

ICSE Paper 2007

PHYSICS

SECTION-I (40 Marks)

Compulsory : Attempt all questions from this Section.

Question 1.

- (a) Which class of levers has a mechanical advantage always greater than one ? What change can be brought about in this lever to increase its mechanical advantage ? [2]
- (b) Two bodies, A and B of equal mass are kept at heights 20 m and 30 m respectively. Calculate the ratio of their potential energies. [2]
- (c) What is the S.I. unit of upthrust ? Mention one factor on which the upthrust of a liquid depends. ** [2]
- (d) Why are infra-red radiations preferred over ordinary visible light for taking photo-graphs in fog ? [2]
- (e) Define Relative density of a substance. ** [2]

Answer :

- (a) Class II lever has a mechanical advantage always greater than one. To increase mechanical advantage effort arm must be increased and load arm must be decreased.
- (b) Given two bodies of equal mass.

$$\text{Height of A} = 20 \text{ m}$$

$$\text{Height of B} = 30 \text{ m}$$

$$\begin{aligned} \frac{P.E_1}{P.E_2} &= \frac{mg h_1}{mg h_2} \\ &= \frac{m \times g \times 20}{m \times g \times 30} \end{aligned}$$

$$\frac{P.E_1}{P.E_2} = \frac{2}{3}$$

Ans.

- (d) Infra-red radiations are preferred because it scatters less and can penetrate through fog so photography can be done easily.

Question 2.

- (a) Mention two reasons why water is not a suitable barometric liquid. ** [2]
- (b) State Snell's Law of Refraction of light. [2]
- (c) (i) What will be the colour of a blue flower when it is seen in magenta coloured light ? **
- (ii) Name another secondary colour of light in which the flower will show the same colour as it shows in the magenta coloured light. ** [2]

** Answer has not given due to out of present syllabus.

- (d) The upper blood pressure of a patient is 160 cm of mercury whereas the normal blood pressure should be 120 cm of mercury. How much extra pressure is generated by the heart above the normal pressure? (Give your answer in S.I. unit).^{**}

(Density of mercury = 13600 kg m^{-3} ; $g = 9.8 \text{ m s}^{-2}$).

[2]

- (e) Draw an approximate graph to show the variation of atmospheric pressure with altitude.^{**}

[2]

Answer.

- (b) Snell's law of refraction states that the ratio of sine of angle of incidence to the sine of angle of refraction is constant for a given pair of media. This constant is called refractive index of the medium.

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

Question 3.

- (a) Define the terms :^{**}

(i) Amplitude (ii) Frequency (as applied to sound waves.)

[2]

- (b) An object is placed in front of a converging lens at a distance greater than twice the focal length of the lens. Draw a ray diagram to show the formation of the image.

[2]

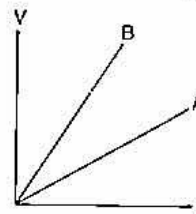
- (c) Mention one difference between reflection of light from a plane mirror and total internal reflection of light from a prism.

[2]

- (d) The V-I graph for a series combination and for a parallel combination of two resistors is as shown in the figure alongside :

Which of the two, A or B, represents the parallel combination? Give a reason for your answer.

[2]



- (e) Of the three connecting wires in a household circuit :

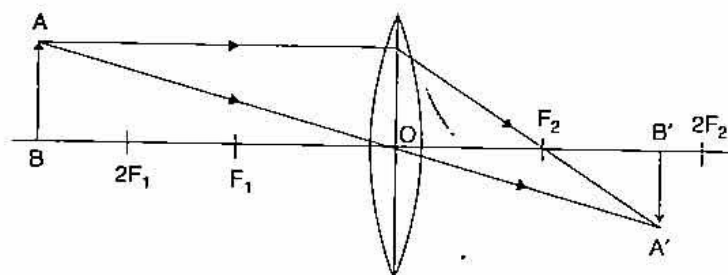
(i) Which two of the three wires are at the same potential?

