ICSE Paper 2005

PHYSICS

Section–I (40 marks)

***Compulsory :** (Attempt **all** questions from this Section)*

Question 1.

(a) *Which physical quantity does the electron volt measure? How is it related to the S.I. unit of this quantity?* [2]

(b) *What should the angle between force and displacement be to get the:*
(i) *minimum work.* (ii) *Maximum work?* [2]

(c) *State Newton's second law of motion.*** [2]

(d) *The work done by the heart is 1 joule per beat. Calculate the power of the heart, if it beats 72 times in one minute.* [2]

(e) *Mention two properties of a wave: one property which varies and the other which remains constant when the wave passes from one medium to another.* [2]

Answer.

(a) Energy is measure in electron volt.

$$1 \text{ eV} = 1{\cdot}6 \times 10^{-19} \text{ Joule.}$$

(b) The angle between force and displacement for :
(i) minimum work—Angle should be 90°.
(ii) maximum work—Angle should be 0°.

(d) The work done in 1 beat = 1 joule
Therefore in 72 beats = 72 joule

$$\text{Power} = \frac{\text{Workdone}}{\text{Time}}$$

$$= \frac{72 \text{ joule}}{60 \text{ sec.}} = \frac{6}{5}$$

$$= 1{\cdot}2 \text{ Watt}$$ **Ans.**

(e) When a wave passes from one medium to another :
(i) Wavelength or velocity varies (changes).
(ii) Frequency remains constant.

Question 2.

(a) *Explain briefly what causes the twinkling of stars at night.* [2]

(b) *State two advantages of an aneroid barometer.*** [2]

(c) *Explain why a gas bubble released at the bottom of a lake grows in size as it rises to the surface of the lake.*** [2]

(d) *What is meant by the statement, 'the critical angle for diamond is 24°' ? How is the critical angle of a material related to its refractive index ?* [2]

(e) *A block of wood of volume 25 cm^3 floats in water with 20 cm^3 of its volume immersed. Calculate :*** (i) *The density and* (ii) *The weight of the block of wood.* [2]

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

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Answer.

(a) The phenomenon of the change in direction of a ray of light, in going from one medium to another is called refraction.

Twinkling of stars due to refraction of light by the atmosphere.

(d) It means that a ray of light is incident on a diamond air interface at an angle more than 24°, it would be totally internally reflected back.

The relation between critical angle and refractive index is

$$\mu = \frac{1}{\sin i_c}$$

Question 3.

(a) *Name any two electromagnetic waves which have a frequency higher than that of violet light. State one use of each.* [2]

(b) *State two ways by which the frequency of transverse vibrations of a stretched string can be decreased.* [2]

(c) *Why does the temperature of the surroundings start falling when the ice of a frozen lake start melting ?* [2]

(d) *Four resistances of 2.0Ω each are joined end to end, to form a square ABCD. Calculate the equivalent resistance of the combination between any two adjacent corners.* [2]

(e) *In a three-pin plug, why is the earth pin made longer and thicker than the other two pins ?* [2]

Answer.

(a) The frequency of X-rays and gama-rays is higher than violet light.

X-rays are used in X-ray crystallography.

Gamma rays are used in radiotherapy.

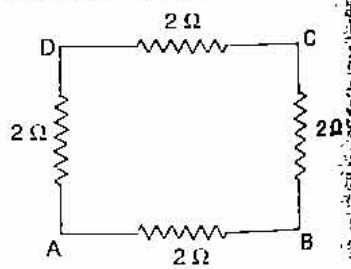
(b) The frequency of transverse vibration can be decreased by :

(i) Increasing the length (T and m keeping constant)

(ii) Decreasing the tension (l and m keeping constant)

(c) When ice converts into water it needs 80 cal. heat per gram. Therefore, when frozen lake starts melting it withdraw a large amount of heat from the surrounding. Therefore temperature of surroun-ding starts falling.

