MOCK TEST PAPER (SOLVED)

SCIENCE - X (ICSE)

Paper-I (Physics)

(One hour and a half)

Answer to this paper must be written on the paper provided separately.
You will not be allowed to write during the first 15 minutes.
This time is to be spent in reading the question paper.
The time given at the head of this paper is the time allowed for writing the answers.

Section I is compulsory. Attempt any four questions from Section II.
The intended marks for questions or parts of questions are given in brackets [ ].

SECTION - I

(*40 marks*)

(*Attempt all questions from this Section*)

Question 1.

(*a*) If P is the momentum of an object of mass m then write the name of the physical quantity which has the same unit as the expression $\frac{P^2}{2m}$ has. [2]

(*b*) When a coin of rupee five is dropped from a height of 50 cm on a glass plate, does not break it, but the same coin when dropped from a height of 2 m on the same glass plate, breaks it, explain. [2]

(*c*) To which class of levers do the following belong. Show the positions of the fulcrum, effort and load in each case.

(*i*) Knife (*ii*) Nut cracker. [2]

(*d*) What is the role of swimming bladder of fish ? [2]

(*e*) If a cube of side 3 cm is dipped in a liquid of density 500 kg/m^3, find the loss in the weight of the cube. [2]

Answer

(*a*) Energy. $\because \frac{P^2}{2m} = \frac{(mv)^2}{2m} = \frac{1}{2}\frac{m^2v^2}{m} = \frac{1}{2}mv^2$ = Kinete energy.

(*b*) When the coin falls from a large height, it acquires more momentum when it strikes the glass plate. It exerts a larger force on the glass plate which breaks it.

(*c*) (*i*) Class III (*ii*) Class II lever.

(*d*) Swim or air bladder is a long air filled sac. This makes it buoyant so that it does not sink when it stops swimming. At different depths the air pressure in the swim bladder is regulated by the fish.

(*e*) Loss in weight = wt. of the liquid displaced

$= V \times d \times g$

Here, $V = 3 \times 3 \times 3 = 27\ cm^3 = 27 \times 10^{-6}\ m^3$

$\therefore$ Loss in wt. $= 27 \times 10^{-6} \times 500 \times 10 = 135 \times 10^{-3}$ N

$= 0{\cdot}135$ N.

Question 2.

(*a*) List one similarity and one difference between the human eye and photographic camera. [2]

(*b*) Why is there no increase in temperature when a substance is heated at its melting or boiling point ? [2]

(*c*) Mention two ways to increase the pitch of a stringed musical instrument. [2]

(*d*) An atom emits light of wavelength 400 nm. Calculate the frequency of the emitted light. Velocity of the emitted light is 3×10^8 m/s. [2]

(*e*) An electric bulb is rated as 100 W, 220 V. What does it mean ? [2]

Answer

(*a*) **Similarity :** Both the camera and the human eye form the image of the object. Whereas the camera lens forms the image on the photographic film, the eye lens forms it on the retina.

Difference : The distance between the lens and the film is variable. However, the distance between the eye lens and the retina is fixed. The camera lens is made of glass and its focal length is fixed. The eye lens is an organ made of live tissues and its focal length can be changed.

(*b*) When a substance at its melting or boiling point is heated, the whole of the heat supplied to the substance is used in changing the state of the solid from solid to the liquid state or from the liquid to the gaseous state. Hence there is no rise of temperature. It is called latent heat because it does not appear on the thermometer.

(*c*) The pitch of a stringed instrument can be changed (*i*) by changing the thickness of the wire (*ii*) by changing the tension in the string.

(*d*) Here, $\lambda = 400 \times 10^{-9}$ m, $n = ?$, $v = 3 \times 10^8$ ms^{-1}

We know, $v = n\lambda$

$$n = \frac{v}{\lambda} = \frac{3\times10^8}{400\times10^{-9}} = 0{\cdot}75 \times 10^{15} \text{ Hz}$$

$$= 7{\cdot}5 \times 10^{14} \text{ Hz.}$$

(*e*) It means that when 220 V supply is applied to the electric bulb, it will consume 100 W. It will draw a current

$$I = \frac{P}{V} = \frac{100}{220} = \frac{5}{11} A$$

Question 3.

