ICSE 2025 EXAMINATION

Sample Question Paper - 12

Physics

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

General Instructions:

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

SECTION A

*(Attempt **all** questions)*

Question 1 **[15]**

Choose the correct answers to the questions from the given options. (Do not copy the questions, write the correct answer only).

i) Which of the following is true about the position of the center of gravity of a body?
   (a) It remains unchanged when the body is deformed.
   (b) It changes when the body is deformed.
   (c) It is always located at the center of the body.
   (d) It is affected by external forces.

ii) When a spring is held fixed at one end, and the other end is stretched, the spring tends to regain its original shape due to _____.
   (a) Compressive Force
   (b) Tensile Force
   (c) Restoring Force
   (d) Electrostatic Force

iii) If the mechanical advantage of a machine is greater than 1, choose the correct statement.
   (a) The effort required by the machine to overcome a load is greater than the load.
   (b) The effort required by the machine to overcome a load is equal to the load.
   (c) The effort required by the machine to overcome a load is less than the load.
   (d) No effort is required.

iv) If work is done at a faster rate, then _____.
   (a) Power is more.
   (b) Power is less.
   (c) No power is required to do work.
   (d) Infinite power is required.

v) **Assertion (A):** TV and radio transmitters are the source of radio waves.
Reason (R): Radio waves have the shortest wavelength.
(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 fish is looking at a 1.0 m high plant at the edge of the pond. The plant will appear _____.
(a) shorter than its actual height
(b) taller than its actual height
(c) equal to its actual height
(d) None of the above

vii) The refraction takes place in the lens because the refractive index of glass is _____.
(a) More than air
(b) Less than air
(c) Equal to the air
(d) Refraction does not depend on the refractive index.

viii) Resonance occurs when the frequency of the applied force is:
(a) exactly half the natural frequency of the vibrating body
(b) exactly equal to the natural frequency of the vibrating body
(c) twice the value of natural frequency
(d) any value greater than the natural frequency

ix) When a number of resistors are connected in parallel, then their resultant resistance is _____ the smallest individual resistance.
(a) Same as
(b) Less than
(c) Greater than
(d) Sometimes less and sometimes greater than

x) As a coil is removed from a magnetic field, an emf is induced in the coil, causing a current to flow within the coil. This current interacts with the magnetic field, producing a force which _____.
(a) Causes the coil to tend to flip over.
(b) Acts at right angles to the coil's motion.
(c) Acts in the direction opposite to the coil's motion.
(d) Acts in the direction of the coil's motion.

xi) Plants are protected from wilting during summer due to:
(a) high specific latent heat of vaporisation of water
(b) low specific latent heat of vaporisation of water
(c) high specific heat capacity of water
(d) low specific heat capacity of water

xii) What type of radiation is most dangerous to living organisms?
   (a) Alpha radiation
   (b) Beta radiation
   (c) Gamma radiation
   (d) X-ray radiation

xiii) In which direction a ray of light bends while emerging out of a prism?
   (a) Towards the upper end of the prism.
   (b) Towards the base of the prism.
   (c) Can bend in any direction.
   (d) Bends at 90°.

xiv) How fast should a person of mass 50 kg run so that his kinetic energy is 625 J?
   (a) 5 km/s
   (b) 5 m/s
   (c) 0.5 m/s
   (d) 15 km/s

xv) Action-reaction forces act:
   (a) On two different bodies.
   (b) On the same body.
   (c) In the same direction.
   (d) Along different lines.

Question 2

i) Complete the following by choosing the correct answer from the bracket: [6]
   (a) Instrument used for listening sounds produced within the body is called _____ *[Stethoscope/Telescope/Microscope].*
   (b) The minimum distance between a sound source and reflector for a distinct echo is _____ [34.2/17.2/30] m.
   (c) The sound which is produced due to a mixture of several frequencies is called _____ [Note/Noise/Tone].
   (d) Between a football and stone of same size but different masses, stone being heavier the inertia of _____ [Stone is greater/Football is greater/Both the objects is equal.]
   (e) A _____ *[total reflecting prism/ spherical lens/ mirror]* is used in place of _____ *[total reflecting prism/ spherical lens/ mirror]* in a periscope to deviate light by 90° and 180° in binoculars.

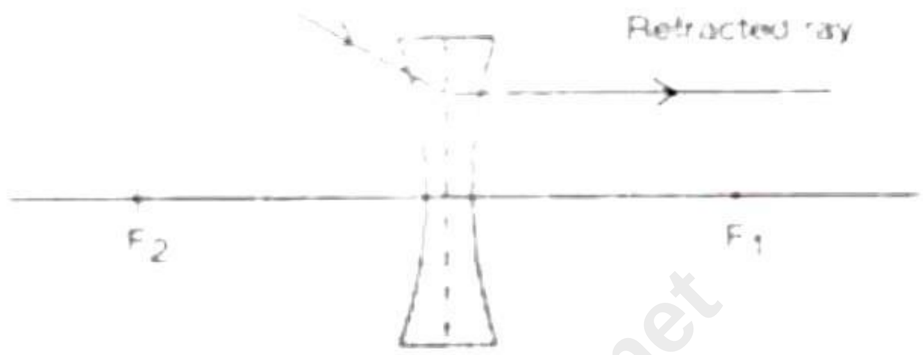
ii) A load of 800 N is lifted through a height of 2 m by an effort of 40 N applied at a distance of 50 m. Calculate the efficiency. [2]

iii) PQ is the incident ray as shown on Prism ABC. Show the corresponding refracted and emergent ray. [2]

Question 3

i) [3]

(a) Complete the diagram by drawing the corresponding incident ray.



(b) Write two uses of ultraviolet radiation.

