ICSE Board
Class X Physics
Silver Series
Sample Paper – 2 Solution

Section I

Answer 1

(a) Two electromagnetic waves whose frequencies are higher than those of violet light are

i. Ultraviolet radiation
Use: In treatment of skin disorders and for killing bacteria

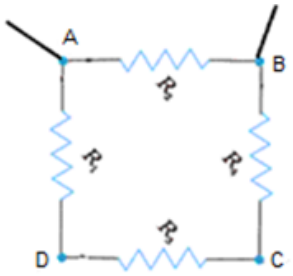
ii. X-rays
Use: In radiography and for detecting flaws in metals

(b) Frequency of transverse vibration of a stretched string can be decreased by

1. Decreasing the tension in the string
2. Increasing the length of the string

(c) Ice has a high specific latent heat of fusion of 336,000 J/kg. Thus, when the ice of the frozen lake starts melting, it absorbs a large amount of heat energy from the surroundings. This leads to a decrease in the surrounding temperature.

(d)



Resistances $R_1 = R_2 = R_3 = R_4 = 2\Omega$ are connected as shown in the diagram above.
Between A and B, the series combination of resistors R_1, R_3 and R_4 is connected in parallel with R_2. Total resistance between A and B = R_{AB}.
Then

$$\frac{1}{R_{AB}} = \frac{1}{2} + \frac{1}{6} = \frac{3+1}{6} = \frac{4}{6}$$

$$R_{AB} = 1.5\ \Omega$$

(e) The earth pin is long so that the earth connection is made first. This ensures the safety of the user because if the appliances are defective, then the fuse will blow off. The earth pin is made thicker so that even by mistake it cannot be inserted into the hole for a live or neutral connection of the socket.

Answer 2

(a) Electron volt measures energy.

1 eV = 1.6×10^{-19} J

(b)

i. For minimum work, $\theta = 90°$

ii. For maximum work, $\theta = 0°$

(c) The forces which act on the bodies without being in physical contact with them are known as non-contact forces. Example: Magnetic force

(d) Work done in 1 beat = 1 J

Work done in 72 beats = 72 J

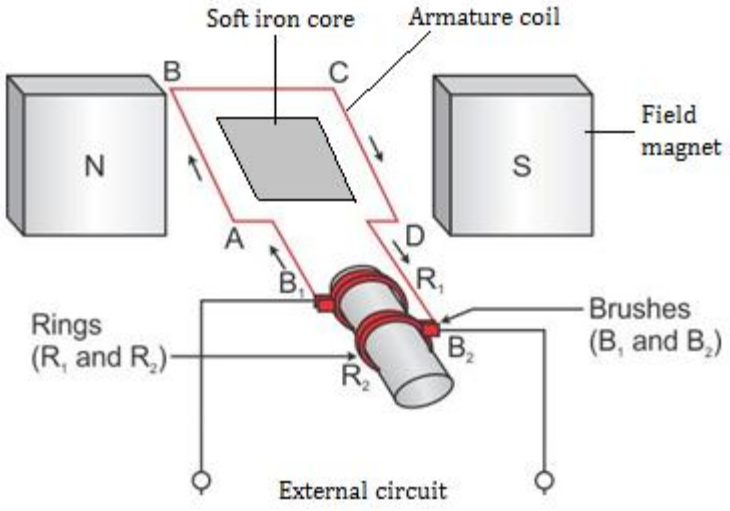
Time in which work is done, t = 60 s

$\therefore$ Power = $\frac{\text{Work done}}{\text{time taken}} = \frac{72}{60} = 1.2$ W

(e) The two properties of a wave are wavelength and frequency. The wavelength of a wave changes when a wave passes from one medium to another and the frequency of a wave remains constant when it passes from one medium to another.

Answer 3

(a)



(b) Given, mass of steam m = 5 kg

Temperature of steam = 100°C

Temperature of water = 100°C

Specific latent heat of vaporisation of steam, L = 2268 kJ/kg

Heat energy released is H = mL = 5 × 2268 = 11340 kJ

(c) Let x = no. of α decays and y = no. of β decays

During alpha decay, the product nucleus has mass no. 4 less and atomic no. 2 less than that of the parent nucleus. During beta decay, the mass number remains constant but the atomic no. increases by 1.