(*a*) Mention two uses of cathode ray tube. [2]

(*b*) State the law of transmission of pressure in liquids. [2]

(*c*) A narrow beam of white light is incident upon a triangular glass prism. Draw a clear diagram to illustrate what is deviation ? [2]

(*d*) State the principle of hydrometer. [2]

(*e*) Draw a neat labelled diagram for a device which converts 240 V ac to 12 V ac. [2]

Answer

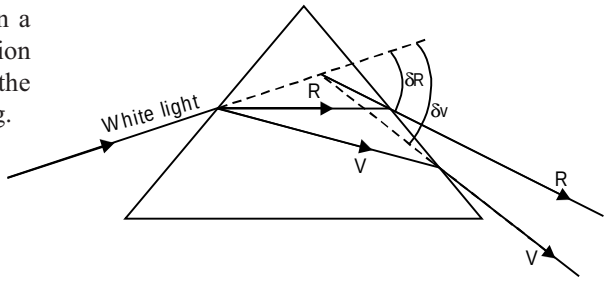
(*a*) The two uses of cathode ray tube are :

(1) As a picture tube in television.

(2) A CRO (cathode ray oscilloscope) which has a cathode ray tube as an essential component is used as a research tool and in many experiments in electronics.

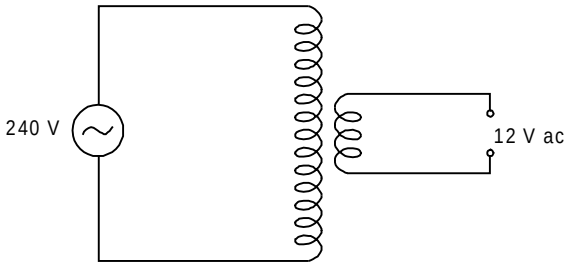
(*b*) This law is called Pascal's law. It states that when a pressure is applied on an enclosed mass of a liquid, it is transmitted equally and undiminished in all directions.

(*c*) When a narrow beam of white light is incident on a glass prism, it suffers dispersion as well as deviation as shown in the fig. The deviations suffered by the extreme colours red and violet are shown in the fig.



(*d*) A hydrometer works on the principle of floatation which states that whenever a body floats in a liquid, the weight of the body is equal to the weight of the liquid displaced by its immersed part.

(*e*) A step down transformer converts 240 V ac to 12 V ac as shown in the fig.



Question 4.

(*a*) A radioactive atom 'A' releases an α-particle followed by two β-particles to form 'B'. What is the relation between A and B ? [2]

(*b*) A fuse is always connected in series with the live wire. Why ? [2]

(*c*) The specific heat capacities of water, alcohol and lead are 1 cal/g°C, 0·52 cal/g°C and 0·031 cal/g°C respectively.

(*i*) Convert them into S.I. unit.

(*ii*) If the same amount of heat is given to the same mass of the three substances, which will show the highest rise in temperature ? [2]

(*d*) Give one word for

(*i*) The light sensitive screen in the eye.

(*ii*) The aperture at the centre of the iris. [2]

(*e*) Give an example of a device in which

(*i*) heat energy is converted into mechanical energy.

(*ii*) electrical energy is converted into mechanical energy. [2]

Answer

(*a*) The relation between A and B is as shown

$$A_Y^X \xrightarrow[\alpha]{} L_{Y-2}^{X-4} \xrightarrow[\beta]{} M_{Y-2+1}^{X-4} \longrightarrow B_{Y-2+2}^{X-4} \xrightarrow[\beta]{} B_Y^{X-4}$$

It is clear that mass number of B is 4 less than that of A and its atomic number is same as that of A.

(*b*) So that the heavy current passes through the fuse also. A large amount of heat melts the fuse and the circuit is borken.

(*c*) (*i*) The specific heat capacities of water, alcohol and lead in SI units will be 1 K cal/Kg°C, 0·52 K cal/Kg°C and 0·031 K cal/Kg°C respectively.

(*ii*) We know that $Q = mst$

$\therefore$ $t = \dfrac{Q}{ms}$, Since Q and m are constants.

$\therefore$ $t \propto \dfrac{1}{s}$

$\therefore$ rise in temperature of lead will be highest and that of water will be lowest.

(*d*) (*i*) Retina (*ii*) Pupil.