(c) State the factors on which the e.m.f. of a cell depends.

ii) A train is travelling on a one level track at a speed of 72 km/h. It is pulled by an engine which exerts a force of 12000 N. Calculate the power of the engine in kilowatts. [2]

iii) What is an inclined plane? Give two examples of its use in daily life. [2]

iv) When a bird looks at a fish in water, does it appear raised or deeper than it actually is? Similarly when a fish looks at a bird, does it appear nearer or further away? [2]

v) How do the infrared and γ-rays differ in their following properties: wavelength, and penetrating power? [2]

vi) Why do ice molecules at 0°C have greater potential energy than water molecules at 0°C? [2]

vii) What is the purpose of using C-14 dating? [2]

SECTION B

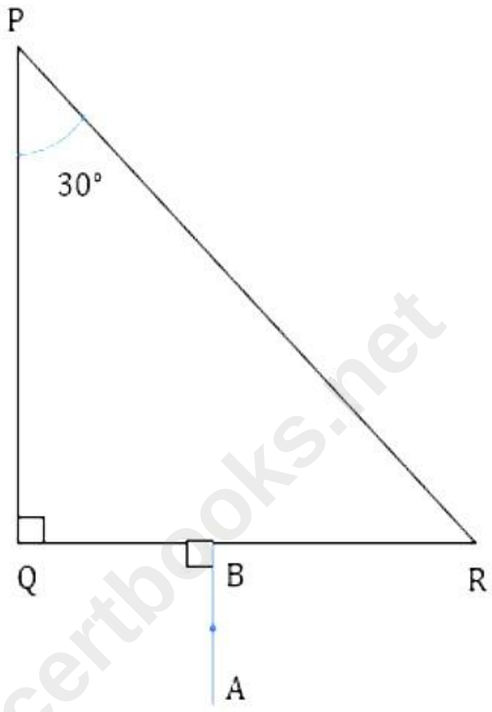
*(Attempt **any four** questions from this Section)*

Question 4

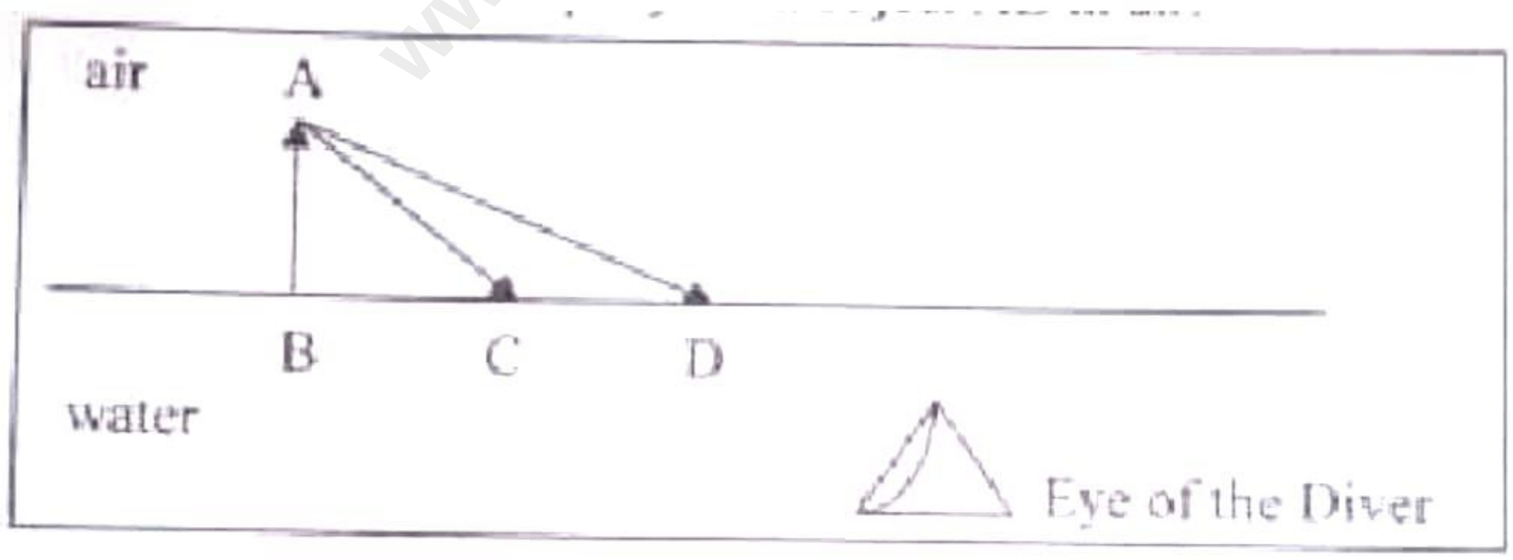
i) [3]

(a) Which of the two prisms, A made of crown glass and B made of flint glass, deviate a ray of light more?

(b) Complete the path of the ray AB through the glass prism in PQR till it emerges out of the prism. Given the critical angle of the glass as 42°.