$206 = 238 - 4x$ ..... (i)

And $82 = 92 - 2x + y$ ..... (ii)

From equation (i), we have

$4x = 238 - 206$

$\therefore x = 8$

Putting this value of x in equation (ii), we get

$82 = 92 - (2 \times 8) + y$

$\therefore y = 6$

$\therefore$ No. of alpha particles emitted = 8

No. of beta particles emitted = 6

(d) Rate of emission of electrons from a heated surface depends on

i. Nature of the metal surface
ii. Temperature of the surface

(e) Mechanical energy is converted to electrical energy when a magnet is moved inside a coil. The phenomenon is 'electromagnetic induction'.

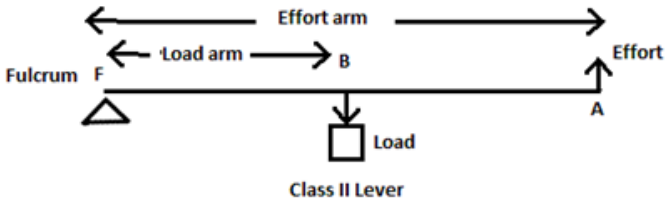
Answer 4

(a)

i. The law of conservation of energy states that energy cannot be created or destroyed; the sum total of energy in a closed system remains unchanged and energy only changes from one form to another.
ii. (1) Electrical energy to sound energy
(2) Chemical energy to electrical energy

(b)

i. An inclined plane is a sloping surface which behaves like a simple machine whose mechanical advantage is always greater than 1.
ii.



Example: Nut cracker

(c)

i. The function of the fixed pulley P_2 is to change the direction of application of effort to a convenient direction; i.e. downwards.

ii. If the free end of the string moves through the distance x, then the load W will rise by a distance of x/2.

iii. Let the force to be applied at C be equal to 'E'.

Given, load W = 20 kgf

In equilibrium, W = 2T and E = T

$\therefore$ Effort needed, $E = \frac{W}{2} = \frac{20\text{kgf}}{2} = 10$ kgf

Section II

Answer 5

(a)

i. Magnification = 1

ii. Characteristics of image formed: Inverted and real

iii. Focal length of the lens

(b)

i.

(1) The image of all the letters will not be in the same place.

(2) The letter of violet colour (i.e. V) appears to be raised by the maximum amount, while the letter of red colour (i.e. R) appears to be raised by the minimum amount. Since

$$\text{apparent depth} = \frac{\text{real depth}}{\text{refractive index}}$$

and refractive index of glass is maximum for violet light and minimum for red light; therefore, the apparent depth is least for violet and most for red.

ii.

Convex lens	Concave lens
1. A convex lens is thicker in the middle and thinner at its edges. 2. A light beam converges on passing through a convex lens.	1. A concave lens is thicker at the edges and thinner in the middle. 2. A light beam diverges on passing through a concave lens.

(c)

i. Refraction is the bending of light at the surface of separation, which takes place when it passes from one optical medium to another optical medium with different optical densities.

ii. (1) Refractive index, $\mu = \frac{\text{Speed of light in vacuum or air (c)}}{\text{Speed of light in that medium (v)}}$

(2) Refractive index, $\mu = \frac{\sin i}{\sin r}$

iii. Refractive index of medium I is the same as the refractive index of medium II.

Answer 6

(a) Potential energy possessed by falling water = mgh = m × 10 × 50 = 500 m

Heat absorbed by water = m c Δt = m × 4200 × Δt

By law of conservation of energy, we have

Heat absorbed by water = PE of falling water

m × 4200 × Δt = 500 m

or $\Delta t = \frac{500}{4200} = 0.1190\ ^{\circ}C$

(b)

i. kW (kilowatt) is the unit of electrical power and kWh (kilowatt-hour) is the unit for electrical energy consumed in one hour.
1 kilowatt = 1000 W
1 kilowatt-hour = 1 kilowatt × 1 hour = 3.6×10^6 J

ii. One kilowatt-hour is the electrical energy consumed by an electrical appliance of power 1 kW when it is used for 1 hour.
1 kilowatt-hour = 1 kilowatt × 1 hour
= 1000 watt × 1 hour
= 1000 J/s × (60 × 60 s)
= 3.6×10^6 J
= 3.6 MJ

iii. The practical units of power are watt-hour and kilowatt-hour.