(d) Equivalent resistance between A and B :



$$\frac{1}{R} = \frac{1}{R_{AB}} + \frac{1}{R_{BC} + R_{CD} + R_{AD}}$$

$$\frac{1}{R} = \frac{1}{2} + \frac{1}{2+2+2} = \frac{1}{2} + \frac{1}{6}$$

$$\frac{1}{R} = \frac{3+1}{6} = \frac{4}{6}$$

$$R = \frac{6}{4} = 1{\cdot}5\ \Omega \text{ (ohm)}.$$ Ans.

(e) The earth pin is made longer and thicker because :

(i) To make save that the body of appliance can a good contact with the earth.

(ii) To avoid the chance of confusion between earth pin and other two pins.

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Question 4.

(a) *State the energy change which takes place when a magnet is moved inside a coil having a galvanometer at its ends. Name this phenomenon.* **[2]**

(b) *Draw a labelled diagram of an A.C. generator.* **[2]**

(c) *Calculate the heat energy that will be released when 5.0 kg of steam at 100°C condenses to form water at 100°C. Express your answer in S.I. unit. (Specific latent heat of vaporization of steam is 2268 kJ/kg.)* **[2]**

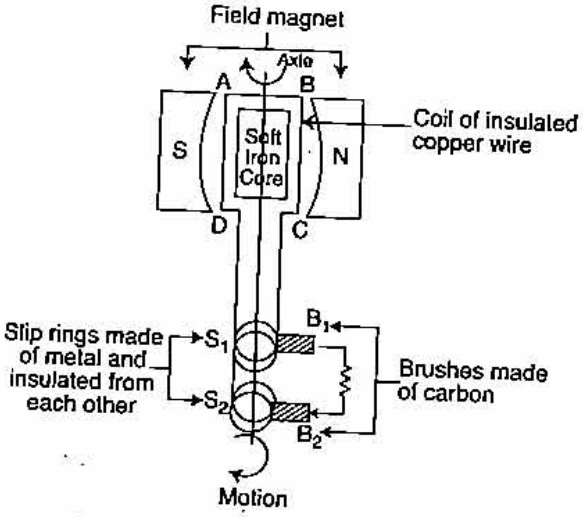
(d) *How many alpha and beta particles are emitted when Uranium nucleus* $^{238}_{92}U$ *decays to Lead* $^{206}_{82}Pb$ *?* **[2]**

(e) *With the help of an equation, state the mechanism of energy production in a nuclear fusion reaction.*** **[2]**

Answer.

(a) When a magnet is moved inside a coil (galvanometer at its ends), mechanical energy converts into electrical energy.
The phenomenon is known as electromagnetic induction.

(b)



(c) *Given* : $m = 5$ kg, specific latent heat of steam = 2268 kJ/kg.
We know that,

$$Q = mL$$
$$= 5 \times 2268 = 11340 \text{ kJ}$$
$$= 11{\cdot}34 \times 10^6 \text{ joule.}$$

Ans.

(d)

$$_{92}U^{238} \longrightarrow {}_{82}Pb^{206}$$

Change in mass no. = $238 - 206 = 32$

Change in Atomic no. = $92 - 82 = 10$

To decrease in mass by 32 units 8 α-particle should be emitted

To decrease in Atomic no. 8 α-particle reduced the Atomic no. $8 \times 2 = 16$ unit.

But atomic no. is reduced by 10.

∴ 6-Beta particle should be emitted.

$$-16 + 6 = -10$$

No. of α-particle = 8

No. of β-particle = 6

Ans.

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

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(iii) *If a ray of light passes from medium I to medium II without any change of direction, what can be said about the refractive indices of these media (angle i is not 0) ?* [4]

Answer.

(a) (i) The magnification is 1.

(ii) The image real, inverted and of the same sized as the object.

(iii) The distance between the object and the optical centre of the lens equal to the **focal length of the lense.**

(b) (i) (1) No, the letter of each colour has different (slightly) height.

(2) The letter V (violet) is raised more.

Because 'μ' is maximum for violet colour, therefore, it raised more.

(ii) The colour of an object is green.

