Mock Bord Exam

ICSE SEMESTER 2 EXAMINATION

PHYSICS

Section A

Choose the correct answers to the questions from the given options. (Do not copy the question, Write the correct answer only.)

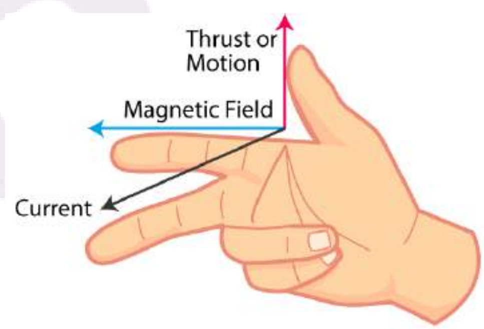
Question 1

(i) The middle finger in Fleming’s right hand rule represents the direction of which quantity?

[1]

a) Motion of conductor
b) Induced current
c) Magnetic field
d) Force on the conductor

Ans. Option b. Induced current.



In Fleming's right-hand rule the thumb represents the direction of the motion of the conductor, the forefinger represents the direction of the magnetic field, and the middle finger represents the direction of the induced current.

(ii) The amplitude of a sound wave determines its:

[1]

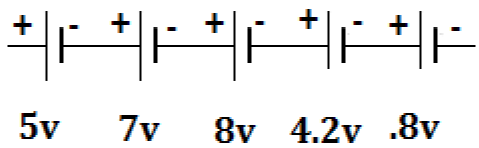
a) Pitch
b) Quality
c) Timbre
d) Loudness

Ans. Option d. Loudness.

The amplitude of a sound wave determines its loudness or intensity. More the amplitude, the louder is the sound.

The loudness of sound is directly proportional to the square of the amplitude. When the amplitude is doubled, loudness becomes 4 times.

(iii) For the figure given below, find the effective potential difference when the batteries are connected in series. [1]



a) 20 volts
b) 24 volts
c) 26 volts
d) 25 volts

Ans. Option d. 25 volts.

In the circuit diagram, the cells are connected in series.

In series connection of cells the total potential difference is the sum of potential difference of all the individual cells.

Effective potential difference = 5 V + 7 V + 8 V + 4.2 V + 0.8 V = 25 V

(iv) The strength of an electromagnet CANNOT be increased by [1]

a) Changing the number of turns of winding in the solenoid
b) Increasing the current through the solenoid
c) Increasing the voltage across the solenoid
d) Changing the direction of flow of current in the solenoid

Ans. d. Changing the direction of flow of current in the solenoid.

- Increasing the number of turns increases the strength of the electromagnet.
- Increasing the current also increases the strength of the electromagnet.
- Increasing the voltage while keeping other factors constant increases the amount of current in the circuit, thus increasing voltage also increases the strength of the electromagnet.

- But changing the direction of flow of current in the solenoid affects the polarity of the electromagnet but the strength of the electromagnet remains as long as other factors remain the same.

(v) A metal ball requires 2000 J heat energy to increase its temperature by 20°C. Calculate the heat capacity of the metal ball. [1]

a) 1000 J/K
b) 500 J/K
c) 100 J/K
d) 250 J/K

Ans. c. 100 J/K.
The change in temperature is Δt = 20 kelvin.
The amount of heat energy required is Q = 2000 J.
Heat capacity C' = Q/Δt = 2000/20 = 100 J/K.

(vi) Which of the following is NOT a property of gamma radiation? [1]

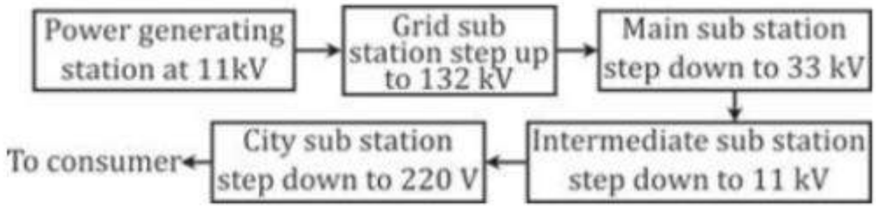
a) Gamma radiations are electromagnetic waves like X-rays and light
b) The speed of gamma radiation is always less than 3×10^8 m/s in air
c) Gamma radiations are not deflected by electric and magnetic fields
d) The ionizing power of gamma radiation is very low

Ans. b. The speed of gamma radiation is always less than 3×10^8 m/s in the air.
The speed of gamma radiation is the same as the speed of light (3×10^8 m/s).
So this statement is not a property of gamma radiation.

