ICSE QUESTION PAPER
Class X Physics
(2015)

Time: 2 hour **Maximum Marks: 80**

General Instructions:

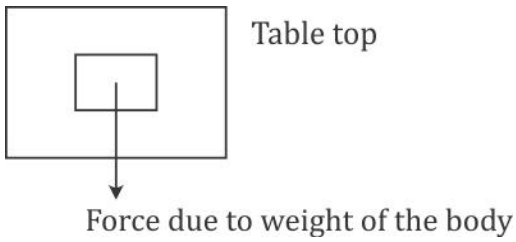
1. *Answers to this paper must be written on the paper provided separately.*
2. *You will **not** be allowed to write during the first **15** minutes. This time is to be spent in reading the question paper.*
3. *The time given at the head of paper is the time allotted for writing the answers.*
4. *Attempt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

SECTION - I (40 Marks)

Attempt all question from this Section.

Question 1

(a) When a body is placed on a table top, it exerts a force equal to its weight downwards on the table top but does not move or fall. [2]



(i) Name the force exerted by the table top.

(ii) What is the direction of the force?

(b) [2]

(i) Name one factor that affects the lateral displacement of light as it passes through a rectangular glass slab.

(ii) On reversing the direction of the current in a wire, the magnetic field produced by it gets _____.

(c) [2]

(i) On what factor does the position of the centre of gravity of a body depend?

(ii) What is the SI unit of the moment of force?

(d) Name the factors affecting the turning effect of a body. [2]

(e) [2]

(i) Define equilibrium.

(ii) In a beam balance when the beam is balanced in a horizontal position, it is in _____ equilibrium.

Question 2

(a) How is work done by a force measured when the force: [2]

(i) is in the direction of displacement?

(ii) is in an angle to the direction of displacement?

(b) State the energy in the following while in use: [2]

(i) Burning of a candle.

(ii) A steam engine.

(c) [2]

(i) A scissor is a _____ multiplier.

(ii) 1 kWh = _____ J.

(d) Explain the motion of a planet around the Sun in a circular path. [2]

(e) Rajan exerts a force of 150 N in pulling a cart at a constant speed of 10 m/s. Calculate the power exerted. [2]

Question 3

(a) [2]

(i) Give the expression for mechanical advantage of an inclined plane in terms of the length of an inclined plane.

(ii) Name a common device where a gear train is used.

(b) The speed of light in glass is 2×10^5 km/s. What is the refractive index of glass? [2]

(c) [2]

(i) Draw a graph between displacement and the time for a body executing free vibrations.

(ii) Where can a body execute free vibrations?

(d) [2]

(i) What happens to the resistivity of semi-conductor with the increase of temperature?

(ii) For a fuse, higher the current rating _____ is the fuse wire.

(e) [2]

(i) Name the high energetic invisible electromagnetic waves which help in the study of the structure of crystals.

(ii) State an additional use of the waves mentioned in part (e)(i).

Question 4

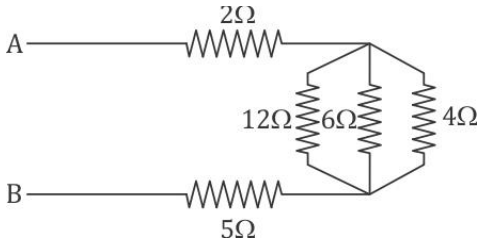
(a) Rishi is surprised when he sees water boiling at 115°C in a container. Give reasons as to why water can boil at the above temperature. [2]

(b) [2]

(i) Why does a current carrying, freely suspended solenoid rest along a particular direction?

(ii) State the direction in which it rests.

(c) Find the equivalent resistance between points A and B. [2]



(d) Give two similarities an AC generator and a DC motor [2]

(e) [2]

(i) Why is a cathode ray tube evacuated to a low pressure?

(ii) What happens if the negative potential is changed on a grid?

SECTION - II (40 Marks)

Attempt any four questions from this Section.

Question 5

(a) Draw a simplified diagram of a lemon crusher, indicting of load and effort. [2]

(b) [4]

(i) Name the physical quantity measured in terms of horse power.