(ii) In which of the three wires should the switch be connected?

[2]

Answer.

(b)



- (c) The reflection from a plane mirror depends upon the polishing of the surface whereas in prism it is not so and light is totally reflected.

- (d) 'A' represents parallel combination because resistance of 'A' is less than 'B' as we know resistance in parallel combination is less than series combination.

- (e) (i) Neutral and Earth Wires.
(ii) Switch should be connected in line wire.

Question 4.

- (a) What will an alpha particle change into when it absorbs :
(i) One electron;
(ii) Two electrons ? [2]
- (b) Some hot water was added to three times its mass of cold water at 10°C and the resulting temperature was found to be 20°C . What was the temperature of the hot water ? [2]
- (c) Calculate the value of the resistance which must be connected to a $15\ \Omega$ resistance to provide an effective resistance of $6\ \Omega$. [2]
- (d) Why are burns caused by steam more severe than those caused by boiling water at the same temperature ? [2]
- (e) Mention two important properties of a metal that make it a good thermionic emitter. [2]

Answer :

- (a) (i) Alpha particle becomes single ionised helium (He^+) on absorbing one electron.
(ii) Alpha particle becomes Helium atom on absorbing two electrons.
- (b) Let mass of hot water = m kg
So mass of cold water = $3m$ kg.
Let temperature of hot water be $t^{\circ}\text{C}$.

$$\begin{aligned}\text{Heat taken by cold water} &= mc \Delta Q_1 \\ &= 3m \times c \times (20 - 10)\end{aligned}$$

$$\text{Heat given by hot water} = m \times c \times (t - 20)$$

By principle of calorimetry

$$\begin{aligned}\text{Heat given} &= \text{Heat taken} \\ m \times c \times (t - 20) &= 3m \times c \times (20 - 10) \\ t - 20 &= 3 \times 10\end{aligned}$$

i.e.,

$$t = 50^{\circ}\text{C}.$$

Ans.

- (c) Given : $R_1 = 15\ \Omega$, Resistance of combination = $R = 6\ \Omega$
As equivalent resistance is less than the individual resistance. So resistance are connected in parallel.

So

$$\begin{aligned}\frac{1}{R} &= \frac{1}{R_1} + \frac{1}{R_2} \\ \frac{1}{6} &= \frac{1}{15} + \frac{1}{R_2} \\ \frac{1}{R_2} &= \frac{1}{6} - \frac{1}{15} = \frac{5-2}{30} = \frac{3}{30} \\ \frac{1}{R_2} &= \frac{1}{10} \\ R_2 &= 10\ \Omega.\end{aligned}$$

Ans.

- (d) Burns caused by steam are more painfully because steam has latent heat of vaporisation which is the highest. So burns by steam are more severe as compared to boiling water.

- (e) Two important properties of a metal :
- (1) Melting point of the substance should be high.
 - (2) Work function should be low.

SECTION-II (40 Marks)

Answer any **four** questions from this Section.

Question 5.

- (a) (i) Define a kilowatt hour. How is it related to the joule ?
 (ii) How can the work done by measured when force is applied at an angle to the direction of displacement ? [3]
- (b) (i) What is the main energy transformation that occurs in :
 (1) Photosynthesis in green leaves; (2) Charging of a battery.
 (ii) Write an expression to show the relationship between mechanical advantage, velocity ratio and efficiency for a simple machine. [3]
- (c) A block and tackle pulley system has a velocity ratio 3.
 (i) Draw a labelled diagram of this system. In your diagram, indicate clearly the points of application and the directions of the load and effort.
 (ii) Why should the lower block of this pulley system be of negligible weight ? [4]

Answer.