(vii) What happens at the intermediate substation? [1]

a) Voltage is stepped down to 33 kV from 132 kV
b) Voltage is stepped down to 11 kV from 33 kV
c) Voltage is stepped up to 132 kV from 11 kV
d) Voltage is stepped down to 220 V from 11 kV

Ans. b. Voltage is stepped down to 11 kV from 33 kV.



- Power is generated at 11 kV at the power station.
- It is then stepped up to 132 kV at the grid substation.
- After that, it is stepped down to 33 kV at the main substation where it is sent to heavy industry and **intermediate substation where it is further stepped down to 11 kV** and sent off to light industry and city substation where it is stepped down to 220 V for the consumer.

(viii) Which of the following is NOT an example of damped vibrations? [1]

a) A tuning fork vibrating in the air
b) A simple pendulum oscillating in air
c) Oscillation of a simple pendulum in a vacuum
d) The vibrations of spring with a mass at its end

Ans. c. Oscillation of a simple pendulum in a vacuum

- A tuning fork vibrating in the air
  - Air offers resistance and the tuning fork will eventually stop vibrating.
  - This is a damped vibration.
- A simple pendulum oscillating in air, this is similar to option A, air offers resistance and it stops after a while.
- Oscillation of a simple pendulum in a vacuum
  - In a vacuum, there is no air resistance, once set in vibration or oscillation, it should continue to do that and amplitude remains constant.
  - This is not a damped oscillation.
- The vibrations of spring with a mass at its end
  - The mass has a gravitational force pulling it down, this causes the vibration of spring to lose its amplitude.
  - Thus it is a damped vibration.

(ix) A heating device melts 60 g of ice in 1 minute. The power supplied by the device is____.
(Latent heat of ice is 80 cal/g)

[1]

a) 4856 W
b) 336 W
c) 60 W
d) 66 W

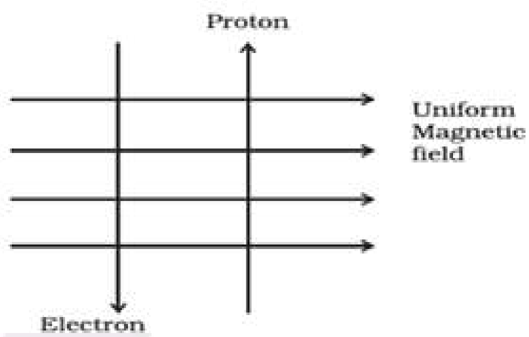
Ans. Option b. 336 W

` Given :

Mass of ice, m = 60 g
Time taken = 1 min = 60 s
Latent heat of ice = 80 cal/g
Work done by the device = W = Heat absorbed by the ice
= 60 x 80 = 4800 cal
= 4800 x 4.2 J = 20160 J
Power, P =W/t = 20160/60 = 336 W

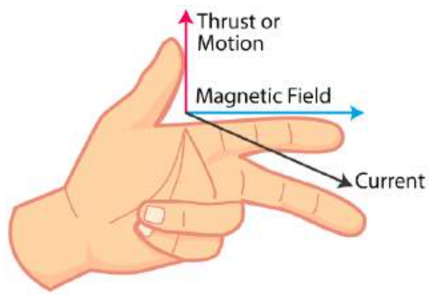
(x) A uniform magnetic field exists in the plane of a paper pointing from left to right as shown in Figure. The electron and the proton in the field experiences a force:

[1]



a) Pointing into the plane of the paper.
b) Pointing out of the plane of the paper.
c) Pointing into the plane of the paper and pointing out of the plane of paper for protons and electrons respectively.
d) Pointing opposite and along the direction of uniform magnetic field for protons and electrons respectively.

Ans. Option a. Pointing into the plane of the paper



Applying Fleming's left hand rule if we keep our index finger in the direction of a magnetic field, and the middle finger in the direction of the current, which is the same direction in which the protons are moving, the direction of the force experienced by them will be in the direction of thumb, which is pointing into the paper.

Section B

*(Attempt any **three questions** from this Section.)*

Question 2

(i) Explain the following parts of an electric motor: [3]

(a) Armature

Ans. A rectangular coil of insulated copper wire wound on a soft iron core makes up a D.C. motor. The armature is made up of this coil coiled on a soft iron core. The coil is positioned between the cylindrical concave poles of a magnet and is mounted on an axle.

(b) Commutator

Ans. A commutator is a device that reverses the direction of current flow. A commutator is a copper ring that is divided into two sections, C1 and C2. The split rings are installed on the motor's axle and are shielded from one another. These rings are attached to the coil's two ends. They spin in time with the coil. A battery is linked to the commutator rings. The cables from the batteries are attached to the brushes, which are in touch with the rings, rather than the rings themselves.

