ICSE PAPER – 2013
Class X
PHYSICS

Time: 1½hrs. **Maximum Marks: 80**

General Instruction

1. Answer to this Paper must be written on the paper provided separately.
2. You will **not** be allowed to write during the first **15** minutes. This time is to be spent in
3. reading the Question Paper.
4. The time given at the head of this Paper is the time allowed for writing the answers.
5. **Section I** is compulsory. Attempt **any four** questions from **Section II**.
6. The intended marks for questions or parts of questions are given in brackets [ ].

Section - I

Question 1 **[10]**

(a) Given any two effects of a force on a non-rigid body.

(b) One end of a spring is kept fixed while the order 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.

(c)

(i) Where is the centre of gravity of 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.**

(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.

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

(i) Name the type of pulley used.

(ii) For what purpose is such a pulley used?

Question 2 **[10]**

(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?

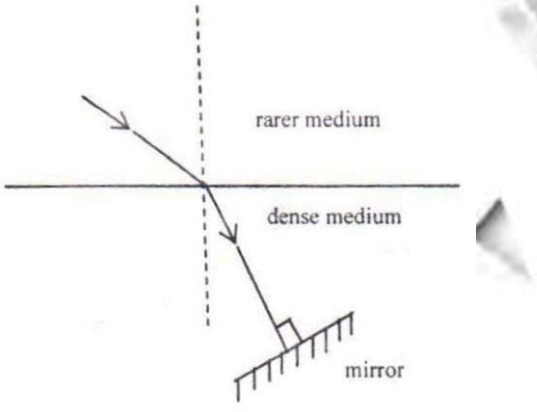
(b) A girl of mass 35 kg climbs up from the first floor of a building at a height 4 m above the ground to the third floor at a height 12 m above the ground. What will be increase in her gravitational potential energy? ($g = 10\ ms^{-2}$).

(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?

(d) A ray of light is moving from a rarer medium to denser medium and strikes a plane mirror placed at 90^o 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 arrows to show the direction of the ray.

(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?

Question 3 **[10]**

(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?

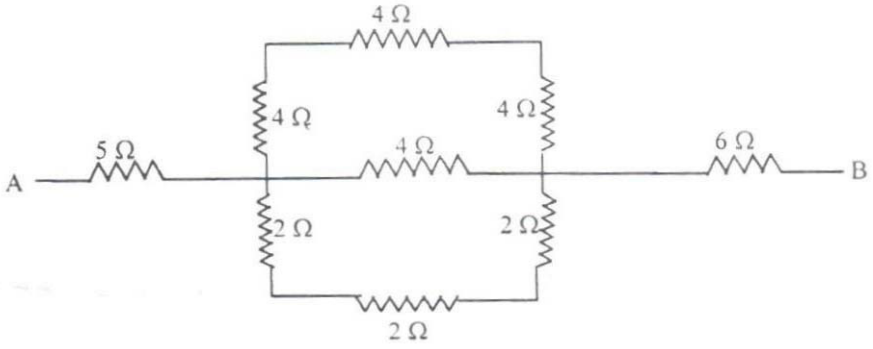
(ii) What causes the change in the sound?

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

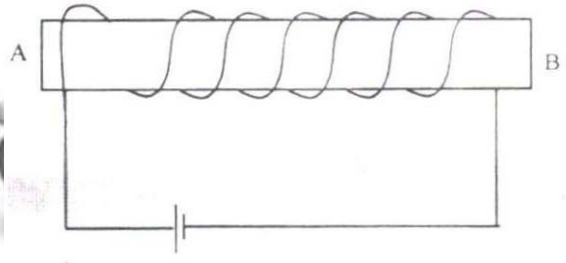
Velocity of sound in air = 330 ms^{-1}

Velocity of sound in water = 1450 mx^{-1}

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



(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.

(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?

Question 4 **[10]**

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

(b) What is meant by Global warming?

(c) How much heat energy is released when 5 g of water at 20 ^{o}C changes to ice at 0 ^{o}C?
[Specific heat capacity of water = 4.2 J g^{-1} $^{o}C^{-1}$
Specific latent heat of fusion of ice = 336 J g^{-1}]

(d) Which of the radioactive radiations-
(i) can cause severe genetical disorders.
(ii) are deflected by an electric field?

(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?

Section - II

Question 5 **[10]**

(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.

(b) A coolie is pushing a box weighing 1500 N up an inclined plane 7.5 m long on to a platform, 2.5 m above the ground.
(i) Calculate the mechanical advantage of the inclined plane.
(ii) Calculate the effort applied by the collie.
(iii) In a actual practice, the collie needs to apply more effort than what is calculated. Give one reason why you think the coolie needs to apply more effort.