(ii) A nut is opened by a wrench of length 20 cm. If the least force required is 2N, find the moment of force needed to loosen the nut.

(iii) Explain briefly why the work done by a fielder when he takes a catch in a cricket match is negative.

(c) A block and tackle system has V.R. = 5. [4]

(i) Draw a neat labelled diagram of a system indicating the direction of its load and effort.

(ii) Rohan exerts a pull of 150 kgf. What is the maximum load he can raise with this pulley system if its efficiency = 75%?

Question 6

(a) [3]

(i) Where should an object be placed so that a real and inverted image of the same size as the object is obtained using a convex lens?

(ii) Draw a ray diagram to show the formation of the image as specified in the part a(i).

(b) [3]

(i) Why does the Sun appear red at sunrise?

(ii) Name the subjective property of light related to its wavelength.

(c) Jatin puts a pencil into a glass container having water and is surprised o see the pencil in a different state. [4]

(i) What change is observed in the appearance of the pencil?

(ii) Name the phenomenon responsible for the change.

(iii) Draw a ray diagram showing how the eye sees the pencil.

Question 7

(a) [2]

(i) State the safe limit of sound level in terms of decibel for human hearing.

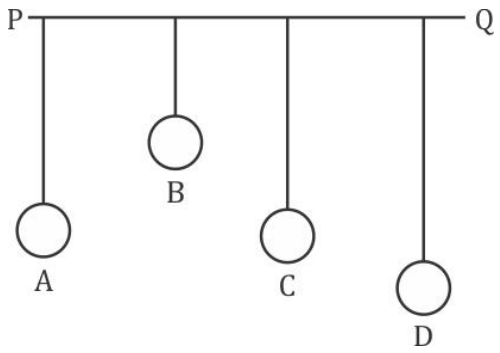
(ii) Name the characteristic of sound in relation to its waveform.

(b) A person standing between two vertical cliffs and 480 m from the nearest cliff shouts. He hears the first echo after 3s and the second echo 2s later. Calculate: [3]

(i) The speed of sound.

(ii) The distance of the other cliff from the person.

(c) In the diagram below, A, B, C, D are four pendulums suspended from the same elastic string PQ. The length of A and C are equal to each other while the length of pendulum B is smaller than that of D. Pendulum A is set in to a mode of vibrations. [5]



(i) Name the type of vibrations taking place in pendulums B and D?

(ii) What is the state of pendulum C?

(iii) State the reason for the type of vibrations in pendulum B and C.

Question 8

(a) [3]

(i) Name the device used to increase the voltage at a generating station.

(ii) At what frequency is AC supplied to residential houses?

(iii) Name the wire in a household electrical circuit to which the switch is connected.

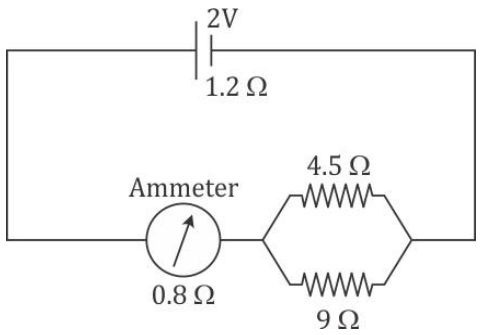
(b) The relationship between the potential difference and the current in a conductor is stated in the form of a law. [3]

(i) Name the law.

(ii) What does the slope of V-I graph for a conductor represent?

(iii) Name the material used for making the connecting wire.

(c) A cell of Emf 2 V and internal resistance 1.2 Ω is connected with an ammeter of resistance 0.8 Ω and two resistors of 4.5 Ω and 9 Ω as shown in the diagram below: [4]



(i) What would be the reading on the Ammeter?
(ii) What is the potential difference across the terminals of the cell? [4]

Question 9

(a) [2]
(i) Name a gas caused by the Greenhouse effect.
(ii) Which property of water makes it an effective coolant?

(b) [4]
(i) Water in lakes and ponds do not freeze at once in cold countries. Give a reason is support of your answer.
(ii) What is the principle of Calorimetry?
(iii) Name the law on which this principle is based.
(iv) State the effect of an increase of impurities on the melting point of ice.