(c) Brushes

Ans. Brushes are two thin strips of carbon that press on the two split rings, and the split rings revolve between them. A D.C. source is used to power the carbon brushes**.**

(ii) (a) What is the difference between Fleming’s left and right-hand rule? [4]

Ans

Fleming’s Left-Hand Rule	**Fleming’s Right-Hand Rule**
It is used for electric motors.	It is used for electric generators.
The purpose of the rule is to find the direction of motion in an electric motor.	The purpose of the rule is to find the direction of induced current when a conductor moves in a magnetic field.
The thumb represents the direction of the thrust on the conductor.	The thumb represents the direction of motion of the conductor.
The index finger represents the direction of the magnetic field.	The index finger represents the direction of the magnetic field.
The middle finger represents the direction of the current.	The middle finger represents the direction of induced current..

(b) Explain different ways to induce a current in a coil

Ans. For electromagnetic induction, the coil and the magnet should be in relative motion. This can be insured by any of the following ways;

- The coil should be moved within a magnetic field such that the flux changes.
- The magnet should be moved keeping the coil at rest.
- Both the coil and magnet be moved.
- The magnetic field strength can be changed.

(c) Which instrument can be used to show that a magnetic field exists around a wire carrying current? Why does a compass needle get deflected when brought near a bar magnet?

Ans.

1) By using a magnetic compass which shows deflection when brought in an external magnetic field we can show magnetic field exists around a wire carrying current.
2) When the compass needle is brought near a bar magnet, the compass needle experiences a deflection. This happens because of the interaction of the magnetic fields of the compass needle and the bar magnet.

(iii) (a) Write one advantage of connecting electrical appliances in parallel combination. [3]

Ans. In a parallel connection, each appliance works independently i.e., any change in one appliance does not affect the other appliance(s).

(b) What characteristics should a fuse wire have?

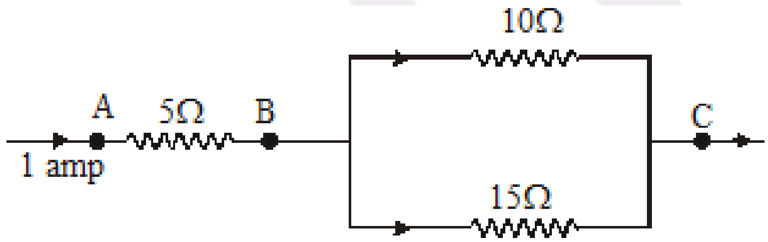
Ans. It should have high specific resistance and low melting point.

(c) Which wire in a power circuit is connected to the metallic body of the appliance?

Ans. Earth wire.

Question 3

(i) Three resistances are connected as shown in the diagram through the resistance 5 Ω, a current of 1 A is flowing : [3]



(a) What is the current through the other two resistors?

Ans For current in parallel conductors

For same potential difference across two parallel resistors

$V = I_1R_1 = I_2R_2$

$I_1 / I_2 = R_2 / R_1 = 3 / 2$

$I_1 + I_2 = 1$ A

Hence

$I_1 = 0.6$ A, $I_2 = 0.4$ A

(b) What is the potential difference (p.d.) across AB and across AC?

Ans. For p.d. across AB

From ohm's law, R - V / I, V = IR

V = I x 5 = 5 V

For p.d. across BC

$V = I_1R_1 = I_2R_2$

V = 0.6 x 10 = 6 V

For p.d. across AC

$V = V_{AB} + V_{BC}$
$V = 5\ V + 6\ V = 11\ V$

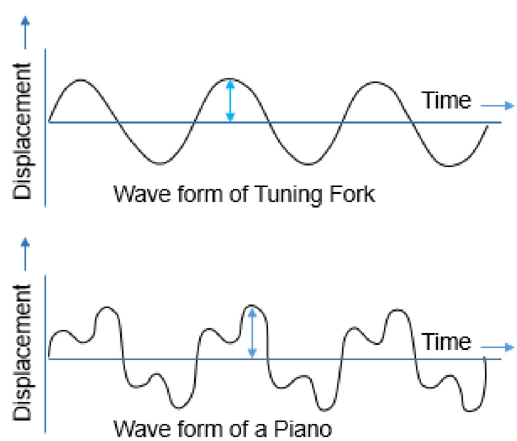
(c) What is the total resistance?
Ans. For total circuit resistance
For 10 ohms and 15 ohms in parallel
$R_P = (10 \times 15) / (10 + 15) = 6$ ohms
Total resistance = 5 + 6 = 11 ohms

(ii) (a) It is observed that during march - past we hear a base drum distinctly from a distance compared to the side drums. Name the characteristic of sound associated with this observation and explain why it is so. [3]

Ans.
- The sound from the two types of drums have different pitch and amplitude, so they can easily be distinguished at a distance due to their different pitch and loudness.
- The sound from the base drum is of large amplitude but of grave note (having low frequency), while the sound from side drums have high pitch (high frequency).

