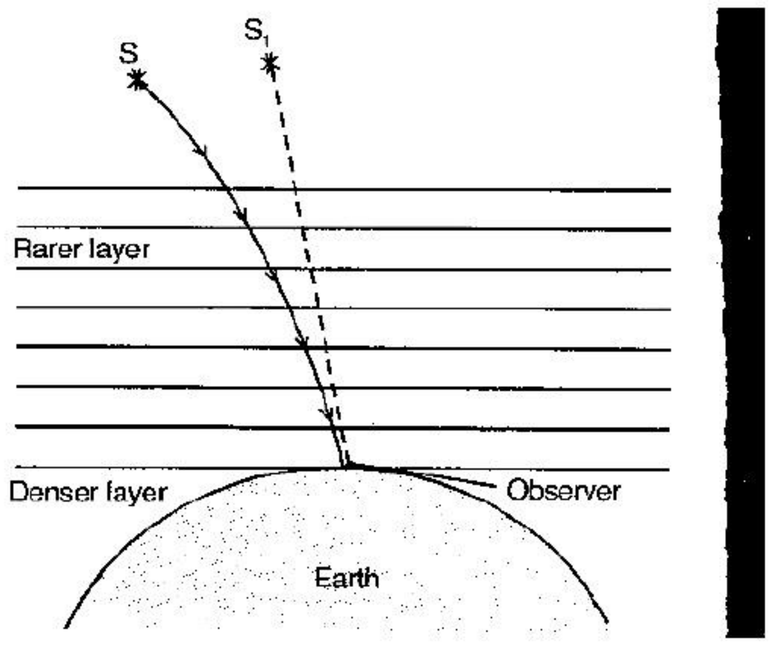
i)

(a) The pond appears to be three-quarters of its actual depth due to the property of refraction of light.

$$\mu = \frac{\text{Real depth}}{\text{apparent dept}} \Rightarrow \text{Apparent dept} = \frac{3}{4} \times \text{real depth}$$

(b) The refractive index of a diamond is 2.42, and the critical angle is 24.40 only. The faces of the diamond are cut so that a ray of light entering the diamond suffers repeated total internal reflections (angle of incidence is greater than the critical angle) at different faces and remains confined within the diamond. Thus, it sparkles.

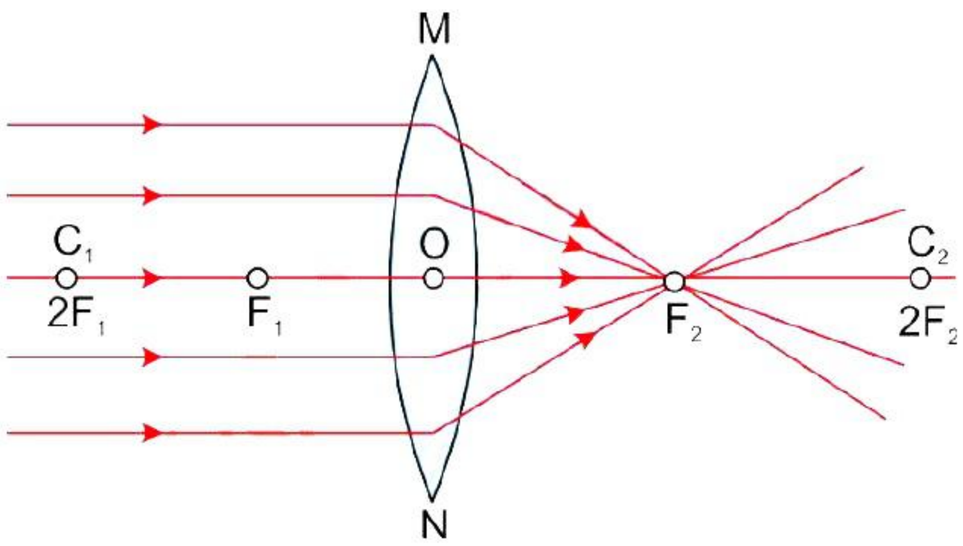
(c) The light from the star suffers a series of refractions due to atmospheric layers of different densities and different refractive indices. Due to this reason, a ray of light starting from a star S bends more and more towards the normal before reaching the observer on the Earth. However, the observer sees the star in the direction of the ray reaching finally in the eye, so the star appears to him at S_1 instead of S. On account of changes in temperature and density, the star's apparent position continuously changes, which gives the twinkling effect to the star.