(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 is an ideal pulley system?

Question 6 **[10]**

(a) Name the radiations:

(i) That are used for photography at night.

(ii) Used for detection of fracture in bones.

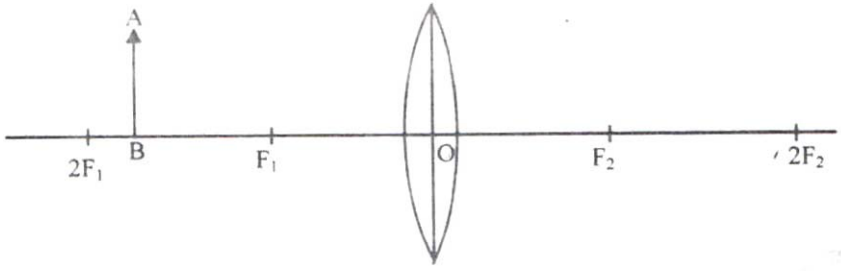
(iii) Whose wavelength range is from 100 $\overset{o}{A}$ to 4000 $\overset{o}{A}$ (or 10 nm to 400 nm).

(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 eater is 4/3, find the depth of the water in the beaker.

(c) An object AB is place 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.

Question 7 **[10]**

(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 1.8 s. Calculate the distance between the cliff and the observer if the velocity of sound in air is 340 ms^{-1}.

(b) A vibrating tuning fork is place 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?

(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.

Question 8 **[10]**

(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?

(b)

(i) Why does a bottle of soft drink cool faster when surrounded by ice cubes than by ice cold water, both at 0^{o} C?

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

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

Question 9 **[10]**

(a)

(i) State Ohm's law.

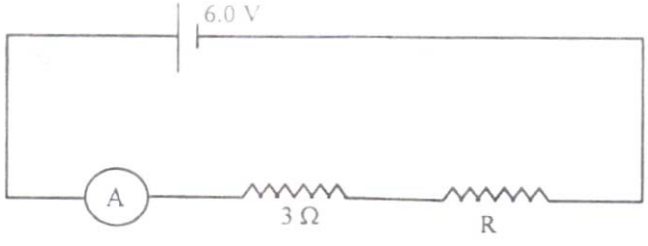
(ii) A metal wire of resistance 6 Ω is stretched so that its length is increased to twice its original length. Calculate its new resistance.

(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?

(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 3 Ω resistor in 120 s.

(iii) Calculate the power dissipated in the 3 Ω resistor.

Question 10 **[10]**

(a) Name the three main parts of Cathode Ray Tube.

(b)

(i) What is meant by Radioactivity?

(ii) What is meant by nuclear waste?

(iii) Suggest one effective way from the safe disposal of nuclear waste.

(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.

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SOLUTION

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Section – 1

Answer 1 **[10]**

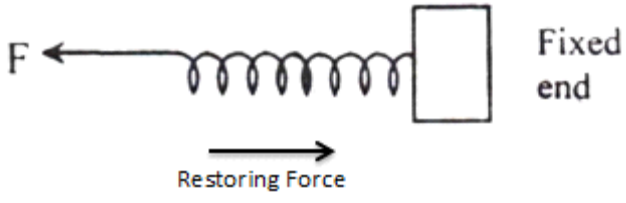
(a) The two effects of a force on a non-rigid body are:-

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

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

(b)

(i)



(ii) A spring-balance works on this principle.

(c)

(i) The centre of gravity of uniform ring is situated at the centre of ring.

(ii) False.

(d) Given,

Mass, m = 20 kg

Initial velocity, u = 40 m/s

Final velocity, v = 50 m/s

Time, t = 2 sec

$W = F.S$

$F = ma$

$a = \frac{v-u}{t} = \frac{50-40}{2} = 5\,m/s$

$F = 20 \times 5 = 100\,N$

$S = \frac{v^2-u^2}{2a} = \frac{50^2-40^2}{2\times 5} = 90\,m$

$W = FS$

$= 100 \times 90$

$= 9000\,J$ or $9\ kJ$

(e)

(i) The name of the pulley which does not give any mechanical advantage is Single Fixed Pulley.

(ii) This pulley is used to change the direction of force applied, i.e., with the help of single fixed pulley the effort can be applied in a more convenient direction.

Answer 2 **[10]**

(a)

(i) An ideal machine is that in which there is no dissipation of energy in any manner. The efficiency of an ideal machine is 100%.; whereas, the efficiency of all the practical machines is always less than 100% due to the energy loss in friction, etc.