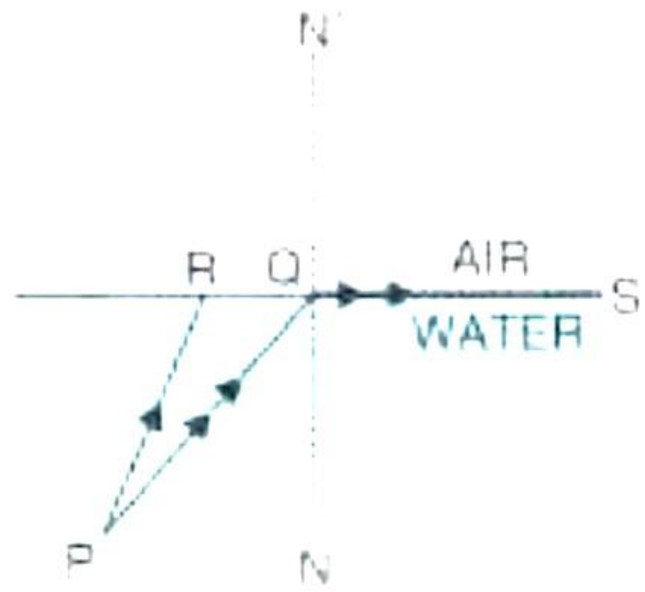
ii) A diver in water looks obliquely at an object AB in air. [3]



(a) Does the object appear toiler, shorter or of the same size to the diver?

(b) Draw a graph showing the variation in the angle of deviation with the angle of incidence at a prism surface.

iii) In the figure, PQ and PR are the two light rays emerging from an object P. The ray PQ is refracted as QS. [4]



(a) State the special name given to the angle of incidence ∠ PQN of the ray PQ.
(b) What is the angle of refraction for the refracted ray QS?
(c) Name the phenomenon that occurs if the angle of incidence ∠PQN is increased.
(d) The ray PR suffers partial reflection and refraction on the water-air surface. Give reason.

Question 5

i) Give reasons for the following: [3]
During the day:
(a) Clouds appear white.
(b) Sky appears blue.
(c) we see the Sun 2 minutes before the Sunrise.

ii) An object is placed in front of a lens between its optical centre and the focus and forms a virtual, erect and diminished image. [3]
(a) Name the lens which forms this image.
(b) Draw a ray diagram to show the formation of the image with the above stated characteristics.

iii) A lens of focal length 20 cm forms an inverted image at a distance 60 cm from the lens.[4]
(a) Identify the lens.
(b) How far is the lens present in front of the object?
(c) Calculate the magnification of the image.

Question 6

i) A man standing 25 m away from a wall produces a sound and receives the reflected sound. [3]
(a) Calculate the time after which he receives the reflected sound if the speed of sound in air is 350 m s^{-1}.
(b) Will the man be able to hear a distinct echo? Give a reason for your answer.

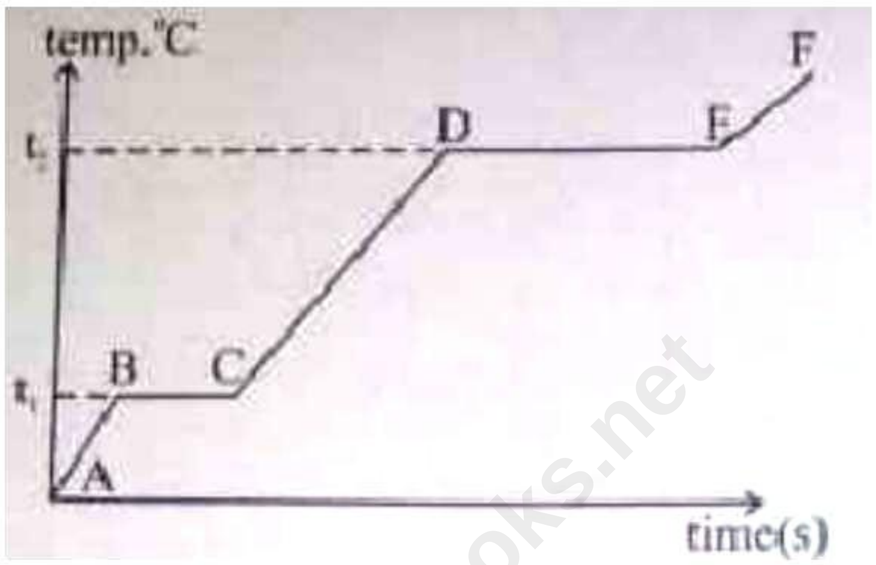
ii) [3]

(a) What is meant by an ideal machine?

(b) Write the relationship between the mechanical advantage (M.A.) and the velocity ratio (V.R.) of an ideal machine.

(c) A coolie carrying a load on his head and moving on a frictionless horizontal platform does not work. Explain the reason.

iii) The diagram below shows the change of phases of a substance on a temperature vs time graph on heating the substance at a constant rate. [4]



(a) Why is the slope of CD less than slope of AB?

(b) What is the boiling and melting point of the substance for the given graph?

(c) If 1 g ice at 0°C melts to form 1 g water at 0°. State whether the latent heat is absorbed or given out by ice.

(d) Water boils at 120 °C in a pressure cooker. Explain the reason.

Question 7

i) [3]

(a) What are superconductors?

(b) Calculate the current drawn by an appliance rated 110 W, 220 V when connected across 220 V supply.

(c) Name a substance whose resistance decreases with the increase in temperature.

ii) [3]

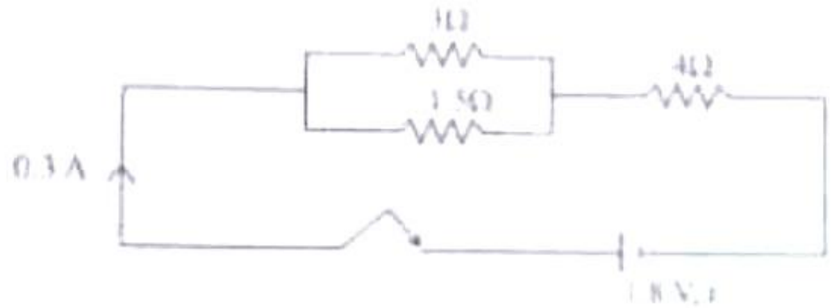
(a) Name two safety devices which are connected to the live wire of a household electrical circuit.