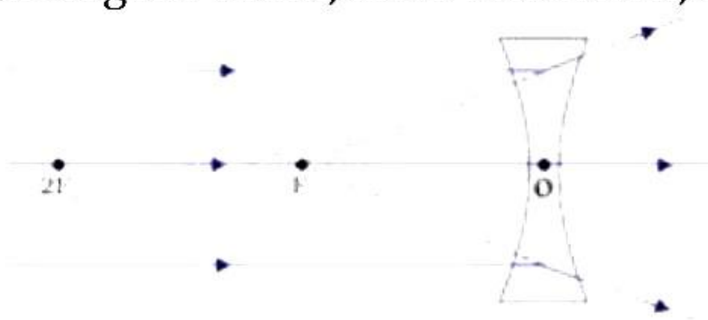
However, the planets do not twinkle because they are nearer to the Earth and subtend a greater angle at the eye. Hence, the amount of light received from them is much larger than the stars. Therefore, the change in their position and brightness is not noticeable.

ii)

(a) Real focus is obtained in the case of a convex lens where the parallel rays meet after refraction.



Virtual focus is an apparent location of the point on the principal axis from where the divergent beam, after refraction, appears to emerge.



(b) Given that,

Power, P = -1.5 D

$\therefore$ Focal length, $f = \frac{1}{p}$

$$f = \frac{1}{-1.5\ D} = -0.67m$$

Since the focal length is negative, the lens is diverging, i.e., concave lens.

(c) Every part of a lens forms a complete image. If the lower part of the lens is blackened, even then, the complete image will be formed, but its intensity will decrease.

iii)

(a) White light has seven colours: Violet, Indigo, Blue, Green, Yellow, Orange and Red (VIBGYOR).

(b) Dispersion of white light occurs only at the first surface, in the given image on surface AB of the prism.

(c) Deviation takes place at both surfaces of the prism, in the given image surface AB and AC of the prism.

(d) Violet colour deviates most towards the base of the prism.

Solution 6

i)

(a) When we burst a cracker, is it correct to say that the chemical energy of crackers gets used up or is destroyed as we are left with just ashes after bursting the cracker?

(b) 1 Kilowatt hour = 36, 00,000 joules = 3.6×10^6 J One kilowatt hour is the amount of electrical energy consumed when an electrical appliance having a power rating of 1 kilowatt is used for 1 hour.

(c) A kilowatt hour is used for measuring electricity consumed, as a joule represents a very small quantity of energy, and therefore, it is inconvenient to use joules where large quantities of energy are involved.

ii)

(a) According to the principle of moments, if the algebraic sum of all the forces acting on the body about the axis of rotation is zero, the body is in equilibrium.

(b) Action and reaction forces are equal and opposite but act on two different bodies. Hence, they do not cancel each other. Therefore, they result in a change in momentum in the respective bodies.

(c) The fan tends to continue its circular motion even after it is switched off due to the inertia of motion. Thus, the fan continues to move for some time, even after switching it off.

(d) When a boatman takes the boat away from the bank of the river, he sits in a boat and pushes the riverbank with his ore. When the boatman exerts a force of action on the bank with his ore, the bank exerts an equal and opposite force of reaction on the boat. Hence, the boat moves away from the bank.

iii)

(a) Work is said to be done only when the force applied on a body makes the body move. It is a scalar quantity.

(b) Given that,
Mass, m = 100 g = 0.1 kg
Acceleration due to gravity, g = 9.8 m/s^2
Height of cliff, h = 200 m
Now,
The total work done by the force of gravity when the stone hits the ground will be:
W = mgh
W = 0.1 × 9.8 × 200m = 196 J.

(c) The direction of force and displacement for this case will be downwards, towards the centre of the earth. As a result, the angle between force and displacement will be zero since both are acting along same direction.

