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ICSE Paper 2013

PHYSICS

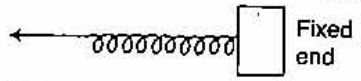
SECTION–I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1.

(a) *Give any two effects of a force on a non-rigid body.* **[2]**

(b) *One end of a spring is kept fixed while the other end is stretched by a force as shown in the diagram.*



(i) *Copy the diagram and mark on it the direction of the restoring force.*

(ii) *Name one instrument which works on the above principle.* **[2]**

(c) (i) *Where is the centre of gravity of a uniform ring situated ?*

(ii) *"The position of the centre of gravity of a body remains unchanged even when the body is deformed." State whether the statement is **true** or **false**.*

[2]

(d) *A force is applied on a body of mass 20 kg moving with a velocity of 40 ms^{-1}. The body attains a velocity of 50 ms^{-1} in 2 seconds. Calculate the work done by the body.* **[2]**

(e) *A type of single pulley is very often used as a machine even though it does not give any gain in mechanical advantage.*

(i) *Name the type of pulley used.*

(ii) *For what purpose is such a pulley used ?* **[2]**

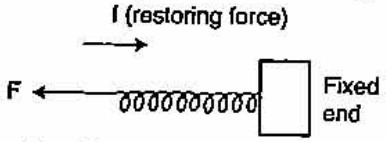
Answer :

(a) Two main effects :

(i) It can change the state of rest or of motion of the body.

(ii) It can change the size or shape of the body.

(b) (i)



(ii) Spring Balance.

(c) (i) At the centre of the ring

(ii) False

(d)

$$\text{Force} = m\frac{(v-u)}{t} = m.a.$$

$$\text{Displacement} = \frac{(v^2-u^2)}{2a}$$

$$\text{Work done} = \text{Force} \times \text{Displacement}$$

$$= m.a.\frac{(v^2-u^2)}{2a}$$

$$W = \frac{1}{2}m\,(v^2-u^2)$$

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$$W = \frac{1}{2} \times 20 \times (2500 - 1600)$$

$$= \frac{1}{2} \times 20 \times 900$$

$$= 9000 \text{ Joule.}$$ **Ans.**

(e) (i) Single fixed pulley.

(ii) Single fixed pulley is used only to change the direction of the force applied.

Question 2.

(a) (i) *In what way does an 'Ideal machine' differ from a 'Practical machine' ?*

(ii) *Can a simple machine act as a force multiplier and a speed multiplier at the same time ?* **[2]**

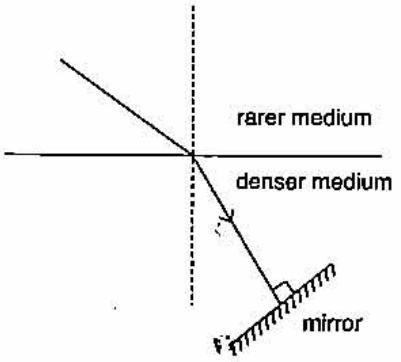
(b) *A girl of mass 35 kg climbs up from the first floor of a building at a height 4m above the ground to the third floor at a height 12m above the ground. What will be the increase in her gravitational potential energy ? ($g = 10\ ms^{-2}$).* **[2]**

(c) *Which class of lever found in the human body is being used by a boy :*

(i) *When he holds a load on the palm of his hand.*

(ii) *When he raises the weight of his body on his toes ?* **[2]**

(d) *A ray of light is moving from a rarer medium to a denser medium and strikes a plane mirror placed at 90° to the direction of the ray as shown in the diagram.*



(i) *Copy the diagram and mark arrows to show the path of the ray of light after it is reflected from the mirror.*

(ii) *Name the principle you have used to mark the arrow to show the direction of the ray.* **[2]**

(e) (i) *The refractive index of glass with respect to air is 1.5. What is the value of the refractive index of air with respect to glass ?*

(ii) *A ray of light is incident as a normal ray on the surface of separation of two different mediums. What is the value of the angle of incidence in this case ?* **[2]**

Answer :

(a) (i) The efficiency of an ideal machine (free from friction etc) is equal to 1. But in actual practical, the efficiency is less than 1 due to the energy loss in friction.