(b) Explain briefly the function of the following in the household wiring.

1. a three-pin plug
2. main switch.

iii) The diagram above shows three resistances connected across a cell of e.m.f. 1.8 V and internal r. [4]

Calculate:



(a) Current through 3 Ω resistor.

(b) The internal resistance r.

Question 8

i) [3]

(a) Define heat capacity of substance.

(b) Write the SI unit of heat capacity.

(c) What is the relationship between heat capacity and specific heat capacity of a substance?

ii) [3]

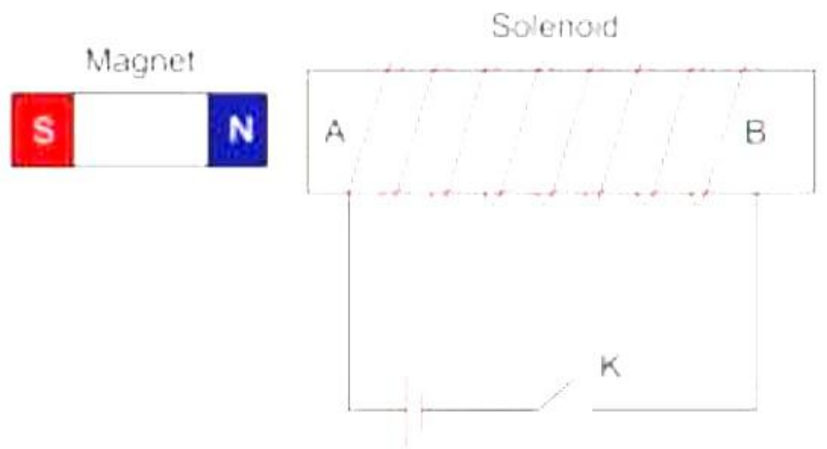
(a) Suggest one way, in each case, by which we can detect the presence of:

1. Infrared radiations.
2. Ultraviolet radiations.

(b) Give one use of Infrared radiations.

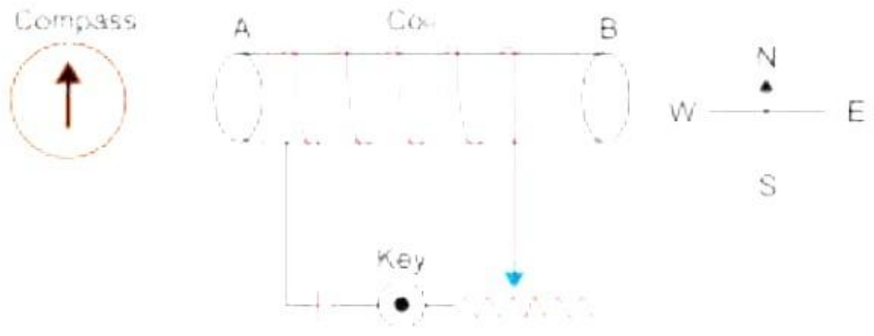
iii) [4]

(a) The adjacent diagram shows a small magnet placed near a solenoid AB. Current is switched on in the solenoid by pressing the key K.



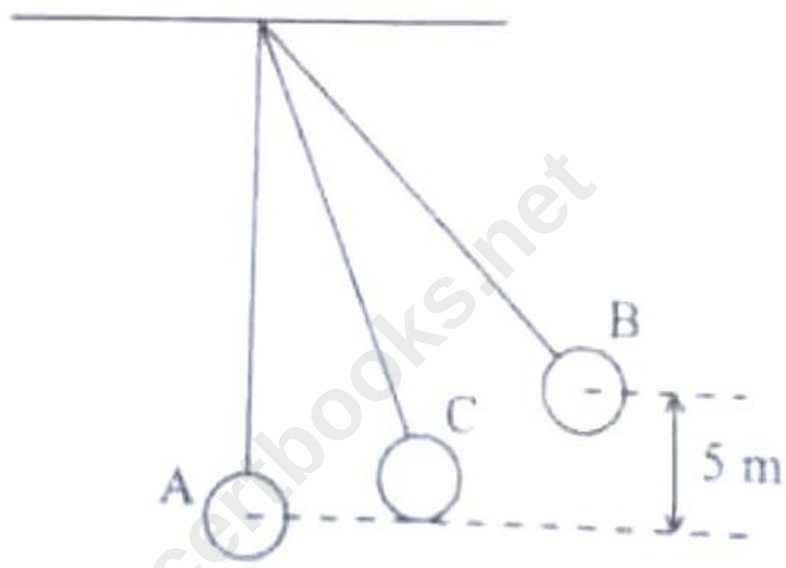
1. State the polarity at the ends A and B.
2. Will the magnet be attracted or repelled? Give a reason for your answer.

(b) The following diagram shows a spiral coil wound on a hollow cardboard tube AB. A magnetic compass is placed close to it. Current flows by closing the key. How will the compass needle be affected? Give reason.



Question 9

i) The figure below shows a simple pendulum of mass 200 g. It is displaced from the mean position A to the extreme position B. The potential energy at the position A is zero. At the position B the pendulum bob is raised by 5 m.
(Take g = 10 ms^{-2} and there is no loss of energy). [3]



(a) What is the potential energy of the pendulum at the position B?
(b) What is the total mechanical energy at point C?
(c) What is the speed of the bob at the position A when released from B?

ii) Atomic nucleus A is composed of 84 protons and 128 neutrons. Nucleus A emits an alpha particle and is transformed into 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 mass number of the nucleus A?

iii) [4]
(a) When a tuning fork [vibrating] is held close to ear, one hears a faint hum. The same [vibrating tuning fork] is held such that its stem is in contact with the table surface, then one hears a loud sound Explain.
(b) A man standing in front of a vertical cliff fires a gun. He hears the echo after 3.5 seconds. On moving closer to the cliff by 84 m, he hears the echo after 3 seconds. Calculate the distance of the cliff from the initial position of the man.
(c) Explain with example the meaning of free or natural vibrations. Also state the cause of vibrations.