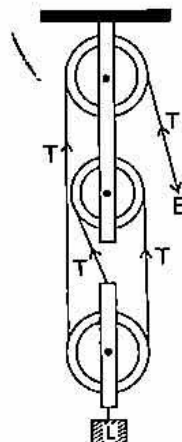
- (a) (i) One kilowatt hour is the electrical energy consumed by an electrical appliance of power 1 kW when it is used for 1 hour.

$$1 \text{ kWh} = 3.6 \times 10^6 \text{ J}$$

 (ii)
$$\text{Work done} = Fd \cos \theta$$

 Where θ is the angle between force and displacement.
- (b) (i) (1) **Energy change which takes place in photosynthesis :** Light energy to chemical energy.
 (2) **Charging of a battery :** Electrical energy to chemical energy.
 (ii) Relation between mechanical advantage, velocity ratio and efficiency is

$$\text{Efficiency} = \frac{\text{M.A.}}{\text{V.R.}} \times 100$$
- (c) (i) See figure given below :



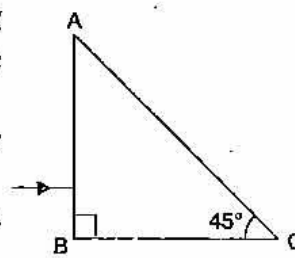
- (ii) Lower block of this pulley system should be of negligible weight to increase the efficiency of the system.

Question 6. **

- (a) (i) Name and state the principle on which the working of a hydraulic machine is based.
- (ii) A balloon filled with hydrogen rises to a certain height and then stops rising. Why does it stop rising? [3]
- (b) (i) State Archimedes Principle.
- (ii) Explain why a piece of iron sinks in water while a ship made of iron floats. [3]
- (c) A piece of wood of volume 200 cm^3 and density 0.84 g cm^{-3} floats in a liquid of density 1.05 g cm^{-3} .
- (i) What volume of wood will remain above the surface of the liquid?
- (ii) What force must be exerted on the wood to keep it totally submerged? [4]

Question 7.

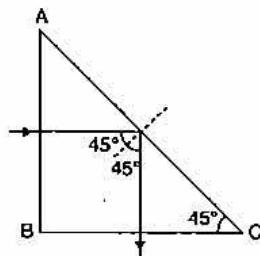
- (a) The diagram given alongside shows a right-angled prism with a ray of light incident on the side AB. (The critical angle for glass is 42°).



- (i) Copy the diagram and complete the path of the ray of light in and out of the glass prism. [3]
- (ii) What is the value of the angle of deviation shown by the ray?
- (b) (i) A particular type of high energy invisible electromagnetic rays help us to study the structure of crystals. Name these rays and give another important use of these rays.
- (ii) How does the speed of light in glass change on increasing the wavelength of light? [3]
- (c) (i) With the help of a well-labelled diagram show that the apparent depth of an object, such as a coin, in water is less than its real depth.
- (ii) How is the refractive index of water related to the real depth and the apparent depth of a column of water? [4]

Answer :

- (a) (i)



- (ii) Angle of deviation which is shown by ray = 90° .
- (b) (i) X-rays. Another important use of these rays : To take X-rays of human body.
- (ii) Speed of light in glass increases on increasing the wavelength of light.

- (c) (i) Labelled diagram alongside.

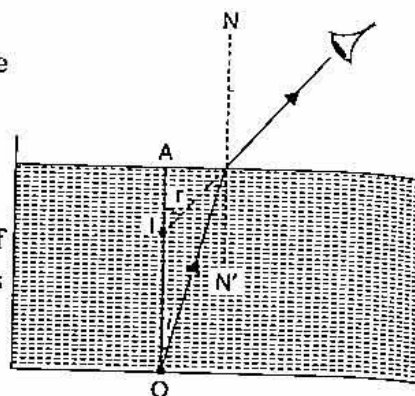
In the figure : O is the position of the object and I is the position of the image.

AI = Apparent depth

OA = Real depth.