(ii) Yes, a simple machine act as a force multiplier and a speed multiplier at the same time.

(b) Gravitational potential energy at

$$\text{Ist floor} = mgh_1$$

$$= 35 \times 10 \times 4$$

$$= 1400 \text{ J}$$

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Potential energy at third floor $= mgh_2$

$= 35 \times 10 \times 12$

$= 4200\ J$

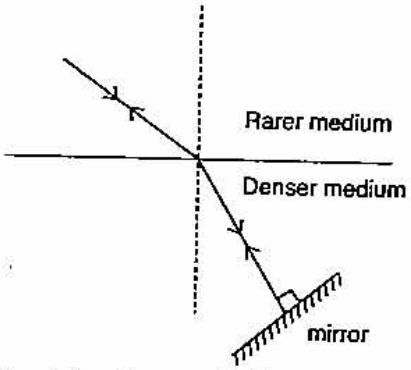
Increase in potential energy $= 4200 - 1400$

$= 2800$ Joule. **Ans.**

(c) (i) Class III lever

(ii) Class II lever.

(d) (i)



(ii) Principle of reversibility

(e) (i) Refractive index of glass w.r. to air $= \dfrac{1}{\text{Refractive index of air w.r. to glass}}$

$$_g\mu_a = \frac{1}{_a\mu_g} = \frac{1}{1{\cdot}5} = \frac{10}{15}$$

$$_g\mu_a = \frac{2}{3}$$ **Ans.**

(ii) Angle of incidence = 0°.

Question 3.

(a) *A bucket kept under a running tap is getting filled with water. A person sitting at a distance is able to get an idea when the bucket is about to be filled.*

(i) *What change takes place in the sound to give this idea ?*

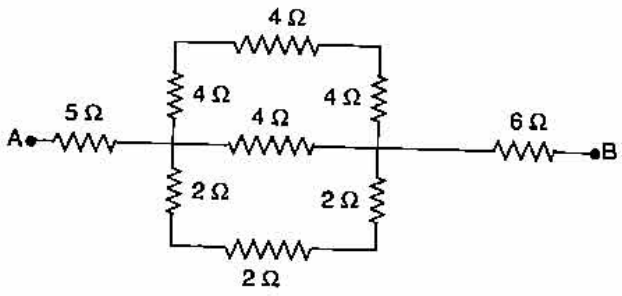
(ii) *What causes the change in the sound ?* **[2]**

(b) *A sound made on the surface of a lake takes 3s to reach a boatman. How much time will it take to reach a diver inside the water at the same depth ?*

Velocity of sound in air = 330 ms^{-1}.

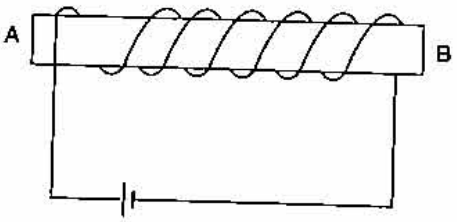
Velocity of sound in water = 1450 ms^{-1}. **[2]**

(c) *Calculate the equivalent resistance between the points A and B for the following combination of resistors :* **[2]**



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(d) *You have been provided with a solenoid AB.*



(i) *What is the polarity at end A ?*

(ii) *Give one advantage of an electromagnet over a permanent magnet.* **[2]**

(e) (i) *Name the device used to protect the electric circuits from overloading and short circuits.*

(ii) *On what effect of electricity does the above device work ?* **[2]**

Answer :

(a) (i) The frequency of sound appear to be increase.

(ii) Because air column is decreased on the filling the water in bucket.