Solution

SECTION A

Solution 1

Choose the correct answers to the questions from the given options. (Do not copy the questions, write the correct answer only).

i) Correct answer – b: It changes when the body is deformed.

When a body is deformed, its shape and mass distribution changes, which affects the position of its center of gravity. For example, when a person bends forward, the center of gravity of their body shifts forward as well.

ii) Correct answer – a: Compressive Force

When a spring is held fixed at one end and the other end is stretched, the spring tends to regain its original shape due to Restoring Force.

iii) Correct answer – c: The effort required by the machine to overcome a load is less than the load.

The mechanical advantage of a machine is greater than 1. The statement means that the effort required by the machine to overcome a load is less than the load.

iv) Correct answer – a: Power is more

We know that,

$$Power = \frac{work}{time}$$

If work is done in a shorter span of time, then more is the power required.

v) Correct answer – d: Assertion is true reason is false.

Radio waves have the longest wavelength. Wavelength of radio waves is above 10^{10} Å.

vi) Correct answer –c: X-ray

X-rays are the electromagnetic waves of wavelength nearly 0.1 nm.

vii) Correct answer – a: More than air

Refraction is a phenomenon for which the difference is the optical density of the two materials is necessary. Since the optical density of glass is more than air hence refraction takes place.

viii) Correct answer – b: exactly equal to the natural frequency of the vibrating body
Resonance occurs when the frequency of the applied force is exactly equal to the natural frequency of the vibrating body.

ix) Correct answer – b: Less than
When a number of resistors are connected in parallel, then their resultant resistance is less than the smallest individual resistance.

x) Correct answer – c: Acts in the direction opposite to the coil's motion.
Lenz's Law says that the system tries to prevent change. If you are removing a coil from a field, you are lowering the magnetic flux. The induced current will try to increase the magnetic field to prevent it from lowering.

xi) Correct answer – a: high specific latent heat of vaporisation of water
Plants are protected from wilting during summer due too high specific latent heat of vaporisation of water (2260000 J/kg); water from the soil does not evaporate quickly by the heat of the sun. As a result, plants are protected from wilting in the sun during summer.

xii) Correct answer – c: Gamma
Gamma radiation is the most dangerous type of radiation to living organisms. Gamma radiation has the highest energy and the most penetrating power, making it the most hazardous form of radiation. Gamma radiation can pass through the body, damaging cells and DNA, leading to cancer and other health problems.

xiii) Correct answer – b: Towards the base of the prism.
While emerging out of a prism, a ray of light bends towards the base of the prism.

xiv) Correct answer – b: 5 m/s
Given:
K.E= 625 J
m = 50 kg
Now, we use the formula of K.E.

$$K.E = \frac{1}{2}mv^2$$

$625 = 0.5 \times 50 \times v^2$
i.e., $v^2 = 625 / 25 = 25$
$\therefore v = 5$ m/s

xv) Correct answer – a: On two different bodies.
Action-reaction forces are equal and opposite and always act on two different bodies.

Solution 2

i)

(a) Instrument used for listening sounds produced within the body is called ***Stethoscope***.

(b) The minimum distance between a sound source and reflector for a distinct echo is ***17.2 m***.

(c) The sound which is produced due to a mixture of several frequencies is called ***Noise.***

(d) Between a football and stone of the same size but different masses, stone being heavier, the inertia of the ***stone is greater.***

(e) A ***total reflecting prism*** is used in place of a ***mirror*** in a periscope to deviate light by 90° and 180° in binoculars.

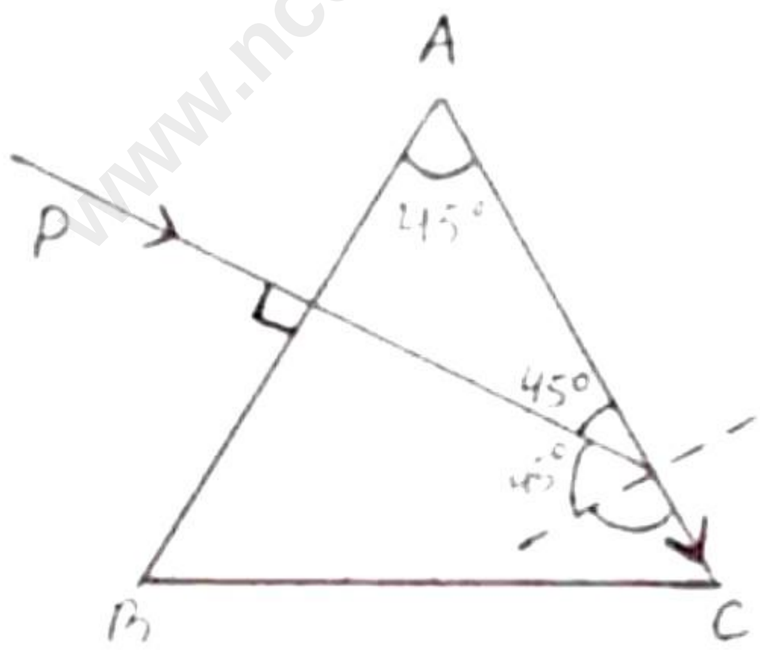
ii)

$$\text{Efficiency}, \eta = \frac{W_{out}}{W_{inp}}$$

$$= \frac{800 \times 2}{40 \times 50} \times 100 = 80\%$$

Efficiency is 80 %

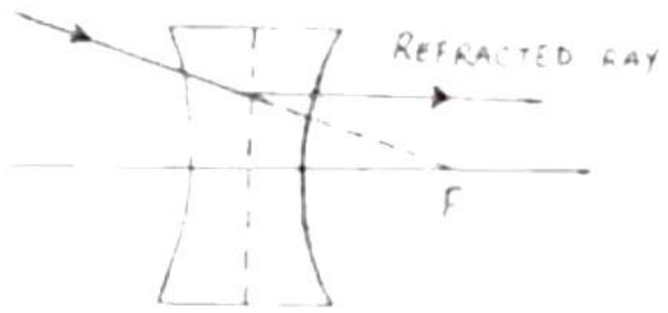
iii)