(*e*) (*i*) A railway engine (*ii*) An electric motor.

SECTION - II

(*40 marks*)

(*Attempt any four questions from this Section*)

Question 5.

(*a*) A man raises a box of 50 kg mass to a height 2 m in 2 minutes while the other man raises the same box to the same height in 5 minutes. Compare

(*i*) the work done and

(*ii*) the power developed by them. [2]

(*b*) A machine is driven by a 100 kg mass that falls 8·0 m in 4·0 s. It lifts a load of mass 500 kg vertically upwards.

(*i*) What is the force in newton, exerted by the falling mass ?

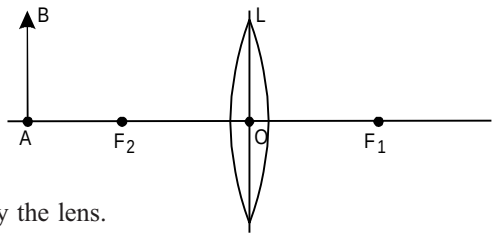
(*ii*) What is the work done by 100 kg mass falling through 8·0 m ?

(*iii*) What is the power input to the machine ?

(*iv*) If the efficiency of the machine is 75%, what is the power output of the machine ?

(*v*) What is the work done by the machine in 4·0 second ? (Take $g = 10$ m/s^2) [5]

(*c*) The diagram below shows an object AB placed on the principal axis of a lens L. The two focii of the lens are F_1 and F_2. The image formed by the lens is real, enlarged and inverted. Copy the diagram and answer the following questions :



(*i*) Draw the ray of light starting from B and passing through O. Show the same ray after refraction by the lens.

(*ii*) Draw another ray from B, which after passing parallel to the principal axis, is incident on the lens and emerges after refraction from it.

(*iii*) Locate the final image formed. [3]

Answer

(*a*) Work done by the first man, $W_1 = mg \times s$

$= 50 \times 10 \times 2 = 1000$ J

Work done by the second, $W_2 = 50 \times 10 \times 2 = 1000$ J

$\therefore \quad \frac{W_1}{W_2} = \frac{1000\,J}{1000\,J} = 1$

Power P_1 of the first man $P_1 = \frac{W}{t} = \frac{1000\,J}{2 \times 60s} = \frac{100}{6 \times 2}$ Watts

Power P_2 of the second man $P_2 = \frac{1000}{5 \times 60} = \frac{100}{5 \times 6}$ Watts

$\therefore \quad \frac{P_1}{P_2} = \frac{100}{12} \times \frac{30}{100} = \frac{5}{2}$

(*b*) Here m = 100 kg, g = 10 ms^{-2}

(*i*) Force mg = 100 × 10 = 1000 N

(*ii*) Work done W = F × S = 1000 × 8 = 8000 J

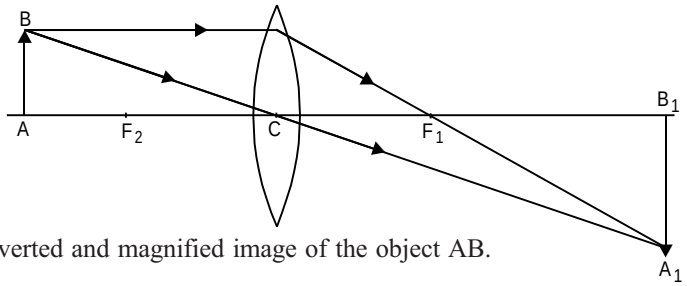
(*iii*) Input power = $\frac{W}{t} = \frac{8000\,J}{4s} = 2000$ W

(*iv*) Output power = $2000 \times \frac{75}{100} = 1500$ W

(*v*) Work done by the machine in 4 *s*

W = P × *t* = 1500 × 4 = 6000 J

(*c*) The course of rays is as shown in the fig.



A_1B_1 is the real, inverted and magnified image of the object AB.

Question 6.