(ii) No

(b)

Given,

Mass, $m = 35\,kg$

$h_1 = 4\,m$

$h_2 = 12\,m$

$g = 10\,m/s^2$

Imcrease in gravitational potential energy,

$$\Delta U = mg\left(h_2 - h_1\right)$$
$$= 35 \times 10 \times (12 - 4)$$
$$= 2800\,J$$

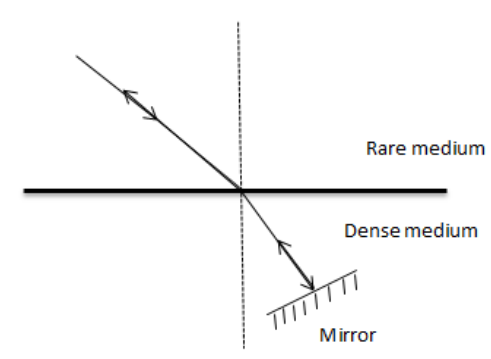
(c)

(i) Class III lever

(ii) Class II lever

(d)

(i)



(ii) The principle of reversibility of the path of light is used here.

(e)

(i)

$$_g\mu_a = \frac{1}{_a\mu_g}$$

$$_g\mu_a = \frac{1}{1.5} = \frac{2}{3}$$

(ii) For normal incidence, the angle of incidence, $i = 0°$.

Answer 3 **[10]**

(a)

(i) As the water level increases sound becomes shriller and shriller.

(ii) Change in the sound is a result of increase in frequency of sound due to decrease in the length of the air column.

(b)

Given,

Time taken by the sound to reach boatman, $t_1 = 3s$

Velocity of sound in air, $v_1 = 330 m/s$

Velocity of sound in water, $v_2 = 1450 m/s$

Distance of boatman from source of sound, $d_1 = v_1 \times t_1 = 330 \times 3$

$$d_1 = 990\,m = d_2$$

where d_2 is the distance of diver from source of sound

Time taken to reach sound to diver, $t_2 = \frac{d_2}{v_2} = \frac{990}{1450} = 0.68\,sec.$

(c)

$R_1 = 4 + 4 + 4 = 12\,\Omega$

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

$$\frac{1}{R_3} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{4} = \frac{1}{12} + \frac{1}{6} + \frac{1}{4}$$

$$= \frac{1}{2}$$

$R_3 = 2\,\Omega$

$R_{eq} = 5 + R_3 + 6 = 5 + 2 + 6 = 13\,\Omega$

(d)

(i) North polarity

(ii) An electromagnet can produce a stronger magnetic field.

(e)

(i) A fuse is used to protect the electric circuits from overloading and short circuits.

(ii) It works on heating effect of electric current.

Answer 4 **[10]**

(a) Heat capacity of a body is the amount of heat energy required to raise its temperature by $1^{o}C$ or 1 K. The SI unit of heat capacity is joule per Kelvin (J/K).

(b) Global warming means a gradual increase in the earth's average surface temperature due to an increase in the amount of green house gases in its atmosphere.

(c)

Given : Mass, m = 5g

Change in temperature = $(20 - 0)^{O}$ C = 20^{O}C

Heat energy released when temperature of water decreases from 20^{O}C to 0^{O}C

= m × c_{water} × change in temperature

= 5 × 4.2 × 20 = 420 J

Heat energy liberated when water changes into ice at 0^{O}C

= mL_{ice}

= 5 × 336 = 1680J

Total energy liberated = 420 + 1680 = 2100 J

(d)

(i) Gamma radiations

(ii) Alpha and beta radiations

(e)

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

The mass no. and atomic no. of element X is 180 and 72 respectively.

Answer 5 **[10]**

(a)

(i) Centripetal force is directed towards the centre of circle while centrifugal force acts away from the centre of the circular path.

(ii) According to the principle of conservation of energy, energy can neither be created nor can it be destroyed. It only changes from one form to another.

(iii) Potential energy.