(c) (i) When a ray of light passes from one medium to the other medium, it changes its path. This phenomenon is called Refraction of light. In passing from a rarer to a denser medium, it bends towards the normal, while in passing from a denser to a rarer medium, it bends away from the normal.

(ii) (1) Refractive Index $({}_1\mu_2) = \frac{\text{Velocity of light in first medium}}{\text{Velocity of light in second medium}}$

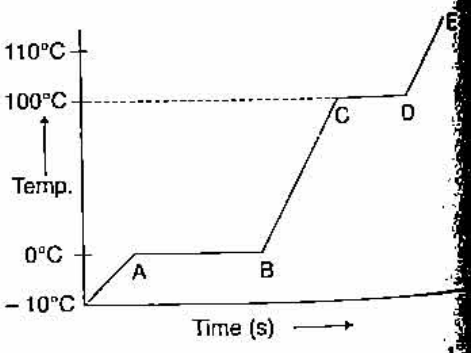
(2) Refractive index $({}_1\mu_2) = \frac{\sin i}{\sin r}$

(iii) If light ray is passing through another medium without changing its path even when, i is not 0, the refractive index of two medium must be equal.

Question 8.

(a) *A radar is able to detect the reflected waves from an enemy aeroplane, after a time interval of 0.02 milliseconds. If the velocity of the waves is 3×10^8 ms^{-1}, calculate the distance of the plane from the radar.* [3]

(b) *A piece of ice is heated at a constant rate. The variation of temperature with heat input is shown in the graph below :*



(i) *What are represented by AB and CD ?*

(ii) *What conclusion can you draw regarding the nature of ice from the above graph ?* [3]

(c) *If there is no heat loss to the surroundings, the heat released by the condensation of m_1 g of steam at 100°C into water at 100°C can be used to convert m_2 g of ice at 0°C into water at 0°C.*

(i) *Find :*

(1) *The heat lost by steam in terms of m_1.*

(2) *The heat gained by ice in terms of m_2.*

(ii) *Form a heat equation to find the ratio of $m_2 : m_1$.*

(Specific latent heat of vaporization of steam = 2268 kJ/kg;

Specific latent heat of fusion of ice = 336 kJ/kg.

Specific heat capacity of water = 4200 J/kg°C.

Answer.

(a) Let x be the distance of plane from the Radar then

$$x + x = 2x = \text{velocity} \times \text{time}$$
$$2x = 3 \times 10^8 \times \cdot 02 \times 10^{-3}$$
$$= 6 \times 10^3 \text{ m} = 6 \text{ km}. \quad \textbf{Ans.}$$

(b) (i) AB $\longrightarrow$ represents the time interval in which ice changes into water at 0°C.

CD $\longrightarrow$ represents the time interval in which water converts into vapour at 100°C.

(ii) The initial temperature of ice is –10°C, it can possible only by addition of some salt or under high pressure.

(c) (i) (1) The heat lost by the steam = $m_1 L_s$
(L_s = Specific latent heat of steam)

(2) Heat gained by the ice = $m_2 L_i$
(L_i = Specific latent heat of ice)

(ii) Heat given by steam = Heat taken by ice

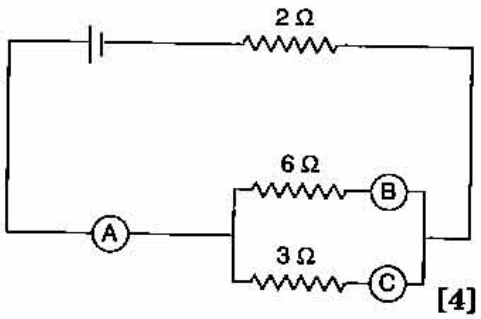
$$m_1 L_s = m_2 L_i$$
$$\frac{m_2}{m_1} = \frac{L_s}{L_i} = \frac{2268}{336} = \frac{27}{4}$$
$$m_2 : m_1 = 27 : 4 \quad \textbf{Ans.}$$

Question 9.