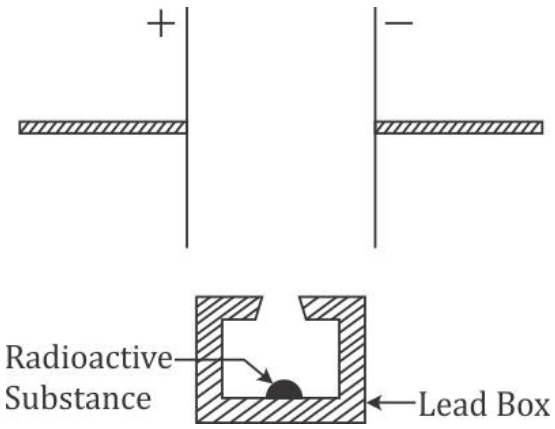
(c) A refrigerator converts 100 g of water at 20°C to ice at −10°C in 35 minutes. Calculate the average rate of heat extraction in terms of watts.
Given: Specific heat capacity of ice = 2.1 J $g^{-1}°C^{-1}$
Specific heat capacity of water = 4.2 J $g^{-1}°C^{-1}$
Specific latent heat of fusion of ice = 336 J g^{-1} [4]

Question 10

(a) [2]

(i) What is thermionic emission?

(ii) Name the unit in which the work function of a metal is expressed.



(b) [5]

(i) Complete the diagram as given above by drawing the deflection of radioactive radiations in an electric filed.

(ii) State any two precautions to be taken while handling radioactive substances.

(c) An atomic nucleus A is composed of 84 protons and 128 neutrons. [3]

(i) The nucleus A emits an alpha particle and is transformed into nucleus B. What is the composition of nucleus B?

(ii) The nucleus B emits a beta particle is transformed into nucleus C. What is the composition of nucleus C?

(iii) Does the composition of nucleus C change if it emits gamma radiations?

ICSE QUESTION PAPER

Class X Physics

2015 (Solution)

SECTION - I

1.

(a)

(i) Normal reaction force is exerted by the table top.

(ii) The force is in the upward direction.

(b)

(i) The thickness of the glass block, angle of incidence and refractive index of glass (any one) are the factors which affect the lateral displacement of light as it passes through a rectangular glass slab.

(ii) On reversing the direction of the current in a wire, the magnetic field produced by it gets **reversed**.

(c)

(i) The position of the centre of gravity of a body depends on its shape, that is, on the distribution of mass.

(ii) The SI unit of moment of force is newton × metre (Nm).

(d) The following are the factors which affect the turning effect of a body:

- Magnitude of the force applied
- Distance of line of action of the force from the axis of rotation

(e)

(i) When several forces acting on a body produce no change in its state of rest or motion, the body is said to be in equilibrium.

(ii) In a beam balance, when the beam is balanced in a horizontal position, it is in **static** equilibrium.

2.

(a)

(i) When force is in the direction of displacement $\theta = 0°$, then $\cos 0 = 1$.
Hence, the work done by a force measured in the direction of displacement is
$W = F \times S$
The work done is maximum and positive.

(ii) When the displacement is in the direction making an angle θ with the direction of force,
Work done = Component of force in the direction of displacement × displacement
$\therefore W = F \cos\theta \times S$

(b)

(i) Burning of a candle: Conversion of chemical energy to light energy.
When a candle burns, it gives light.

(ii) A steam engine: Conversion of heat energy into mechanical energy.
In a steam engine, chemical energy of coal first changes to heat energy of steam, and then heat energy changes to mechanical energy.

(c)

(i) A scissor is a force multiplier because the effort applied is less than the load.

(ii) 1 kWh = 1 kilowatt × 1 hour
$= 1000 \text{ J s}^{-1} \times 3600 \text{ s}$
$= 3.6 \times 10^6 \text{ J}$

(d) A planet moves around the Sun in a nearly circular path for which the gravitational force of attraction on the planet by the Sun provides the necessary centripetal force required for circular motion.