(b) What distinguishes between the sounds of same pitch and loudness produced from a tuning fork and a piano?

Ans.
- Quality or timbre of sound distinguishes between the sounds of same pitch and loudness produced from a tuning fork and a piano.
- The quality of a musical sound depends on the waveform. It depends on the number of subsidiary notes and their relative amplitudes present in it along with the principle note.



(iii) (a) Distinguish between natural and forced vibrations. [4]

Ans.

Natural Vibrations	Forced Vibrations
The vibrations of a body in absence of any resistive or external force are called natural vibrations.	The vibrations of a body in a medium in presence of an external periodic force are called forced vibrations.
The frequency of vibration depends on the shape and size of the body.	The frequency of vibration is equal to the frequency of the applied force.
The frequency of vibration remains constant.	The frequency of vibration changes with a change in the frequency of the applied force.
The amplitude of vibration remains constant with time (in the absence of the surrounding medium).	The amplitude of vibration depends on the frequency of the applied force.

(b) What is resonance and its condition for occurrence?

Ans. Resonance is a special case of forced vibrations.

- When the frequency of the externally applied periodic force on a body is equal to its natural frequency, the body readily begins to vibrate with an increased amplitude. This phenomenon is known as resonance.
- The vibrations of large amplitudes are called resonant vibrations. Resonance occurs only when the applied force causes forced vibration in the body and the frequency of the applied force is exactly equal to the natural frequency of the vibrating body.

(c) List down at least three examples for resonance.

Ans. Examples of resonance:

1. *Resonant vibrations of pendulums* - if two pendulums of the same length are suspended from a rubber string and one pendulum is made to vibrate, the other pendulum also starts to vibrate with a large amplitude and in the same phase because of resonance.
2. Resonance in machine parts - When a vehicle is driven, the piston of the engine makes to and fro motion at a frequency depending on the speed of the vehicle. These vibrations are communicated to the entire vehicle. It is possible that at a certain speed of the vehicle, the natural frequency of the frame of the vehicle may match with the frequency of vibrations of the piston. This causes a rattling sound at that speed. This is resonance.

3. *Resonance in a stretched string and soundbox* (eg. hollow chamber of a guitar) of musical instruments and sonometer - Vibrating string by itself produces a very weak sound which cannot be heard at a distance. Therefore all stringed musical instruments such as guitar and sonometer are provided with a sound box (hollow chamber). This box is constructed such that the natural frequency of the column of air inside it is the same as that of the string stretched on it.
4. *Resonance in the air column and tuning fork* - when a vibrating tuning fork is brought near a burette which is draining water slowly, at a certain length of the air column, a loud sound is heard. This is due to resonance.
5. Resonance in a bridge - when a troop crosses a suspension bridge, the soldiers are asked to break their steps. The reason is that when each soldier exerts a periodic force in the same phase, a forced vibration is produced in the bridge, when this frequency of the forced vibration matches with the natural frequency of the bridge, the bridge will vibrate with a large amplitude due to resonance and the suspension bridge may collapse.

Question 4

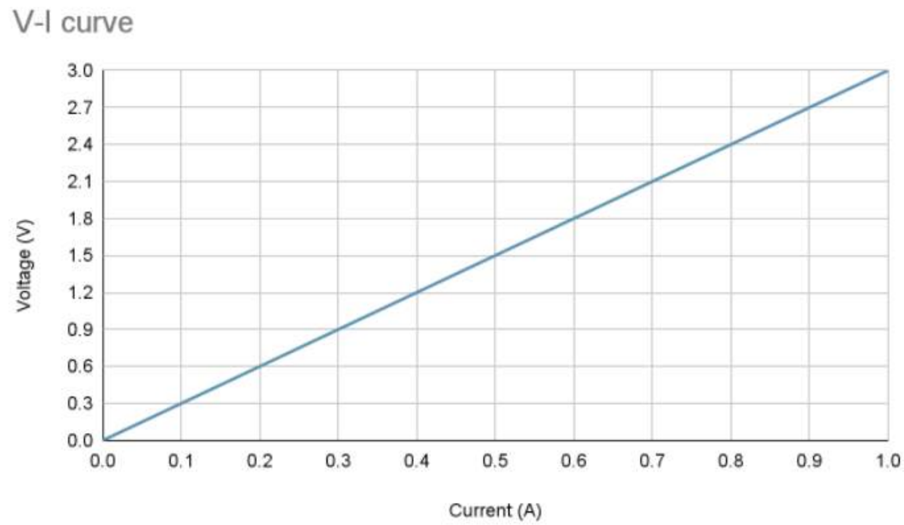
(i) In the experimental verification of Ohm's law, the following observations are obtained. [3]