(b)

$$\text{depth of lake} = v \times t$$
$$= 330 \times 3$$
$$= 990 \text{ m}$$
$$\text{depth of diver} = 2 \times 990$$
$$= 1980 \text{ m}$$
$$\text{Time taken by sound in water} = \frac{990}{1450}$$
$$= 0{\cdot}68 \text{ sec.}$$
$$\text{Total time} = 3 + 0{\cdot}86$$
$$= 3{\cdot}68 \text{ second.}$$

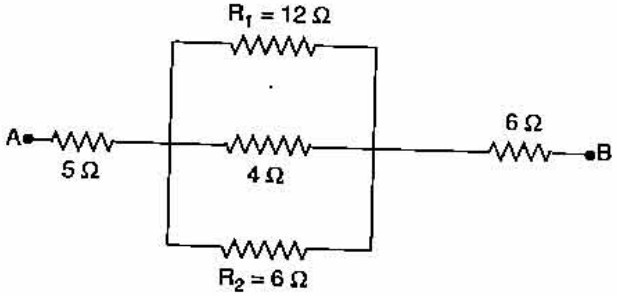
Ans.

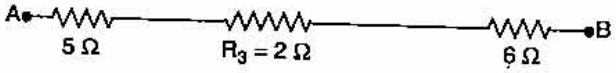
(c) $R_1 = 4 + 4 + 4 = 12\ \Omega.$

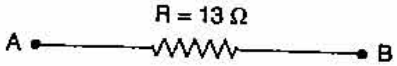
$R_2 = 2 + 2 + 2 = 6\ \Omega$

$$\frac{1}{R_3} = \frac{1}{12} + \frac{1}{4} + \frac{1}{6}$$
$$= \frac{1 + 3 + 2}{12}$$
$$= \frac{6}{12} = \frac{1}{2}$$

$R_3 = 2\Omega$







Resistance between A and B, $R = 5 + 2 + 6$

$= 13\Omega$

Hence, Equivalent resistance between A and B = 13Ω **Ans.**

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(d) (i) North polarity

(ii) The magnetic field strength can be change in electromagnete. But not in parmanent magnete.

(e) (i) Electric fuse

(ii) Heating effect of electrical current.

Question 4.

(a) *Define the term 'Heat capacity' and state its S.I. unit.* **[2]**

(b) *What is meant by Global warming ?* **[2]**

(c) *How much heat energy is released when 5g of water at 20°C changes to ice at 0°C ?*

[Specific heat capacity of water = 4.2 J $g^{-1}°C^{-1}$.

Specific latent heat of fusion of ice = 336 J g^{-1}] **[2]**

(d) *Which of the radioactive radiations :*

(i) *Can cause severe genetical disorders.*

(ii) *Are deflected by an electric field ?* **[2]**

(e) *A radioactive nucleus undergoes a series of decays according to the sequence*

$$X \xrightarrow{\beta} X_1 \xrightarrow{\alpha} X_2 \xrightarrow{\alpha} X_3.$$

If the mass number and atomic number of X_3 are 172 and 69 respectively, what is the mass number and atomic number of X ? **[2]**

Answer :

(a) **Heat Capacity :** The amount of heat required to increase 1 °C temperature of whole body is called heat capacity.

SI unit of heat capacity = Joule/Kg

(b) **Global Warming :** An increase in the average effective temperature of earth's surface due to an increase in the amount of green house gases in its atmosphere is called **Global Warming.**

(c) Heat energy $= mc\,\Delta T + mL$

$= 5 \times 4{\cdot}2 \times 20 + 5 \times 336 = 420 + 1680$

$= 2100$ Joule. **Ans.**

(d) (i) Gamma radiations

(ii) α and β radiations.

(e) $_{72}X^{180} \xrightarrow{\beta} {}_{73}X_1^{180} \xrightarrow{\alpha} {}_{71}X_2^{176} \xrightarrow{\alpha} {}_{69}X_3^{172}$

Mass number of X = 180

Atomic number of X = 72

SECTION–II (40 Marks)

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

Question 5.