(e) Given that
Force = 150 N
Velocity = 10 m s^{-1}
$\therefore$ Power = $F \times v$
$= 150 \text{ N} \times 10 \text{ m s}^{-1}$
$= 1500 \text{ W}$

3.

(a)

(i) M.A. = $\frac{1}{\sin\theta} = \frac{1}{\frac{h}{l}} = \frac{l}{h}$

(ii) A clock is a common device where a gear train is used. In a clock, the gear system is used to obtain gain in torque.

(b) Given:

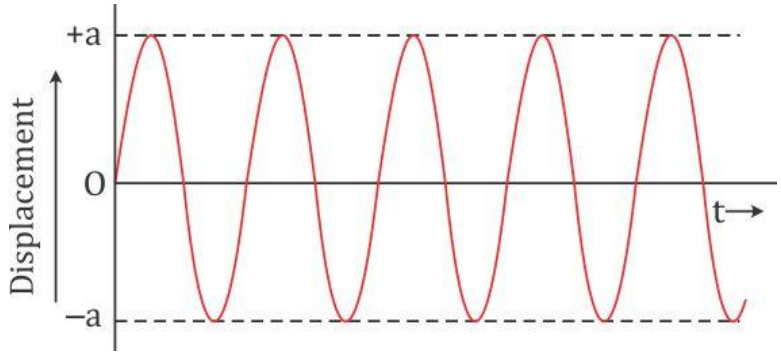
Speed of light in glass = 2×10^5 km/s = 2×10^8 m/s

Refractive index of glass is

$$\mu_{glass} = \frac{3\times10^8}{2\times10^8} = 1.5$$

(c)

(i) The displacement–time graph for a body executing free vibrations is given below:



(ii) The free vibrations of a body actually occur only in vacuum because the presence of a medium offers some resistance due to which the amplitude of vibration does not remain constant and decreases continuously.

Thus, we define free vibrations as the periodic vibrations of a body of constant amplitude in the absence of any external force on it.

(d)

(i) The resistivity of a semiconductor decreases with increase in temperature.

(ii) For a fuse, higher the current rating, thicker is the fuse wire.

(e)

(i) X-rays are used in the study of structure of crystals.

(ii) X-rays are used in the detection of fracture in bones and teeth.

4.

(a) The water boils at the higher temperature because of the reasons given below:

- The water used by Rishi might be impure. The boiling of a liquid increases with the addition of impurities.
- Rishi might have used a container which creates a pressure within. The boiling point of a liquid increases with an increase in pressure.

(b)

(i) A current-carrying freely suspended solenoid acts as a bar magnet, and thus, due to the Earth's magnetic field, it rests along a particular direction.

(ii) It rests in the North–South direction.

(c) Let R_P be the equivalent resistance of the resistors 12 Ω, 6 Ω and 4 Ω connected in parallel. Hence, we have

$$\frac{1}{R_P} = \frac{1}{12} + \frac{1}{6} + \frac{1}{4}$$

$$= \frac{1+2+3}{12} = \frac{1}{2}$$

$$R_P = 2\Omega$$

Therefore, the equivalent resistance of the circuit is

$$2\Omega + R_P + 5\Omega = 2\Omega + 2\Omega + 5\Omega = 9\Omega$$

Thus, the equivalent resistance between points A and B is 9 Ω.

(d) Two similarities between an AC generator and a DC motor are

a. A coil rotates in a magnetic field between the pole pieces of a powerful electromagnet.
b. The external circuit is connected to two carbon brushes B_1 and B_2.

(e)

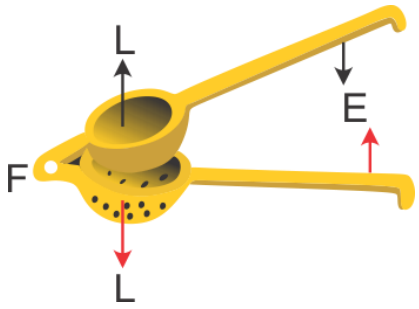
(i) The cathode ray tube is evacuated to a low pressure to avoid collisions of electrons with air molecules.