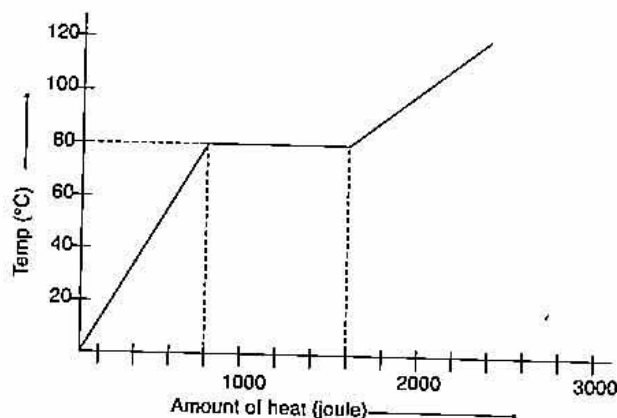
- (ii) Relation between refractive index of water and real and apparent depth is given by

$$n_{lw} = \frac{\text{Real depth}}{\text{Apparent depth}}$$



Question 8.

- (a) A man standing in front of a vertical cliff fires a gun. He hears the echo after 3 seconds. On moving closer to the cliff by 82.5 m, he fires again. This time, he hears the echo after 2.5 seconds. Calculate :
- The distance of the cliff from the initial position of the man.
 - The velocity of sound.
- [3]
- (b) (i) What is meant by Specific heat capacity of a substance ?
- (ii) Why does the heat supplied to a substance during its change of state not cause any rise in its temperature ?
- [3]
- (c) A substance is in the form of a solid at 0°C . The amount of heat added to this substance and the temperature of the substance are plotted on the following graph :



If the specific heat capacity of the solid substance is $500 \text{ J/kg}^{\circ}\text{C}$, find from the graph :

- The mass of the substance,
 - The specific latent heat of fusion of the substance in the liquid state.
- [4]

Answer.

- (a) Let the distance of cliff from the initial position of the man be ' d ' m.
So, distance travelled by sound in 3 sec. = $2d$ m.

So speed of sound $S = \frac{\text{distance}}{\text{time}}$

$$S = \frac{2d}{3} \quad \dots(1)$$

On moving closer to the cliff by a distance of 82.5 m, the distance becomes $= 2(d - 82.5) \text{ m}$

So,

$$\begin{aligned}
 S &= \frac{d}{t} \\
 S &= \frac{2(d - 82.5)}{2.5} \\
 &= \frac{2d - 2 \times 82.5}{2.5} \quad \dots(2)
 \end{aligned}$$

From eq. (1) and (2),

$$\frac{2d}{3} = \frac{2d - 2 \times 82.5}{2.5}$$

$$5d = 6d - 495$$

$$d = 495 \text{ m}$$

Now,

$$S = \frac{2 \times 495}{3}$$

$$= 330 \text{ m/sec.}$$

Ans.

- (b) (i) Specific heat capacity of a substance is the amount of heat required to raise the temperature of unit mass of substance by 1°C .
- (ii) Heat supplied to a substance during change of state does not cause any rise in temperature because heat supplied is used to increase potential energy. Energy is utilised in increasing the separation between the molecules as work is done against the attractive forces.

- (c) (i) Let mass of substance be m kg.

We know $H = mc \Delta Q$

From graph, $H = 800 \text{ J}$, $\Delta Q = 80^\circ\text{C}$, $C = 500 \text{ J/kg}^\circ\text{C}$ (given)

So $800 = m \times 500 \times 80$

$$m = \frac{800}{500 \times 80}$$

$$= \frac{1}{50} \text{ kg}$$

$$= 20 \text{ gm.}$$

Ans.