(a) (i) *With reference to their direction of action, how does a centripetal force differ from a centrifugal force ?*

(ii) *State the Principle of conservation of energy.*

(iii) *Name the form of energy which a body may possess even when it is not in motion.* **[3]**

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(b) *A coolie is pushing a box weighing 1500 N up an inclined plane 7.5m long on to a platform, 2.5m above the ground.*

(i) *Calculate the mechanical advantage of the inclined plane.*

(ii) *Calculate the effort applied by the coolie.*

(iii) *In actual practice, the coolie needs to apply more effort than what is calculated. Give one reason why you think the coolie needs to apply more effort.* **[3]**

(c) *A block and tackle system of pulleys has a velocity ratio 4.*

(i) *Draw a labelled diagram of the system indicating clearly the points of application and directions of load and effort.*

(ii) *What is the value of the mechanical advantage of the given pulley system if it is an ideal pulley system ?* **[4]**

Answer :

(a) (i) Centripetal force directed towards the centre of circle while centrifugal force is opposite to centripetal force.

(ii) **Principle of Conservation of Energy :** Energy can neither be created nor destroyed. It convert from one form to otherform.

(iii) Potential energy.

(b) (i) *Given* : l = 7·5 m, h = 2·5 m.

$$\text{M.A.} = \frac{l}{h} = \frac{7{\cdot}5}{2{\cdot}5} = 3$$

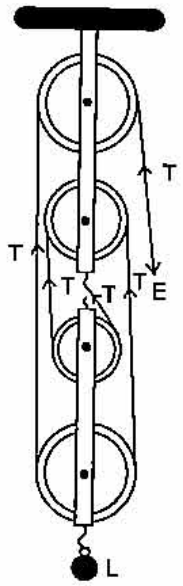
(ii)
$$\text{M.A.} = \frac{\text{Load}}{\text{Effort}}$$

$$\text{Effort} = \frac{\text{Load}}{\text{M.A.}} = \frac{1500}{3}$$

$$\text{Effort} = 500 \text{ N.}$$ **Ans.**

(iii) In actual practice, due to some friction between the plane and the bottom face of the body which is pulled over it, the effort needed is certainly more than L sin θ, so the mechanical advantage is always less than l/h, hence, efficiency is less than 1.

(c) (i)



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(ii) *Given* : V.R. = 4, Load = 4T, Effort = T

$$\text{M.A.} = \frac{\text{Load}}{\text{Effort}}$$

$$= \frac{4T}{T}$$

$$= 4$$ **Ans.**

Question 6.

(a) *Name the radiations :*

(i) *That are used for photography at night.*

(ii) *Used for detection of fracture in bones.*

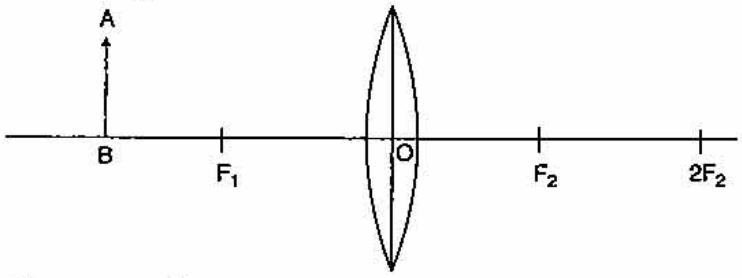
(iii) *Whose wavelength range is from 100 Å to 4000 Å (or 10 nm to 400 nm).*

[3]

(b) (i) *Can the absolute refractive index of a medium be less than one ?*

(ii) *A coin placed at the bottom of a beaker appears to be raised by 4.0 cm. If the refractive index of water is 4/3, find the depth of the water in the beaker.* **[3]**

(c) *An object AB is placed between $2F_1$ and F_1 on the principal axis of a convex lens as shown in the diagram :*



Copy the diagram and using three rays starting from point A, obtain the image of the object formed by the lens. **[4]**

Answer.