(c)

i. Sound heard after reflection from a rigid obstacle is called an echo. To hear the echo of a sound distinctly, the reflecting surface in the air should be at a minimum distance of 17 m from the listener. If the distance is less than 17 m, the reflected sound will reach the ears before the original sound dies out. In such a case, the original sound mixes up with the reflected sound. Due to repeated reflections at the reflecting surface, the sound gets prolonged. This effect is known as reverberation.

If 'd' is the distance between the observer and the obstacle and 'v' is the speed of sound, then the distance covered by the sound to reach the obstacle and to return is 2d. Thus, we have

$$t = \frac{\text{Total distance travelled}}{\text{Speed of sound}} = \frac{2d}{v}\ ;\ d = \frac{vt}{2}$$

By putting t = 0.1 s and v = 340 m/s in air at ordinary temperature, we get

$$d = \frac{340 \times 0.1}{2} = 17\ \text{m}$$

Thus, to hear the echo of a sound distinctly, the reflecting surface in air should be at a minimum distance of 17 m from the listener.

ii. Material medium is necessary for the propagation of sound. On the moon, there is vaccum, i.e. no air; so, sound cannot propagate on the moon. Thus, sound cannot be heard on the surface of the moon.

Answer 7

(a) Given, power P = 1500 W, voltage V = 250 V

i. Current I = P/V

or $I = \frac{1500}{250} = 6$ A

ii. Electrical energy consumed in 6 hrs = power × time = $\frac{1500}{1000} \times 6 = 9$ kWh

iii. Cost of electrical energy at Rs 2.50 per kWh

= Electrical energy consumed × cost per unit

= 9 × 2.50 = Rs 22.5

(b)

i. The function of the split rings is to change the direction of current flowing through the coil after each half rotation.

ii. Whenever there is a change in magnetic flux linked with a conductor, an induced emf is set up in it which gives rise to induced current. This is known as electromagnetic induction.

The necessary condition for electromagnetic induction is that the induced emf lasts as long as there is a change in the magnetic flux linked with the conductor.

(c)

i. The current in ammeters B and C is inversely proportional to the value of resistance in the parallel branch. Therefore,

$\frac{\text{reading of ammeter C}}{\text{reading of ammeter B}} = \frac{6}{3} = 2$

So, reading of ammeter C = 2 × 0.5 = 1.0 A

Hence, reading of ammeter A = (0.5 + 1.0) = 1.5 A

ii. Let the total resistance of the circuit be R.

So,

$R = 2 + R_p$

Here,

$\frac{1}{R_p} = \frac{1}{3} + \frac{1}{6} = \frac{1}{2}$

$\therefore R = 2 + 2 = 4\Omega$

Answer 8

(a) Given, time t = 0.02 millisecond = 0.02×10^{-3} s

$c = 3 \times 10^8$ m/s

Let d be the distance of the plane from the radar.

So,

$2d$ = velocity × time

$2d = 3 \times 10^8 \times 0.02 \times 10^{-3} = 6000$ m

or

$d = 3000$ m = 3 km

(b)

i. AB corresponds to the time interval in which ice melts to form water.
CD corresponds to the time interval in which water (at 100°C) boils to form vapour (steam) at 100°C.

ii. Ice is pure because it melts at 0°C. The ice is initially at −10°C. It may have been formed under high pressure.

(c)

i. Amount of heat given out while converting m_1 kg of steam at 100°C to water at 100°C

$= m_1 L_v$

$= m_1 \times 2268$ kJ

ii. Heat required to convert m_2 kg of ice at 0°C to water at 0°C is given by

$m_2 L_f = 336 \times m_2$ kJ

Amount of heat absorbed by m_2 kg of water to increase the temperature from 0°C to 10°C

$= m_2 \times C \times \theta$

$= m2 \times 4.2 \times 10$

$= 42 \times m_2$ kJ

Heat gained by m_2 kg of ice = $378\ m_2$ kJ

iii. Heat Equation:

Heat lost by steam = Heat gained by ice

$2268\ m_1 = 378\ m_2$

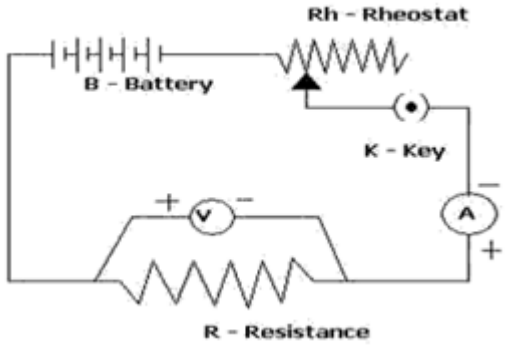
$m_2 : m_1 = 2268 : 378$

Answer 9

(a)

i. Ohm's law states that the current flowing in a conductor is directly proportional to the potential difference applied across the conductor provided that the physical conditions remain constant.

ii. The diagram of connecting a key, a battery, a voltmeter, an ammeter, an unknown resistance and a rheostat is as follows:



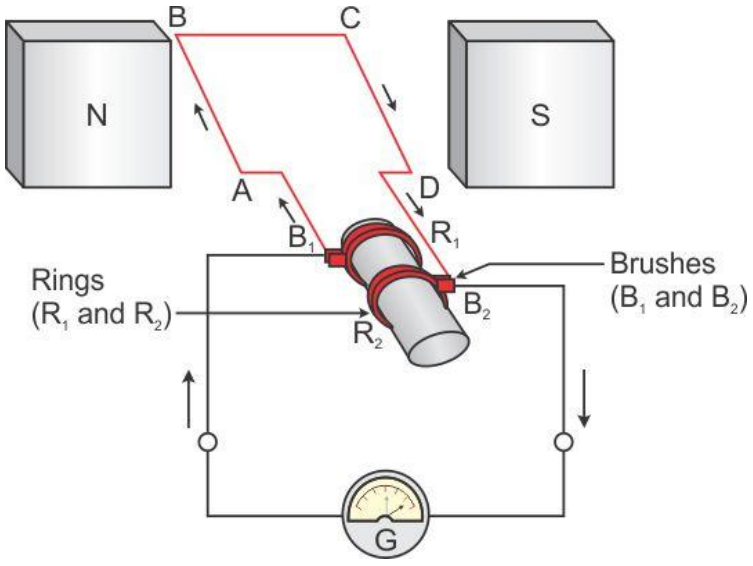
(b) The amount of heat required to

i. Raise the temperature of the body by 1°C is 50 J

ii. Raise the temperature of 1 g of copper by 1°C is 0.4 J

iii. Convert 1 kg of ice at 0°C into water without a change in its temperature is 336000 J

(c)



Answer 10

(a) Isotopes of some elements which are undergoing spontaneous disintegration are called radioisotopes. Some naturally occurring radioisotopes are prepared artificially by nuclear transmutation.

Uses of radioisotopes:

1. Radiation with radioisotopes is used in the treatment of cancer.
2. Yield of crops such as carrot, apple etc. can be increased by irradiation with radioisotopes.

(b)

i. Precautions to be taken while handling radioactive materials:
   1. Sources should always be handled using the forceps which are provided and should never be touched with bare hands.
   2. Food should never be taken where the sources are being used, because it may become contaminated.

ii. Radioisotopes can be used to detect cracks in welding, casting etc.

(c) i) Mass lost in fusion reaction $\Delta m = 0.6\%$

Loss in mass in fusion of 1 kg mass = $\frac{0.6}{100} \times 1 \text{ kg} = 0.006 \text{ kg}$

Energy released E = $(\Delta m)\, c^2 = 0.006 \times (3 \times 10^8)^2$

= 5.4×10^{14} joule

ii) When slow neutrons are bombarded on uranium-235, every uranium nucleus splits into two almost equal fragments with a release of 3 new neutrons and a large amount of energy. These 3 new neutrons can cause fission of the other uranium nuclei. In this way, a chain of splitting of nuclei is formed which continues till all the uranium is depleted. Therefore, energy obtained from nuclear fission continuously increases. Because of this chain reaction, a huge explosion of all uranium occurs in a very short interval of time and a large amount of energy is released which can be very harmful. This is known as an uncontrolled chain reaction. If the chain reaction is controlled by absorbing some of the neutrons emitted in the fission process by means of neutron absorbers, the energy obtained in fission can be utilised for constructive purposes. This is the principle of the nuclear reactor, which is known as a controlled chain reaction.