(*a*) 2 kg of ice melts when a jet of steam at 100°C is passed through a hole drilled in a block of ice. What mass of steam was used ? Given specific. heat capacity of water = 4200 J kg^{-1} K^{-1}, $L_{ice} = 336 \times 10^3$ J kg^{-1} and $L_{steam} = 2268 \times 10^3$ J kg^{-1}. [4]

(*b*) A bullet of mass 10 g travelling at a speed of 150 m/s hits a wooden target. It penetrates a distance of 0·06 m in the wood before coming to rest. Calculate the average retarding force on the bullet. [3]

(*c*) A pitch is placed below a water tap. State what kind of change is produced in the sound as the pitch gets filled with water ? Give reason for your answer. [3]

Answer

(*a*) Heat required by 2 kg of ice at 0°C to melt into water = mL = $2 \times 336 \times 10^3$ J

Let M be the mass of steam used.

Heat given out by M gm of steam into M gm of water at 100°C = $M \times 2268 \times 10^3$ J

Heat lost by M gm of water in cooling from 100°C to 0ºC = mst = M × 4200 × 100 J

Total heat lost = $M \times 2268 \times 10^3 + M \times 4200 \times 100$

$= M\,[2268 \times 10^3 + 420 \times 10^3]$ J

$= M \times 2688 \times 10^3$ J

But Heat lost = Heat given

$\therefore \quad M \times 2688 \times 10^3 = 2 \times 336 \times 10^3$

$M = \frac{2 \times 336 \times 103}{2688 \times 103} = 0.25$ kg

(*b*) Mass m of the bullet = 10 gm = $10 \times 10^{-3} = 10^{-2}$ kg

$u = 150$ ms^{-1}

$v = 0$; $s = 0{\cdot}06$ m

Now $v^2 - u^2 = 2as$

$0 - (150)^2 = 2 \times a \times 0{\cdot}06$

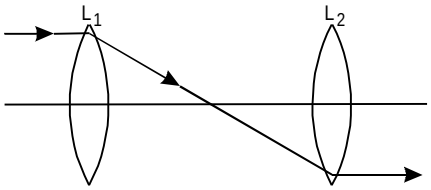
$\therefore \quad a = -\dfrac{150\times150}{2\times{\cdot}06}\text{ms}^{-2}$

$\therefore$ retarding force = $ma = \dfrac{150\times150}{2\times{\cdot}06}\times10^{-2}$ N = 1875 N

(*c*) When a pitch is placed below a water trap, the frequency of the sound produced goes on changing due to the change in length of the air column which is set into forced vibrations. Thus the quality of sound produced goes on changing.

Question 7.

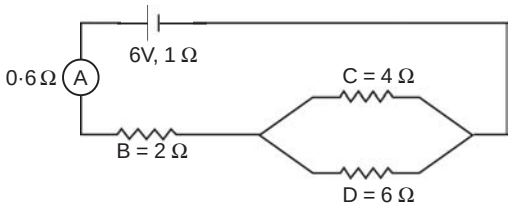
(*a*) Two lenses L_1 and L_2 of focal length F_1 and F_2 are arranged as shown in the diagram what, will be the distance between lenses L_1 and L_2 ?



[2]

(*b*) On warm sunny days metallic roads often appear to be covered with pools of water some distance ahead. But on approaching it disappears. How do you explain this ? [3]

(*c*) In the figure given below B, C and D are three resistances of value 2 Ω, 4 Ω and 6 Ω respectively. An ammeter 'A' of resistance 0·6 Ω is connected in series. Calculate :



(*i*) Ammeter reading.

(*ii*) Potential difference across resistance B.

(*iii*) Current in resistance 'C'.

(*iv*) Potential drop across the terminals of the cell.

(*v*) Terminal voltage offered by the cell. [5]

Answer

(*a*) From the diagram it is clear that the distance between the two lenses = $F_1 + F_2$ = Sum of their focal lengths.

(*b*) This is due to phenomenon of total internal reflection. Air near the ground becomes hotter than further up. Hot air has less refractive index. Thus light from an object passes through a medium whose refractive index decreases towards the ground. As a result light bends more and more away from the normal and reaches the eye after suffering total internal reflection. To the observer it appears to be coming from a pool of water. This gives us a wrong impression of the presence of water.