(a) (i) Infrared radiations

(ii) X-rays.

(iii) Ultraviolet rays

(b) (i) Absolute refractive index can not be less than 1.

(ii) *Given* : Shift = 4 cm, $\mu = \frac{4}{3}$, Real depth = ?

We know that

$$\text{Shift} = \text{Real depth}\left(1 - \frac{1}{{}_a\mu_m}\right)$$

$$4 = \text{Real depth}\left(1 - \frac{3}{4}\right)$$

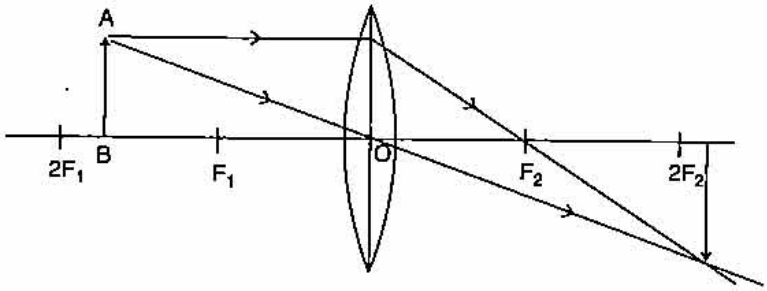
$$4 = \text{Real depth} \times \frac{1}{4}$$

$$\text{Real depth} = \frac{4 \times 4}{1}$$

$$= 16 \text{ cm.}$$ **Ans.**

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(c)



Question 7.

(a) (i) *What is the principle on which SONAR is based ?*

(ii) *An observer stands at a certain distance away from a cliff and produces a loud sound. He hears the echo of the sound after 1.8s. Calculate the distance between the cliff and the observer if the velocity of sound in air is 340 ms^{-1}.* **[3]**

(b) *A vibrating tuning fork is placed over the mouth of a burette filled with water. The tap of the burette is opened and the water level gradually starts falling. It is found that the sound from the tuning fork becomes very loud for a particular length of the water column.*

(i) *Name the phenomenon taking place when this happens.*

(ii) *Why does the sound become very loud for this length of the water column ?* **[3]**

(c) (i) *What is meant by the terms (1) amplitude (2) frequency, of a wave ?*

(ii) *Explain why stringed musical instruments, like the guitar, are provided with a hollow box.* **[4]**

Answer :

(a) (i) Principle of SONAR is based on echo.

(ii) *Given* : $v = 340$ m/s, $t = 1{\cdot}8s$

$$\text{Distance travelled by sound} = 2d$$

$$\text{Distance} = \text{speed} \times \text{time}$$

$$2d = v \times t$$

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

$$= \frac{340 \times 1{\cdot}8}{2} = 170 \times 1{\cdot}8$$

$$= 306 \text{ m.}$$ **Ans.**

(b) (i) Resonance.

(ii) This happens when the frequency of the air column becomes equal to the frequency of the tuning fork.

(c) (i) **Amplitude :** The maximum displacement on either side of the mean position of the vibrating particle is called amplitude.

Frequency : The no. of vibration of particle performed by the wave in one second is called frequency of the wave.

(ii) Musical instruments like guitar are provided with a hollow box so that when the strings are set into vibration, forced vibrations are produced in box. Since the box has a large area, it sets a large volume of air into vibration which produces a loud sound of same frequency as that of the string.

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Question 8.