Solution 3

i)

a.



b. Two uses of ultraviolet radiation are:
   1. To detect the purity of gems, eggs, ghee etc.
   2. To produce Vitamin D in the food of plants and animals.

c. The e.m.f of a cell depends on the following two factors:
   - The material of the electrodes.
   - The electrolyte used in the cell.

ii) Given:
Speed, v = 72 km/ h
Force, F = 12000 N

$$\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{F \times S \times V}{S}$$

$$= 12000\,\text{N} \times 72\,\text{km/h}$$

$$= 12000\,\text{N} \times 72 \times \frac{1000}{3600}\,\text{m/s}$$

= 240000 W
= 240 kW
Power of the engine is 240 kW.

iii) <u>Inclined plane:</u> It is a simple machine that makes it easier to elevate a heavy object. Its two end points are at different heights and hence, it reduces the amount of force needed to lift the object.
Two daily life examples are – 1) Ramp, 2) Sloping roads.

iv) When a bird looks at a fish in the water, it appears raised but when a fish looks at a bird, it appears farther away from where it actually is.

v) Although both the infrared and γ - rays are electromagnetic radiations, γ - rays have much shorter wavelength ($\approx 10^{-13}$) as compared to the infrared whose wavelength is nearly 10^{-6} m or more. γ -rays are much more penetrating as compared to the infrared radiations.

vi) 0°C of water has higher potential energy than 0°C of ice because when a solid changes into liquid without a change in the temperature, the average kinetic energy of the molecules does not change, but the potential energy increases as the distance between the molecules on an average increase.

vii) The purpose of C-14 dating is to estimate the age of organic materials, rocks, wood, charcoal, marine and freshwater shells, bones etc. C-14 dating can also be used to determine the age of the earth.

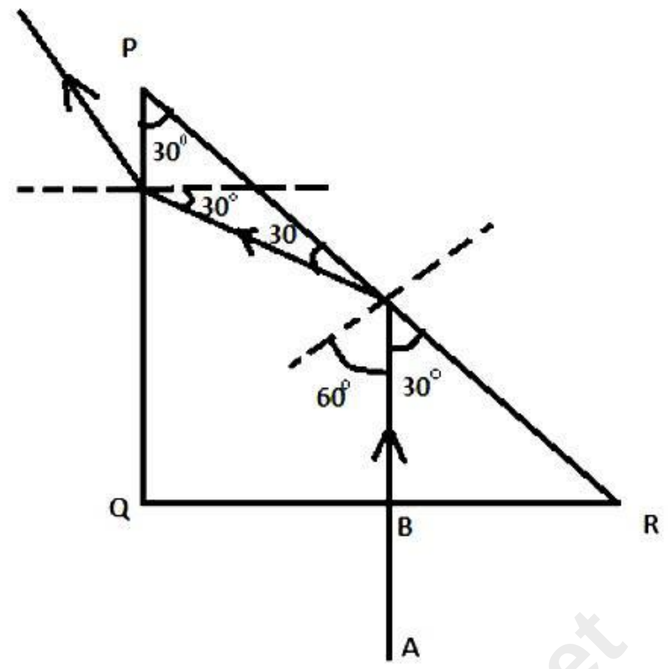
SECTION B

Solution 4

i)

(a) B made of flint glass. Because it has a higher refractive index.

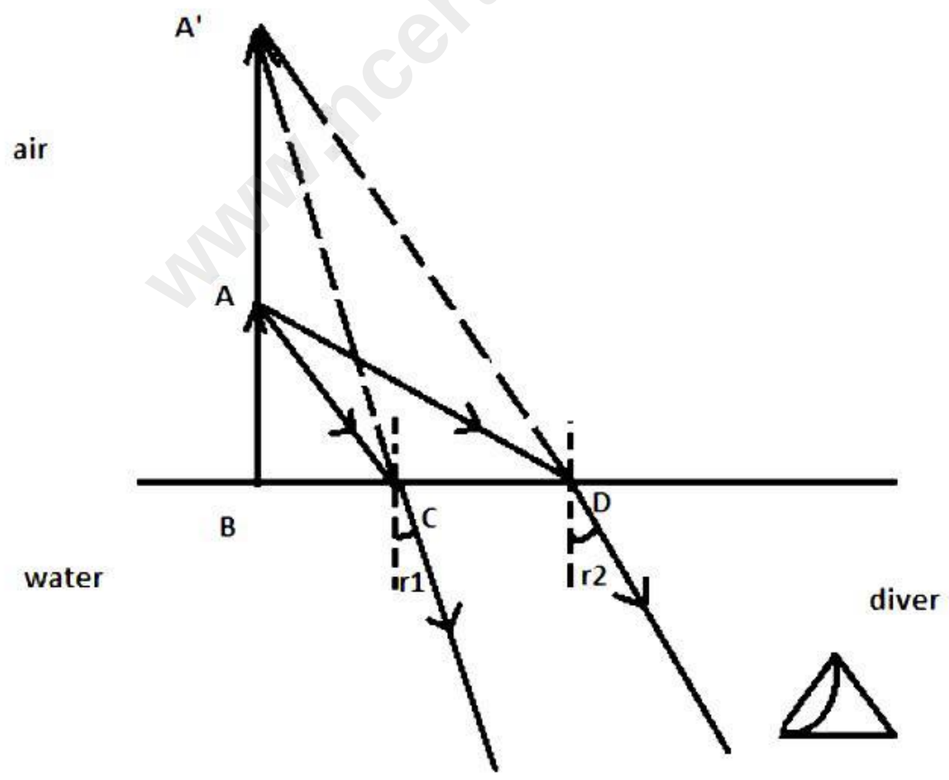
(b)