(a) *An electrical appliance is rated 1500 W, 250 V. This appliance is connected to 250 V mains.*
Calculate :
(i) *the current drawn,*
(ii) *the electrical energy consumed in 60 hours,*
(iii) *the cost of electrical energy consumed at Rs. 2·50 per kWh.* **[3]**

(b) (i) *State the function of a split ring in a D.C. motor.*
(ii) *Mention two reasons why a soft iron core is used within the coil of a moving coil galvanometer.* **[3]**

(c) *In the figure given alongside, A, B and C are three ammeters. The ammeter B reads 0·5A. (All the ammeters have negligible resistance)*
Calculate :
(i) *The readings in the ammeters A and C.*
(ii) *The total resistance of the circuit.* **[4]**



Answer.

(a) (i) The current drawn

$$i = \frac{P}{V} = \frac{1500}{250} = 6A \quad \textbf{Ans.}$$

(ii) Electrical energy consume in 60 hours

$$W = P \times t = 1500 \times 60 = 90 \text{ kWh}$$

or

$$= 1500 \times 60 \times 60 \times 60$$
$$= 3240 \times 10^5 \text{ joule}. \quad \textbf{Ans.}$$

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(iii) $\text{Cost} = 90 \times 2{\cdot}50$

$= \text{Rs. } 225.$

Ans.

(b) (i) The function of split rings in d.c. motor to flow the current in armature coil in such a way that it always keep on rotating in the same manner.

(ii) Soft iron core is used in moving coil galvanometer, because

(a) To make the field 'radial'.

(b) To concentrate the magnetic lines of force.

(c) (i) $\dfrac{\text{Ammeter 'C' Reading}}{\text{Ammeter 'B' Reading}} = \dfrac{6}{3} = 2$

$\text{Reading of 'C'} = 2 \times {\cdot}5$

$= 1{\cdot}0\ \text{A}$

$\text{Reading of 'A'} = (1{\cdot}0 + 0{\cdot}5)$

$= 1{\cdot}5\ \text{A}$

(ii) The total resistance of the circuit

$R = 2 + \text{Resistance conneted in parallel}$

$$\frac{1}{R} = \left(\frac{1}{3} + \frac{1}{6}\right) = \left(\frac{2+1}{6}\right) = \frac{3}{6} \Rightarrow R = 2\Omega$$

$R = 2 + 2$

$= 4\Omega.$

Ans.

Question 10.

(a) *State the functions of the following in a nuclear reactor :* **

(i) *Moderator,*

(ii) *Control rods,*

(iii) *Coolant.*

[3]

(b) (i) *Mention two important precautions that should be taken while handling radioactive materials.*

(ii) *State one use of radio-isotopes.*

[3]

(c) (i) *Draw a labelled diagram of a hot cathode ray tube.*

(ii) *Why are materials of low work function preferred as thermionic cathode materials ?*

(iii) *Write an equation to show the fission of a nucleus of U^{235} with the production of three neutrons.* **

[4]

Answer.

(b) (i) While using radioactive material it is essential that

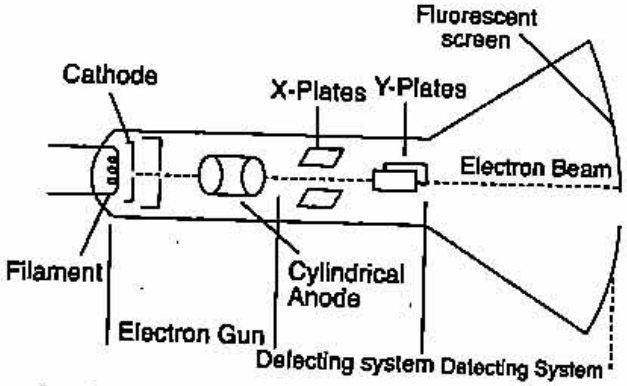
(1) put them in a thick lead box.

(2) wear special protective (led coated) clothes and gloves on the hand.

(ii) Radioisotopes are used in medical diagnosis and in radiotheraphy.

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

(c) (i) Please see given below figure.



(ii) To get more electron at relatively low temperature, we use the material of low work function.

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