(*c*) Since 4 Ω and 6 Ω are in parallel, their combined resistance $= \dfrac{6\times4}{6+4} = \dfrac{24}{10} = 2{\cdot}4\ \Omega$

$\therefore$ Total resistance of the circuit = 2·4 + 2 + 0·6 + 1 = 6 Ω

$\therefore$ Current in the circuit by ohm's law is, $I = \dfrac{6\,\text{V}}{6\,\Omega} = 1\text{A}$

$\therefore$ reading of the ammeter = 1A

Potential difference across B, V = I × R = 1 × 2 = 2 Volts

Potential difference across C or D = 1 × 2·4 = 2·4 V

$\therefore$ Current through C, $I = \dfrac{V}{R} = \dfrac{2{\cdot}4}{4} = 0{\cdot}6\,\text{A}$

Potential drop across the terminals of the cell = IR = 1 × 1 = 1 V

Terminal voltage across the cell = 6 – 1 = 5 V

Question 8.

(*a*) Given below is a simplified diagram of an a.c. generator.

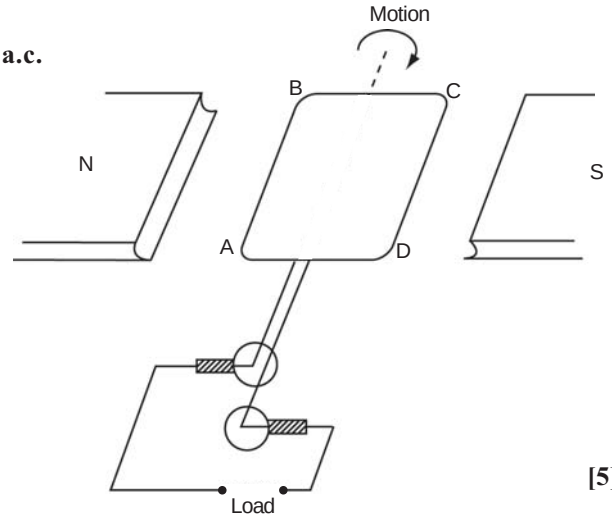
(*i*) What is the role of slip rings shown in this diagram ?

(*ii*) What is the direction of current in wires AB and CD ?

(*iii*) Which law or rule helped you to answer part (*ii*) ?

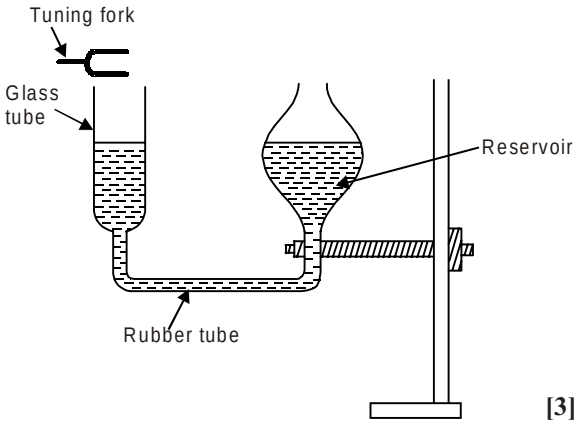
(*iv*) Why are the pole pieces of magnet circular ?

(*v*) Draw a graph of the e.m.f. induced in the coil with respect to time.



[5]

(*b*) A vibrating tuning fork is held above the open end of a glass tube as shown in the figure. The length of the air column in the glass tube can be adjusted by raising or lowering the reservoir. Explain why a loud sound is heard at a particular position of the reservoir ?



[3]

(*c*) Explain why a red flower appears black when it is seen in green light ? **[2]**

Answer

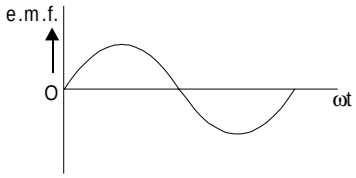
(*a*) (*i*) The role of the slip rings and brushes to take out the induced current in the armature and make it flow through the load.

(*ii*) The direction of current in the wires AB and CD is from A to B and from C to D respectively.

(*iii*) The direction of induced current is found by applying Fleming's right hand rule.

(*iv*) The pole pieces are made cancave to increase the strength of the magnetic field.

(*v*) The variation of e.m.f. *w.r.t.* time is as shown in the fig.



(*b*) The length of the air column can be adjusted. For a certain length of the air column, the frequency of the vibration of the air column becomes equal to the frequency of the tuning fork. In this position resonance takes place and the intensity of sound becomes maximum.

(*c*) A red flower appears black when it is seen in green light. This is so because red flower absorbs green light.

Question 9.