(d) As we know,
Total energy at any instance = Kinetic energy + Potential energy
Whereas the potential energy will be highest at the top of the cliff and lowest at the bottom because potential energy is directly proportional to height.
i.e., P.E = mgh⇒ P.E ∝ h.
Thus, at maximum height potential energy will be maximum and kinetic energy will be minimum.
In our case since the stone is at rest at 200 meters, the kinetic energy will be zero at maximum height.
∴ Total energy = mgh = 198 J

Solution 7

i)

(a) Heat energy supplied by the heater is used for melting the ice in the first 27.5 minutes; therefore, the temperature remains constant. The heater supplies energy 150 joule per second.
Therefore,
Total heat energy supplied by the heater in 27.5 minutes = Power x Time
= 150 x (27.5 x 60) J = 247500 J

(b)

1. Let L J kg^{-1} be the specific latent heat of ice. Heat energy used in melting the ice = mL = 0.75 L
   Now, heat energy used in melting = heat energy supplied.
   i.e., 0.75 x L = 247500
   L = 247500 / 0.75 = 330 x 10^3 J kg^{-1}.
2. Let c J $kg^{-1}K^{-1}$ be the specific heat capacity of water.
   Heat energy is taken by water at 0 °C to raise it to 40 °C = mc x rise in temperature
   = 0.75 x c x (40 - 0) J = 30 c J
   Heat energy supplied by the heater in 14 minutes = Power x Time
   Q= 150 x (14 x60) = 126,000 J
   Now heat energy taken by water = heat energy supplied by the heater
   ∴ 30 c = 126,000
   c = 126000/30 = 4.2 x 10^3 J $kg^{-1}K^{-1}$.

ii)

(a) AB part - rise in temperature of solid from 0 to T_1.

BC part - melting at temperature T_1.

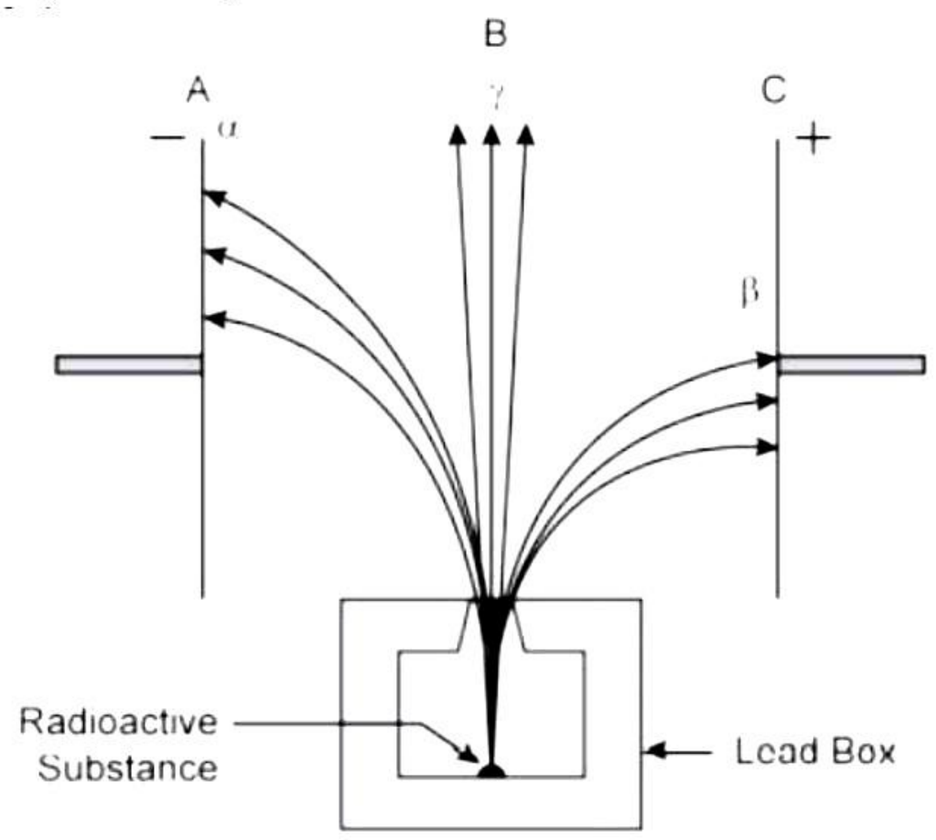
CD part - rise in liquid temperature from T_1 to T_3 DE part - boiling at temperature T_3.

(b) T_1

(c) T_3

iii) The three radiation or particles emitted by the given radioactive source are α-particle, β-particle and γ-ray.