(a) (i) *It is observed that the temperature of the surroundings starts falling when the ice in a frozen lake starts melting. Give a reason for the observation.*

(ii) *How is the heat capacity of the body related to its specific heat capacity ?*

[3]

(b) (i) *Why does a bottle of soft drink cool faster when surrounded by ice cubes than by ice cold water, both at 0 °C ?*

(ii) *A certain amount of heat Q will warm 1g of material X by 3 °C and 1g of material Y by 4 °C. Which material has a higher specific heat capacity ?*

[3]

(c) *A calorimeter of mass 50g and specific heat capacity 0.42 J g^{-1} $°C^{-1}$ contains some mass of water at 20°C. A metal piece of mass 20g at 100 °C is dropped into the calorimeter. After stirring, the final temperature of the mixture is found to be 22 °C. Find the mass of water used in the calorimeter.*
[specific heat capacity of the metal piece = 0.3 J g^{-1} °C–1
specific heat capacity of water = 4.2 J g^{-1} $°C^{-1}$] **[4]**

Answer :

(a) (i) When ice converts into water it needs a high amount of heat energy required. Therefore when frozen lake starts melting it absorbed a large amount of heat from the surrounding. As a result, the temperature of the surrounding falls and it becomes very cold.

(ii) Heat capacity = mass (m) × specific heat capacity (L)

(b) (i) Because 1gm of ice at 0°C takes 336 J of heat energy from the drink to melt into water at 0°C. Thus drink loses an additional 336J of heat energy for 1g ice at 0°C than for 1 gm ice–cold water at 0°C. Therefore cooling produced by 1g ice at 0°C is more than that by 1gm water at 0°C.

(ii) $$\text{Specific heat} = \frac{Q}{m \cdot \Delta T}$$

$$\therefore \quad \text{Specific heat} \propto \frac{1}{\Delta T}$$

So material X has a higher specific heat capacity.

(c) Heat energy given by metal piece $= m \cdot c \cdot \Delta T_1$
$= 20 \times 0{\cdot}3 \times (100 - 22)$
$= 468$ Joule

Heat energy gained by water $= m_w \times c_w \times \Delta T_2$
$= m_w \times 4{\cdot}2 \times (22 - 20)$
$= m_w \times 8{\cdot}4$ Joule

Heat energy gained by calorimeter $= m_c \times c_c \times \Delta T_2$
$= 50 \times 0{\cdot}42 \times (22 - 20)$
$= 42$ Joule

By principle of calorimetry

Heat lost = Heat gained

Heat energy given by metal = Heat energy gained by water + Heat energy gained by calorimeter

$$468 = m_w \times 8{\cdot}4 + 42$$

$$m_w = \frac{468 - 42}{8{\cdot}4}$$

$= 50{\cdot}7$ gm. **Ans.**

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Question 9.

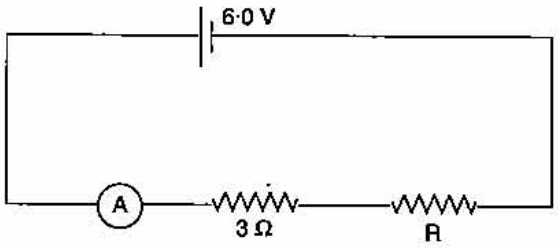
(a) (i) *State Ohm's law.*

(ii) *A metal wire of resistance 6 Ω is stretched so that its length is increased to twice its original length. Calculate its new resistance.* **[3]**

(b) (i) *An electrical gadget can give an electric shock to its user under certain circumstances. Mention any two of these circumstances.*

(ii) *What preventive measure provided in a gadget can protect a person from an electric shock ?* **[3]**

(c) *The figure shows a circuit*



When the circuit is switched on, the ammeter reads 0.5 A.

(i) *Calculate the value of the unknown resistor R.*

(ii) *Calculate the charge passing through the 3Ω resistor in 120 s.*

(iii) *Calculate the power dissipated in the 3 Ω resistor.* **[4]**

Answer :

(a) (i) **Ohm's Law :** The electric current flowing through a conductor wire is directly proportional to voltage difference across the conductor wire if there is no change in physical condition (temperature, length, area of cross section etc.) of wire.