(ii) If the negative potential on the grid is changed, then the number of electrons reaching the anode and striking the screen changes which ultimately changes the brightness of the pattern of the screen.

SECTION - II

5.

(a) The diagram below shows a lemon crusher indicating the direction of effort (E) and load (L).



(b)

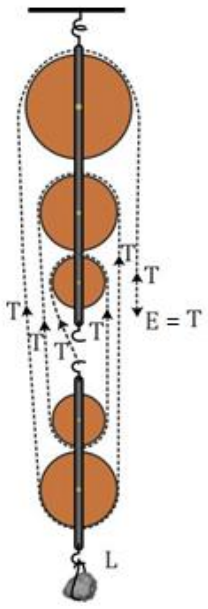
(i) Power is measured in horse power. 1 HP = 746 W

(ii) According to the principle of moments, we have
Moment of load about the fulcrum = Moment of effort about the fulcrum
Load × Load arm = Effort × Effort arm
Given that the effort arm = 20 cm = 0.2 m, the minimum force E = 2 N
Therefore, the moment of load or the moment of force = 0.2 × 2 = 0.4 Nm
The moment of force needed to loosen the nut = 0.4 Nm

(iii) The work done by a fielder when he takes a catch in a cricket match is negative because the force applied by the fielder is in the direction opposite to the displacement of the ball. The angle between the force applied and the displacement of the ball is 180°. We know that work done = F.s cosθ
Therefore, work done = −F.s

(c)

(i) A block and tackle system whose velocity ratio is 5 is as shown below:



(ii) Given that

Velocity ratio, VR = 5

Effort = 150 kgf

Efficiency = 75%

We know that efficiency, $\eta = \frac{\text{Mechanical Advantage}}{\text{Velocity Ratio}}$

$$\frac{75}{100} = \frac{MA}{5}$$

$$MA = 5 \times \frac{75}{100}$$

$\therefore$ Mechanical advantage = 3.75

But, Mechanical advantage $= \frac{\text{Load(L)}}{\text{Effort(E)}}$

$\therefore \text{Load} = \text{Mechanical advantage} \times \text{Effort}$

= 3.75 × 150 Kgf

=562.5 Kgf

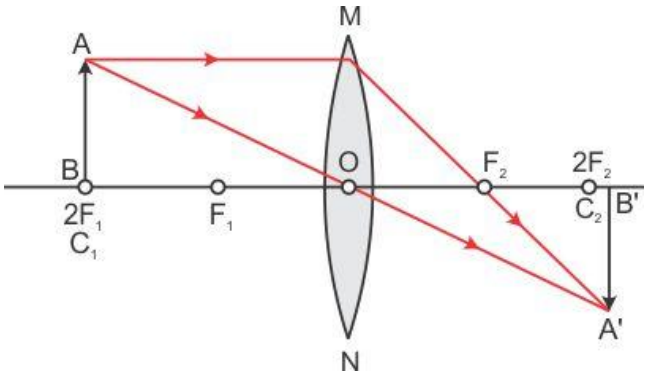
Therefore, Rohan can raise a maximum load of 562.5 kgf with this pulley system.

6.

(a)

(i) When an object is placed **at $2F_1$** of a convex lens, a real and inverted image of the same size as that of the object is formed at $2F_2$.

(ii) The ray diagram for the same is as shown below:



(b)

(i) The Sun appears red at sunrise because of the scattering of light by the atmospheric particles. During sunrise, the light from the Sun has to travel a longer distance through the atmosphere to reach the observer. During this, most of the shorter wavelengths present in it are scattered away from our line of sight by the molecules of air and other fine particles in the atmosphere. So, the light reaching us directly from the rising Sun consists mainly of longer wavelength red colour due to which the Sun appears red.