ii)

(a) The object appears taller to the driver.

(b)



iii)

(a) Critical angle

Hint: The angle of incidence in the denser medium for which the angle of refraction in rarer medium is 90^o is called the critical angle.

(b) 90^o

(c) Total internal reflection.

Hint: When the angle of incidence is greater than the critical angle, the phenomenon of total internal reflection occurs due to which the ray of light is not refracted but is reflected back in the same medium.

(d) For the ray PR, the angle of incidence is less than the critical angle (i.e., ∠PQS)
Hence, at the interface of two media as per the laws of reflection, ray PR suffers partial reflection and refraction.

Solution 5

i)

(a) Cloud droplets tend to scatter all the colours of light efficiently. Thus, clouds appear white.

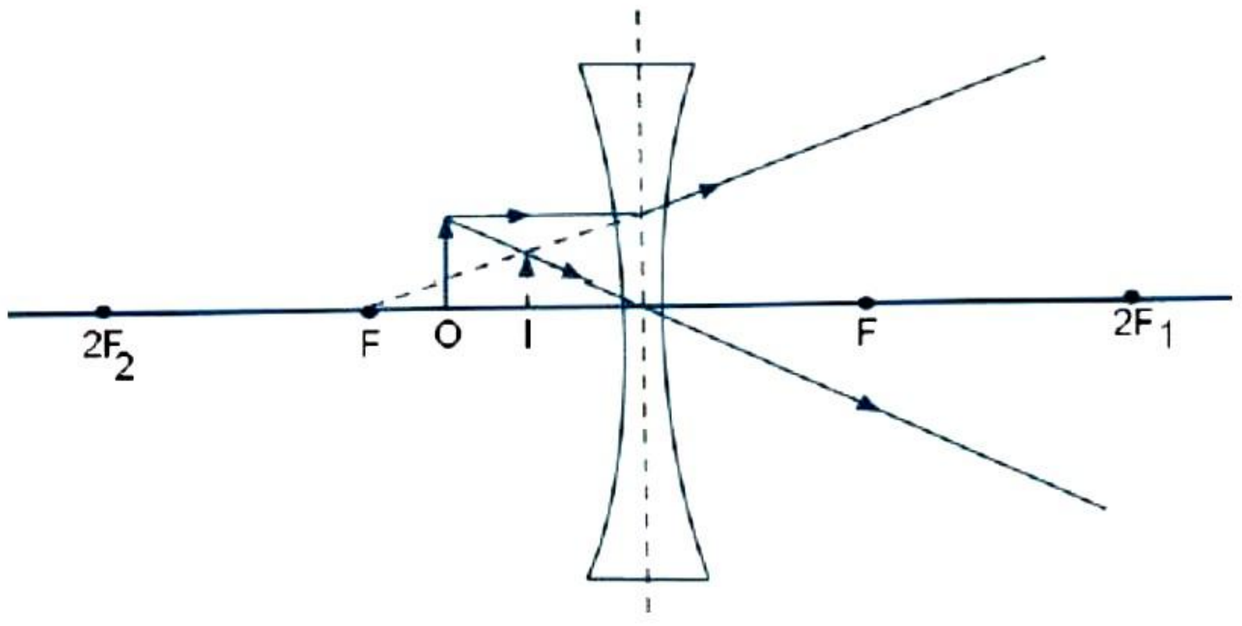
(b) The molecules of air and other fine particles in the atmosphere have a size smaller than the wavelength of visible light. Thus, they are more effective in scattering light of shorter wavelengths than longer wavelengths. Red light has a wavelength greater than blue light. Thus, when sunlight passes through the atmosphere, the fine particles in the air scatter blue colour (shorter wavelengths) more strongly than red. The scattered blue light enters our eyes.

(c) We see the Sun 2 minutes before the Sunrise because of atmospheric refraction. The air near the earth is optically denser than that at higher altitude. The sun rays travel from a rarer to denser medium. So, the light rays coming from sun to earth get refracted and bend towards normal. As a result, the sun appears 2 minutes before the actual sunrise.

ii)

(a) A concave lens formed this image.

(b) Ray diagram to show the formation of the image:



iii)

(a) As the image formed is inverted in nature, it is a convex lens.

(b) Given that,

Using lens formula,

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

$$\frac{1}{u}=\frac{1}{v}-\frac{1}{f}$$

$$\frac{1}{u}=\frac{1}{60}-\frac{1}{20}$$

$$u=-30 \text{ cm}$$

Thus, the object is placed at 30 cm from a convex lens.

(c) Magnification of a lens is given by:

$$m=\frac{v}{u}=\frac{60}{-30}=-2$$

Solution 6

i)

(a) Distance = d = 25m

Speed of sound = v = 350 m/s

$2d = v \times t$

$$\Rightarrow t = \frac{2d}{v}$$

$$\Rightarrow t = \frac{2 \times 25}{350} = \frac{1}{7} = 0.143s$$

The man receives the reflected sound after 0.143 s.