(b)

(i) L=1500 N, l=7.5 m, h=2.5 m

$$MA = \frac{l}{h} = \frac{7.5}{2.5} = 3$$

(ii) $E = L \sin \theta$

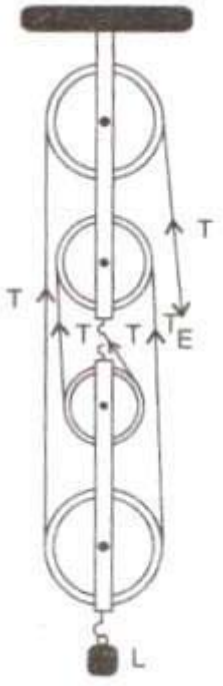
$$E = 1500 \times \frac{h}{l}$$

$$= 1500 \times \frac{2.5}{7.5} = 500\,N$$

(iii) In actual practice, due to some friction between the inclined plane and the bottom face of the box which is pushed over it, the effort applied by the coolie is more than what is calculated.

(c)

(i)



(ii) MA = VR = 4

Answer 6 **[10]**

(a)

(i) Infrared radiations

(ii) X-rays

(iii) Ultraviolet radiations

(b)

(i) No.

$$\mu = \frac{\text{speed of light in vacuum or air (c)}}{\text{speed of light in that medium (v)}}$$

Speed of light in any medium is always less than that in vacuum, so $\mu > 1$.

(ii) Real Depth (RD) - Apparent Depth (AD) = 4 cm

$AD = RD - 4$

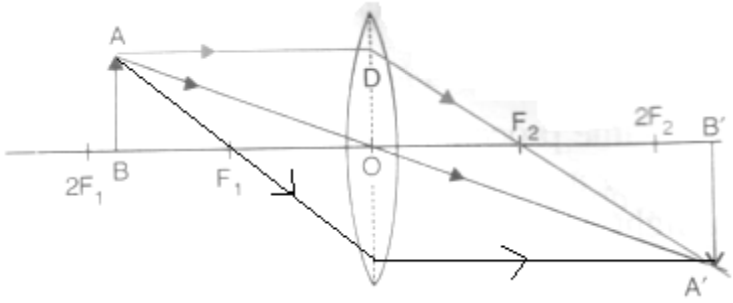
$$\mu = \frac{RD}{AD}$$

$$\frac{4}{3} = \frac{RD}{RD - 4}$$

$$4RD - 16 = 3RD$$

$$RD = 16\,cm$$

(c)



Answer 7 **[10]**

(a)

(i) The *principle* of SONAR is to measure the distance between a source and a reflector (target) *based* on the echo return time.

(ii)

$t = 1.8\,s$

$v = 340\,m/s$

$d = ?$

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

$$d = \frac{v \times t}{2} = \frac{340 \times 1.8}{2} = 306\,m$$

(b)

(i) Resonance

(ii) The sound becomes very loud because the natural frequency of the length of air column becomes equal to the frequency of the vibrating tuning fork.

(c)

(i)

1. The amplitude of a wave is its maximum disturbance from its undisturbed position.
2. The frequency of a wave is the number of waves produced by a source each second. It is also the number of waves that pass a certain point each second.

(ii) When the string of the musical instrument is set into vibration, forced vibration are produced in the air inside the box. As area of the hollow box is large and hence it sets a large volume of air into vibration of the same frequency as that of string. So, a loud sound is produced due to resonance. The sound produced by vibrating string is too weak to be heard.

Answer 8 **[10]**

(a)

(i) When ice in a frozen lake starts melting, the heat energy required for melting the frozen lake is absorbed from the surrounding atmosphere. As a result, the temperature of the surroundings starts falling.

(ii) Heat capacity = mass x specific heat capacity

(b)

(i) A bottle of soft drink cools faster when surrounded by ice cubes than by ice cold water, both at 0^{o} C, because 1 g of ice at 0^{o}C takes 336 J of heat energy from the drink to melt into water at 0^{o}C. Thus soft drink loses an additional 336 J of heat energy for 1 g ice at 0^{o}C than for 1 g ice-cold water at 0^{o}C.

(ii)

$$m_X = m_Y = m = 1\,g$$

$$Q_X = Q_Y = Q$$

$$\Delta T_X = 3^{o}C$$

$$\Delta T_Y = 4^{o}C$$

$$\frac{c_X}{c_Y} = \frac{Q_X}{m_X \times \Delta T_X} \Big/ \frac{Q_Y}{m_Y \times \Delta T_Y}$$

$$= \frac{Q_X}{m_X \times \Delta T_X} \times \frac{m_Y \times \Delta T_Y}{Q_Y}$$

$$= \frac{Q}{m \times 3} \times \frac{m \times 4}{Q}$$

$$\frac{c_X}{c_Y} = \frac{4}{3}$$

$$c_X > c_Y$$

(c)