(ii) Volume of metal wire remains same.

$$\therefore \quad A_1 l_1 = A_2 l_2$$

$$\frac{l_2}{l_1} = \frac{A_1}{A_2}$$

$$R_1 = \rho \frac{l_1}{A_1}$$

New resistance, $$R_2 = \rho \frac{l_2}{A_2}$$

$$\frac{R_2}{R_1} = \frac{l_2}{A_2} \times \frac{A_1}{l_1}$$

$$= \frac{l_2}{l_1} \times \frac{l_2}{l_1}$$

$$R_2 = \left(\frac{l_2}{l_1}\right)^2 R_1 \qquad [\because l_2 = 2l_1 \text{ (Given)}]$$

$$= \left(\frac{2l_1}{l_1}\right)^2 R_1$$

$$R_2 = 4R_1$$

$$= 4 \times 6$$

$$= 24\ \Omega$$

Ans.

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(b) (i) (1) An electric shock may be caused either due to poor insulation of wires.
(2) When the electric appliances are touched with wet hands.

(ii) For prevent, the insulation of wires must be of good quality and it should be checked from time to time particularly when they become old, so that no wire is left naked.

(c) (i) Let $\text{Electric current (I)} = \frac{\text{Total voltage diff. (V)}}{\text{Total resistance (R)}}$

$$0{\cdot}5 = \frac{6}{3+R}$$

$$R + 3 = \frac{60}{5}$$

$$R = 12 - 3$$

$$R = 9\Omega$$ **Ans.**

(ii) Let $q = it$

$$= 0{\cdot}5 \times 120$$

$$\text{Charge } q = 60 \text{ coulomb}$$ **Ans.**

(iii) $P = V.I.$

$$= I^2R$$

$$= (0{\cdot}5)^2 \times 3$$

$$= 0{\cdot}25 \times 3$$

$$P = 0{\cdot}75 \text{ watt.}$$ **Ans.**

Question 10.

(a) *Name the three main parts of a Cathode Ray Tube.* **[3]**

(b) (i) *What is meant by Radioactivity ?*

(ii) *What is meant by nuclear waste ?*

(iii) *Suggest one effective way for the safe disposal of nuclear waste.* **[3]**

(c) (i) *Draw a simple labelled diagram of a d.c. electric motor.*

(ii) *What is the function of the split rings in a d.c. motor ?*

(iii) *State one advantage of a.c. over d.c.* **[4]**

Answer :

(a) (i) Electron gun

(ii) Deflecting system

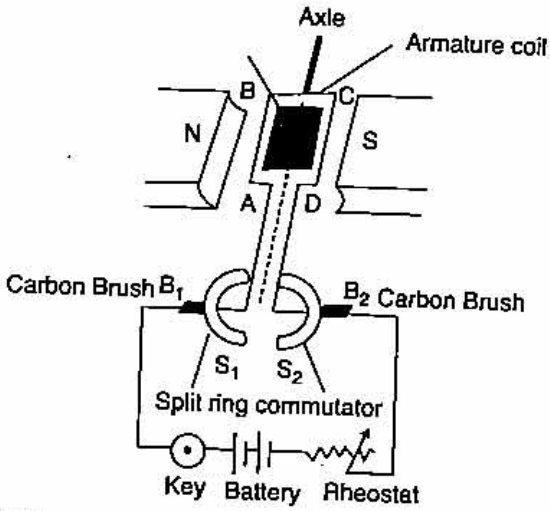
(iii) Fluorescent screen

(b) (i) **Radioactivity :** It is a nuclear phenomenon. It is the process of spontaneous emission of α or β and γ radiations from the nuclei of atoms during their decay.

(ii) **Nuclear Waste :** The radioactive material after its use is known as nuclear waste.

(iii) The nuclear waste obtained from laboratories, hospitals etc. must be first kept in thick casks and then they must be buried in the specially constructed deep underground stores.

(c) (i)



(ii) When the coil rotates, the split parts of ring rotate with it to flow the current in armature coil in such a way that it always keep on rotating in the same manner.

(iii) D.C. can store in battery but A.C. can not be.

●●

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