(b) The man will be able to hear a distinct echo as the time taken for the sound to reflect is nearly 0.1s or the persistence of hearing is 0.1s.

ii)

(a) An ideal machine is the one in which there is no dissipation of energy in any manner. The efficiency of an ideal machine is 100%, that is, the work output is equal to the work input.

(b) In an ideal machine, the mechanical advantage is equal to the velocity ratio, that is, M.A = V.R.

(c) A coolie carrying a load on his head and moving on a frictionless horizontal platform does no work because the displacement of the load in the horizontal direction is normal to the direction of force of gravity (which is in the downward direction).

Hence, according to the formula $W = Fs\cos\theta$,

$\theta = 90^{o}$ which means that $\cos 90° = 0$ or $W = 0$.

Thus, no work is done.

iii)

(a) Slope AB denotes specific heat of a solid, while CD denotes specific heat of a liquid. Specific heat of a substance when liquid is more than specific heat of a substance when solid.

(b) t_1 is the melting point of the substance, while t_2 is the boiling point of the substance.

(c) Latent heat is absorbed by ice.

(d)

- The boiling point of a liquid increases with the increase in pressure and decreases with the decrease in pressure.
- The boiling point of pure water at one atmospheric pressure (= 760 mm of Hg) is 100°C.
- In a pressure cooker, the water boils at about 120 °C to 125 °C due to increase in pressure, as the steam is not allowed to escape out of it.

Solution 7

i)

(a) A superconductor is a substance that conducts electricity without resistance when below a critical temperature.

(b) We know,

P = VI

Thus,

I = 110/220 = 0.5 A

Thus, the current drawn by the appliance is 220 V.

(c) A substance whose resistance decreases with increase in temperature is called a semiconductor. Examples: Silicon and Germanium

ii)

(a) The switch and the fuse are the two safety devices which are connected to the live wire of a household electrical circuit.

(b)

1. A three-pin plug is used to supply electricity to any electrical appliance whose body is earthed. The third big pin of the plug helps us to do this earthing. The user of the electrical appliance is then protected against accidental electrical shocks.
2. The main switch is connected right at the starting point of the household wiring. This enables us to switch off (or 'on') the supply of electricity, to the household, as per our need.

iii)

(a)

$V = IR$

Let current flowing through 3 ohm resistor be I_1

and that through 1.5 ohm be I_2

Thus,

$V = I_1 \times 3$

$V = I_2 \times 1.5 = I_2 \times 3/2$

Thus,

$I_2 = 2I_1$

Thus,

$I_1 + I_2 = 0.3$

$I_1 + 2I_1 = 0.3$

$I_1 = 0.1\ A$

Thus, current through 3Ω resistor is 0.1 A

(b) Internal resistance r =?

Resistors in parallel,

$$\frac{1}{R_P} = \frac{1}{3} + \frac{2}{3} = 1$$

$R_P = 1\Omega$

$R_S = 1\Omega + 4\Omega = 5\Omega$

$V = IR$

Total resistance, $R = (5+r)\Omega$

Thus,

$1.8 = 0.3 \times (5+r)\Omega$

$\therefore 6 = 5 + r$

$\therefore r = 1\Omega$

Solution 8

i)

(a) Heat capacity is defined as the amount of heat supplied to a given mass of material to produce a unit change in temperature.

(b) SI unit of heat capacity is Joule/Kelvin

(c) Heat capacity = m × (specific heat capacity)

ii)

(a)

1. Infrared radiations can be detected by exposing a blackened bulb thermometer to the radiations. The thermometer will show a rise in temperature.
2. Ultraviolet radiations can be detected with the help of silver chloride solution. From red to the violet end of the spectrum, the solution remains unaffected but beyond the violet end that is, in the UV region the solution turns dark brown or black in colour.

(b) Infrared radiations can be used for therapeutic purposes by doctors.

iii)

(a)

1. A - North pole, B - South pole.
2. The magnet will be repelled because the end of the solenoid near the north pole of magnet becomes the north pole as current at this face is anticlockwise and the two like poles repel.

(b) The north pole of compass needle will deflect towards west.

Reason: The end A of the coil behaves like north pole which repels north pole of compass needle towards west.

Solution 9

i)

(a) Potential energy at point B is

$U_B = mgh$

$m = 200\ g = 0.2\ kg$, $g = 10\ m/s^2$, $h = 5\ m$

Thus, $U_B = 0.2 \times 10 \times 5 = 10\ J$

(b) By the law of conservation of energy,

Total energy = KE + PE = 10 J

(c) At point A, potential energy is converted to kinetic energy.

Thus, $KE_A = 10\ J$

$KE_A = \frac{1}{2} mv^2$

$10 = \frac{1}{2} (0.2) (v)^2$

$v = 10\ m/s$

ii) Given that,

Mass number of A = 84 + 128 = 212

Thus,

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

(b) On beta emission,

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

(c) Mass number of nucleus A is 212.

iii)

(a) Sound travels faster in solids than in air. Vibrations produced in the table have greater intensity than those produced in air.

(b) Now,

$$v = \frac{2d}{t}$$

$$\frac{2d}{3.5} = \frac{2(d-84)}{3}$$

$$d = 7 \times 84 = 588 \text{ m}$$

Thus, the distance of the cliff from the initial position of man is 588 m.

(c) When a simple pendulum is displaced slightly from its mean position and released, it begins to perform vibrations which are known as free or natural vibrations. The frequency with which the body vibrates is known as its natural frequency. These vibrations arise due to restoring forces set up by the body internally.