(a) Radiation B or γ-ray will be the only one that is unaffected by the electrostatic field since it is chargeless, just like photons.



(b) Radiation C is beta radiation, and it is nothing but electrons. The mass of electrons is much smaller than alpha particles (radiation A). Hence, beta radiation (radiation C) deflects more.

(c) Radiation A, which is alpha radiation, causes the least biological damage externally because of its lowest penetration depth.

Solution 8

i) Total resistance of the circuit

$R = 1\Omega + 4\Omega + 20\Omega = 25\Omega$

(a) Current in the circuit $I = E/R = 1.5\ V/25\Omega = 0.06$

(b) PD across the 4Ωresistor, $V_1 = IR_1 = 0.06\ A \times 4\Omega = 0.24\ V$

PD across the 20Ω resistor, $V_2 = IR_2 = 0.06\ A \times A\ 20\Omega = 1.20\ V$

(c) PD across the cell is the total PD in the external circuit:

$0.24\ V + 1.20\ V = 1.44\ V$

Alternatively, terminal voltage $V = E - Ir = 1.5\ V - 0.06\ A \times 1\ \Omega = 1.44\ V$

ii)

(a) The direction of the current in the coil is from B to A.

(b) The law used is Lenz's law of electromagnetic induction. The coil is moving towards the North Pole of the magnet. Due to this, there is a change in magnetic flux in the

coil. Now, the direction of induced e.m.f. (induced current) is such that it opposes this change in flux. Hence, the right end of the coil should also behave as the North Pole. Hence, the current will be in the anti-clockwise direction, i.e., from B to A.

(c) The magnitude of e.m.f. induced in the secondary coil depends on the following two factors:

1. The ratio of the number of turns in the secondary coil to the number of turns in the primary coil (i.e., turns ratio) and
2. The magnitude of e.m.f applied in the primary coil.

iii)

(a) When the key 'k' is open, the current only flows through resistance C.
i.e., Total resistance, $R_t = R + r = 4 + 0.2 = 4.2\ k\Omega$

(b) Current drawn

$$I = \frac{V}{R} = \frac{4v}{4.2 \times 10^3\ \Omega} \approx 0.95\ mA.$$

(c) Now,

Resistance is first branch = 1 +3 = 4 kΩ

Now, effective resistance for parallel combination will be

$$\frac{1}{R_e} = \frac{1}{R^i} + \frac{1}{R_C} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4}$$

$$\therefore Re = 2\ k\Omega$$

Total resistance = 2 + 0.2 = 2.2 kΩ

(d) Current drawn, $I = \frac{V}{R} = \frac{5}{2.2 \times 10^3} \approx 2.3\ mA$

Solution 9

i)

(a) The vibration in pendulums B and D is forced vibration.

(b) It is in resonance with pendulum C because of the same string length.

(c) Pendulums C and A have the same length; hence, they vibrate in the same phase, and resonance occurs. In the case of pendulum B, the length is shorter. Hence, it vibrates with lesser amplitude.

ii) Mass number of A = 84 + 128 = 212

Thus,

(a) $^{212}_{84}A \xrightarrow{\alpha emission} {}^{208}_{82}B$

(b) On beta emission,

$$^{208}_{82}B \xrightarrow{\beta\ emission} {}^{208}_{83}C$$

(c) The mass number of nucleus A is 212.

iii)

(a) Forced vibration is the phenomenon that causes paper riders to vibrate as soon as the tuning fork comes into contact with the sonometer. Vibrations in the surrounding air are caused by the tuning fork's vibrations, causing the string to vibrate.

(b) Because of a phenomenon known as resonance, the paper rider flies away since the frequency of the oscillating string becomes maximum.
i.e., The frequency of tuning fork vibration is the same as that of free string vibrations.

(c) When the vibration frequency of a tuning fork is the same as the frequency of the natural vibration of the string, resonance occurs, and the vibration amplitude of the string is maximum. Hence, the paper rider flies off.

(d) Forced vibrations: When a body oscillates/vibrates under the influence of an external periodic force with a frequency different from its natural frequency, the body is said to execute forced vibrations.
Resonance: It is the phenomenon in why the body vibrates under the influence of periodic force, where the frequency of the applied periodic force is equal to the natural frequency of the vibrating body.