- (ii) $H = mL$

$$(1600 - 800) = \frac{1}{50} \times L$$

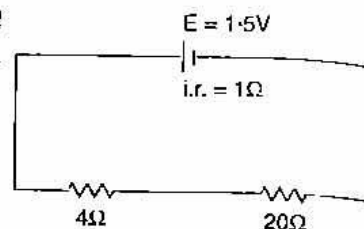
$$L = 800 \times 50$$

$$= 40,000 \text{ J/kg.}$$

Ans.**Question 9.**

- (a) (i) What is meant by earthing of an electrical appliance? Why is it essential?
- (ii) What will be the effect on the working of an electric bell if instead of a direct current, an alternating current is used? [3]
- (b) (i) State two factors on which the strength of an induced current depends.
- (ii) When a solenoid that is carrying current is freely suspended, it comes to rest along a particular direction. Why does this happen? [3]

- (c) A cell of e.m.f. 1.5 V and internal resistance 1.0Ω is connected to two resistors of 4.0Ω and 20.0Ω in series as shown in the figure :



Calculate the :

- (i) Current in the circuit.
- (ii) Potential difference across the 4.0 ohm resistor.
- (iii) Voltage drop when the current is flowing.
- (iv) Potential difference across the cell.

[4]

Answer.

- (a) (i) Earthing of an electrical appliance means the outer casing of an appliance is connected by means of a wire which is then connected to a cu-wire which is connected to earth. This is known as earthing of an electrical appliance. It is essential to save a person from total electrical shock.
- (ii) If an alternating current is fed to electrical bell then it will work intermittently.
- (b) (i) Two factors on which the strength of induced current depends are :
- (1) Rate of change of magnetic flux.
 - (2) Change in magnetic flux.
- (ii) When a solenoid carrying current is freely suspended then it rests in a particular direction because we know current carrying coil behaves as a magnet so it has two poles induced at its two ends. Hence it rests in a particular direction.
- (c) (i) Given : $E = 1.5 \text{ V}$, $r = 1 \Omega$.

$$\begin{aligned}
 i &= \frac{E}{R + r} \\
 &= \frac{1.5}{(4 + 20) + 1} = \frac{1.5}{25} \\
 &= 0.06 \text{ amp.}
 \end{aligned}$$

Ans.

- (ii) We know,

$$\begin{aligned}
 V &= IR \\
 &= 0.06 \times 4 \\
 &= 0.24 \text{ volt hr.}
 \end{aligned}$$

Ans.

- (iii)

$$\text{Voltage drop} = Ir$$

$$\begin{aligned}
 &= 0.06 \times 1 \\
 &= 0.06 \text{ volt.}
 \end{aligned}$$

Ans.

- (iv) Potential difference across the cell = IR

$$\begin{aligned}
 &= 0.06 \times 24 \\
 &= 1.44 \text{ volt.}
 \end{aligned}$$

Ans.

Question 10.

- (a) Name the three main parts of a hot cathode ray tube. Mention one important function of each of the three main parts.

[3]

- (b) (i) State the principle on which the functioning of a nuclear reactor is based. **
- (ii) Name a material that can be used as fuel in a nuclear reactor. **
- (iii) How is the activity in a nuclear reactor controlled? ** [3]
- (c) (i) What happens to the atomic number of an element when it emits :
- (1) an alpha particle;
- (2) a beta particle.
- (ii) Explain why alpha and beta particles are deflected in an electric or a magnetic field but gamma rays are not deflected in such a field. [4]

Answer.

(a) The three main parts of a hot cathode ray tube are :

- (i) **Electron gun** : Its function is to give a fine beam of electrons.
- (ii) **Deflecting system** : Its function is to deflect the electron beam in horizontal and vertical direction.
- (iii) **Fluorescent screen** : Its function is to convert electrical signal to visual pattern.

- (c) (i) (1) Atomic number of an element decreases by 1. When an alpha particle is emitted out.
- (2) Atomic number of the element increases by 1 when a beta particle is emitted.
- (ii) Alpha particles and beta particles are deflected in electric field because alpha particles are positively charged and beta particles are negatively charged. But gamma rays are not deflected because it is uncharged.

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