(*a*) State Lenz's law of electromagnetic induction. [2]

(*b*) Why are the burns caused by steam at 100°C more severe than those caused by water at 100°C ? [2]

(*c*) A man stands at a distance of 25 m from a high wall. He hears the echo of the high wall produced by blowing a whistle. If the velocity of sound in air is 330 m/s, what would be the time interval between the sound produced by the whistle and the hearing of the echo ? [3]

(*d*) Draw two wiring diagrams of a dual control (staircase) switch, both the diagrams showing the combination turned 'ON'. [3]

Answer

(*a*) Lenz's law of electromagnetic induction states that the direction of the induced current is such that its magnetic effect opposes the cause which produced it.

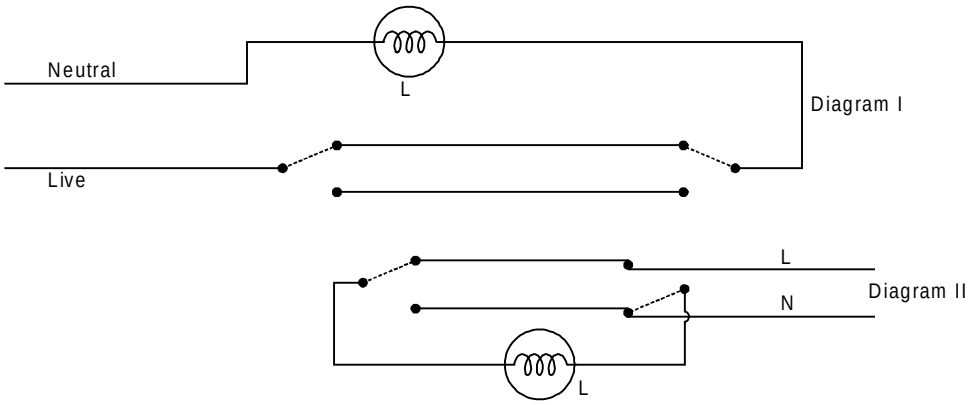
(*b*) Burns caused by steam at 100°C are more severe than water at 100°C because steam at 100°C contains much more heat than water at 100°C.

(*c*) Distance covered by the sound when the echo is heard due to reflection of sound from the wall

$$= 25 + 25 = 50 \text{ m}$$

$\therefore$ time taken by sound to cover this distance, $t = \dfrac{\text{distance}}{\text{velocity}} = \dfrac{50}{330} = \dfrac{5}{33} = 0{\cdot}15\,\text{s}$

(*d*) The circuit diagrams of a dual control (staircase) switch are shown in the fig.



Question 10.

(*a*) Draw a neat labelled diagram of 'Cathode Ray Tube'. **[4]**

(*b*) What is carbon dating ? **[2]**

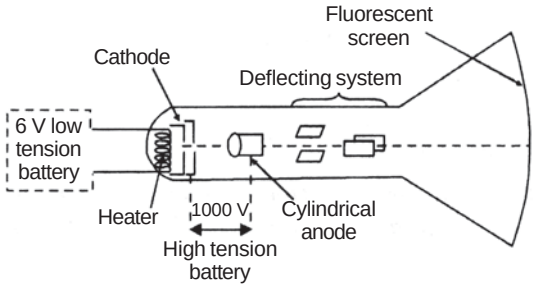
(*c*) Where does nuclear fusion occur in nature ? Why is it difficult to produce it in a laboratory ? **[2]**

(*d*) State one use of radioactivity in

(*i*) Medicine (*ii*) Agriculture. **[2]**

Answer

(*a*) A labelled diagram of a cathode ray tube is as shown in the fig.



(*b*) Carbon dating is the technique of finding the age of a fossil by studying its radioactivity. In this method we find the ratio of C^{14} and C^{12} in a given sample and from there estimate the age of the fossil.

(*c*) The nuclear fusion in nature is taking place at the sun where hydrogen is fusing into helium resulting in the emission of large amount of energy. It is difficult to produce fusion in the laboratory because it is not possibe to produce very high temperature (10^7 K) needed to produce fusion.

(*d*) (*i*) Tumor and cancer are treated by high energy γ-rays from Co^{60}. It is also used as a diagonistic tool using tracer technique.

(*ii*) Radio-isotopes are used to develop new and improved varieties of plants by mutation.

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