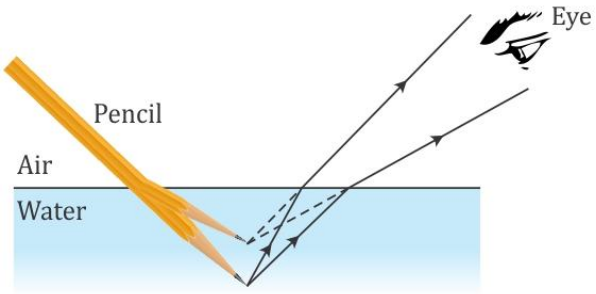
(ii) The subjective property of light related to its wavelength is colour.

(c)

(i) The immersed part of the pencil appears to be shortened and raised.

(ii) The phenomenon responsible for the above observation is the refraction of light in passing from water to air.

(iii) The ray diagram for the same is as shown below:



7.

(a)

(i) The safe limit of sound level for human hearing is 30 decibels (30 dB).

(ii) The characteristic of sound in relation to its waveform is quality or timbre.

(b)

(i) Let d_1 be the distance of the nearest cliff and d_2 be the distance of the farther cliff.

The time for the first echo is $t_1 = 3$ s

The first echo will be heard from the nearest cliff.

The total distance travelled by sound before reaching the person is $2d_1$.

We know that

$$\text{Speed of sound} = v = \frac{2d}{t} = \frac{2d_1}{t_1}$$

$$v = \frac{2 \times 480}{3} = 320 \text{ m/s}$$

Hence, the speed of sound is 320 m/s.

(ii) The second echo is heard 2 s after the first one.

Hence, $t_2 = 3 + 2 = 5$ s

Again the sound travels a total distance $2d_2$ before reaching the person.

So, we get

$$v = \frac{2d_2}{t_2}$$

$$\therefore d_2 = \frac{vt_2}{2} = \frac{320 \times 5}{2} = 800 \text{ m}$$

Hence, the distance between the other cliff and the person is 800 m.

(c)

(i) The vibrations which occur in pendulums B and D are called forced vibrations.

(ii) Pendulum C is in the state of resonance with pendulum A as it is of the same length.

(iii) The pendulums vibrate because the forced vibration from A is transferred due to string PQ.

Pendulum B is of a different length as compared to pendulum A. Hence, it will continuously vibrate with a frequency which is different from that of pendulum A. Its amplitude will also be very small.

Pendulum C is of the same length as compared to pendulum A. Hence, it will vibrate in phase with pendulum A. Its amplitude will be equal to that of pendulum A as it will attain resonance.

8.

(a)

(i) The device used to increase voltage at the generating station is the step-up transformer.

(ii) The residential houses are supplied with AC of frequency 50 Hz.

(iii) The switch is connected to the live (or phase) wire in a household electric circuit.

(b)

(i) The relationship between the potential difference and the current in a conductor is given by Ohm's law.

(ii) The slope of the V–I graph gives the resistance of the conductor.

$$\text{Slope} = \frac{V}{I} = R$$

(iii) The material used for making connecting wires is copper.

(c) Given that

$\varepsilon = 2$ V, $r = 1.2\ \Omega$, $R_A = 0.8\ \Omega$, $R1 = 4.5\ \Omega$, $R2 = 9\ \Omega$

(i) We know that for the circuit

$$\varepsilon = IR_{total}$$

Now, the total resistance of the circuit is

$$R_{total} = r + R_A + R_p$$

$$\frac{1}{R_p} = \frac{1}{4.5} + \frac{1}{9} = \frac{3}{9}$$

$$\therefore R_p = 3\ \Omega$$

$$\Rightarrow R_{total} = 1.2 + 0.8 + 3 = 6\ \Omega$$

Hence, the current through the ammeter is

$$I = \frac{\varepsilon}{R_{total}} = \frac{2}{6} = 0.33\ \text{A}$$

(ii) The potential difference across the terminals of the cell is

$$V_{cell} = Ir = 0.33 \times 1.2 = 0.396 \text{ V}$$

9.

(a)

(i) A gas caused by the greenhouse effect is carbon dioxide.

(ii) The high specific heat capacity of water makes it an effective coolant.

(b)

(i) The specific latent heat of fusion of ice is sufficiently high (=336 J g^{-1}), and so to freeze water, a large quantity of heat has to be withdrawn. Hence, it freezes slowly and thus keeps the surroundings moderate.