Here, mass of calorimeter, $m_c = 50\,g$

specific heat capacity of material of calorimeter, $c_c = 0.42\ J/g/^{0}C$

Initial temperature of water, $T_1 = 20^{o}C$

Mass of metal piece, $m = 20\,g$

Temperature of metal piece, $T_2 = 100^{o}C$

Final temperature of the mixture, $T = 22^{o}C$

Specific heat capacity of metal piece, $c = 0.3\,J/g/^{0}C$

Specific heat capacity of water, $c_w = 4.2\,J/g/^{0}C$

Mass of water in calorimeter, $m_w = ?$

From principle of mixtures,

heat energy lost by metal piece

= heat energy gained by water + heat energy gained by calorimeter

$$mc(T_2 - T) = m_w c_w (T - T_1) + m_c c_c (T - T_1)$$

$$20 \times 0.3 \times (100 - 22) = m_w \times 4.2 \times (22 - 20) + 50 \times 0.42 \times (22 - 20)$$

$$468 = 8.4\,m_w + 42$$

$$8.4\,m_w = 426$$

$$m_w = 50.71\,g$$

Answer 9 **[10]**

(a)

(i) Ohm's law - The current flowing in a conductor is directly proportional to the potential difference across its ends provided the physical conditions and the temperature of the conductor remain constant.

(ii)

$$R = \rho\frac{l}{a} = 6\,\Omega$$

$$l' = 2l$$

$$a' = a/2$$

$$R' = \rho\frac{l'}{a'} = \rho\frac{2l}{a/2} = 4R = 24\,\Omega$$

(iii)

(b)

(i) An electric shock may be caused either due to poor insulation of wires attached to the gadget or when the gadget is touched with wet hands.

(ii) Preventive measures:

1. The wires of the gadget must be of good quality and should be checked from time to time particularly when they become old, so that no wire is left naked.
2. The gadget should never be operated (or touched) with wet hands and it should always be kept in dry condition.

(c)

$I = 0.5\ A$

(i) $V=IR_{tot}$

$6=0.5\times(3+R)$

$12 = 3 + R$

$R = 9\,\Omega$

(ii) $I=\frac{Q}{T}$

$Q = I\times T = 0.5\times 120 = 60\,C$

(iii) $P=I^2R = 0.5^2\times 3 = 0.75\,W$

Answer 10 **[10]**

(a) The electron gun, the deflecting system and the fluorescent screen.

(b)

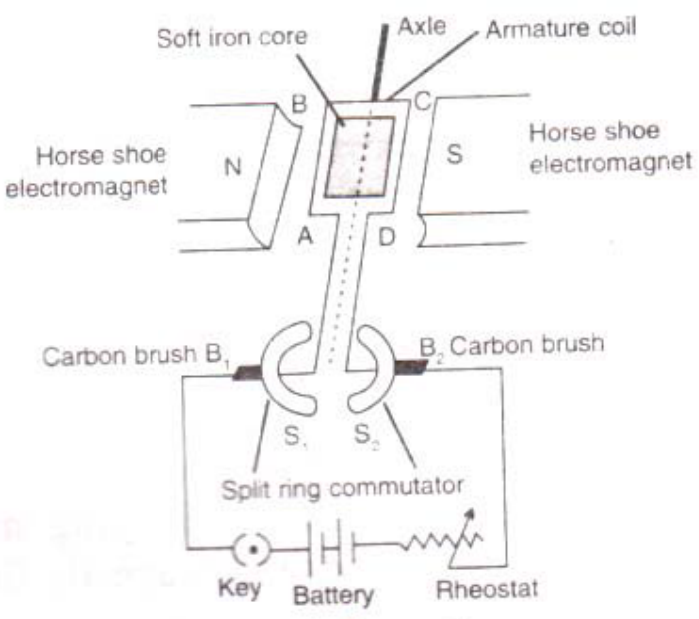
(i) Radioactivity is a nuclear phenomenon. It is the process of spontaneous emission of α or β and γ radiations from the nuclei of atoms during their decay.

(ii) Nuclear waste is the radioactive waste left over from nuclear reactors, research projects, and bomb production.

(iii) The nuclear waste must be first kept in thick casks and then they must be buried in the specially constructed deep underground stores. These stores must be made quite far from the populated area.

(c)

(i)



A d.c. motor

(ii) The split rings act as a commutator in a d.c. motor. With the split rings, the direction of current through the coil is reversed after every half rotation of coil and thus the direction of couple rotating the coil remains unchanged and the coil continues to rotate in the same direction.

(iii) The voltage of a.c. can be stepped up by the use of step-up transformer at the power generating station before transmitting it over long distances. It reduces the loss of electrical energy as heat in the transmission line wires.