(ii) Principle of calorimetry: If no heat energy is exchanged with the surroundings, i.e. if the system is fully insulated, then the heat energy lost by the hot body is equal to the heat energy gained by the cold body.

(iii) The principle of calorimetry is based on the law of conservation of energy.

(iv) Increasing the impurities causes the melting point of ice to decrease.

(c) Given that

Mass of water converted to ice = m = 100 g

Temperature of water t_w = 20°C

Temperature of ice t_i = −10°C

Total time t = 35 min = 2100 s

Specific heat capacity of ice = 2.1 J $g^{-1}°C^{-1}$

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

Specific latent heat of fusion of ice = 336 J g^{-1}

Amount of heat released when 100 g water cools from 20°C to 0°C is

$$Q_1 = mc\Delta T$$
$$= 100 \times 4.2 \times 20$$
$$= 8400 \text{ J}$$

Amount of heat released when 100 g water converts to ice at 0°C is

$$Q_2 = mL$$
$$= 100 \times 336$$
$$= 33600 \text{ J}$$

Amount of heat released when 100 g ice cools from 0°C to −10°C is

$$Q_3 = mc\Delta T$$
$$= 100 \times 2.1 \times 10$$
$$= 2100 \text{ J}$$

Hence, the total heat released is

$$Q = Q_1 + Q_2 + Q_3$$

$$Q = 8400 + 33600 + 2100$$

$$Q = 44100 \text{ J}$$

Therefore, the average rate of heat extraction is

$$P = \frac{Q}{t} = \frac{44100}{2100} = 21 \text{ W}$$

10.

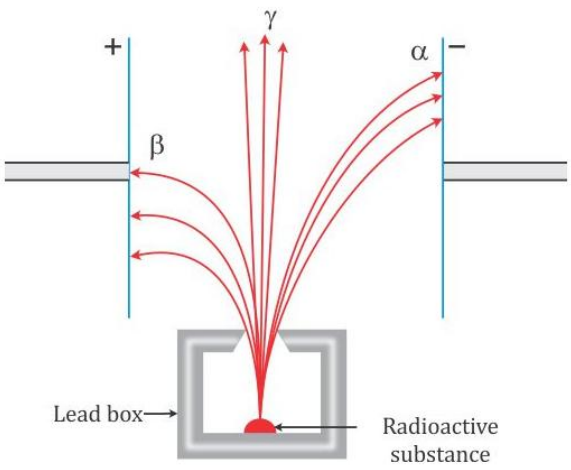
(a)

(i) The emission of electrons from a metal surface when heat energy is imparted to it is called thermionic emission.

(ii) Work function of a metal is expressed in terms of electron volt (eV).

(b)

(i) Deflection of radioactive radiations α, β and γ in an electric field is as shown below:



(ii) The two safety precautions to be taken while handling radioactive substances are (any two):

i. Radioactive substances should be kept in thick lead containers with a very narrow opening so as to restrict the radiations coming out from other directions.

ii. Radioactive materials should be handled with long lead tongs.

iii. People working with radioactive substances should put on special lead lined aprons and lead gloves.

(c) Given that the nucleus contains 84 protons and 128 neutrons, i.e. the atomic number of the nucleus is 84 and the mass number is 128 + 84 = 212.

The atomic nucleus A can be represented as $^{212}_{84}\mathrm{A}$

(i) When the atomic nucleus A emits an alpha particle, the atomic number of the transformed nucleus B decreases by two and the mass number decreases by four. The transformation of nucleus A to B during alpha decay can be represented as

$$^{212}_{84}\mathrm{A} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{208}_{82}\mathrm{B}$$

(ii) When nucleus B emits a beta particle, the transformation can be shown as

$$^{208}_{82}\mathrm{B} \rightarrow {}^{0}_{-1}\mathrm{e} + {}^{208}_{83}\mathrm{C}$$

During beta decay, the atomic number increases by 1, while the mass number remains the same.

(iii) There will not be any change in the mass number and atomic number of nucleus C if it undergoes gamma emission.

Gamma emission normally occurs along with alpha or beta decay.