Potential difference (in volt)	0.6	1.2	1.8	2.4	3
Current (in Ampere)	0.2	0.4	0.6	0.8	1.0

Draw a V-I graph and use this graph to find:

a. The potential difference V when the current is 0.9 A.
b. The current I when the potential difference V is 2.1 V.
c. The resistance in the circuit.

Ans.



The V-I graph for the given table looks like this. From this graph, we can find out the potential difference when the current is 0.9 A.

a. At 0.9 A current, the voltage is 2.7 V.
b. When the potential difference is 2.1 V, the current is 0.7 A.
c. The resistance can be obtained by calculating the slope of the graph.
   Let's take two points when i = 0.2 and 0.4. Then V = 0.6 and 1.2 respectively. Now slope = (1.2-0.6)/(0.4-0.2) = 0.6/0.2 = 3 ohms.
   The resistance is 3 ohms.

(ii) (a) A transformer is designed to give a supply of 10 V to ring a house bell from 240 V AC mains. The primary coil has 4800 turns. How many turns will be in the secondary coil? [3]

Ans.

emf across secondary coil/emf across primary coil = number of turns in secondary coil/number of turns in the primary coil

The primary coil's terminal is connected to AC mains and the secondary coil's terminal to the bell.

From the formula mentioned above,

10/240 = n/4800

10 x 4800/240 = n

n = 200

The turns in the secondary coil will be 200.

(b) Define Faraday's laws of electromagnetic induction.

Ans. Faraday formulated the following two laws of electromagnetic induction:

1. Whenever there is a change in magnetic flux linked with a coil, an emf is induced. The emf induced lasts so long the magnetic flux linked with the coil changes.
2. The magnitude of emf induced is directly proportional to the rate of change of magnetic flux linked with the coil. If magnetic flux changes at a constant rate, a steady emf is produced.

(iii) (a) Distinguish between heat and temperature [4]

Ans.

Heat	Temperature
Heat is that form of energy that flows from a hot body to a cold body when they are kept in contact.	Temperature is a quantity that determines the direction of flow of heat on keeping the two bodies at different temperatures in contact.
The S.I. unit of heat is joule (J).	The S.I. unit of temperature is kelvin (K).
The amount of heat contained in a body depends on the mass, temperature and substance of the body.	The temperature of a body depends on the average kinetic energy of its molecules due to their random motion.
Heat is measured by the principle of calorimetry.	Temperature is measured by a thermometer.
Two bodies having the same quantity of heat may differ in their temperature	Two bodies at the same temperature may differ in the quantities of heat contained in them.
When two bodies are placed in contact, the total amount of heat is equal to the sum of heat of the individual body.	When two bodies at different temperatures are placed in contact, the resultant temperature is a temperature in between the two temperatures.

(b) Calculate the heat capacity of a copper vessel of mass 200 g if the specific heat capacity of copper is 410 J/kg K.

Ans.

Given,

Mass of copper vessel = 200 g = 0.2 kg.

The specific heat capacity of copper is 410 J/kg K

Heat capacity of the copper vessel = specific heat capacity of copper x mass of the copper vessel.

Heat capacity of copper vessel = 410 x 0.2 = 82 J/K

(c) How much heat energy is required to increase the temperature of the vessel in part (b) from 25 °C to 35 °C?

Ans. We got the heat capacity of the vessel as 82 J/K.
Heat energy required to increase the temperature of the vessel = heat capacity x difference in temperature = 82 J/K x 10 K = 820 J

Question 5

(i) (a) List down at least three natural consequences of high specific latent heat of fusion of ice. [2]

Ans.

1. Snow on mountains does not melt all at once.
2. In cold countries water in lakes and ponds does not freeze all at once.
3. Drinks get cooled more quickly by adding pieces of ice than the ice cold water at 0°C.
4. When the ice in a frozen lake starts melting, its surroundings become very cold.
5. It is generally colder after a hail storm (when the ice melts) than during or before the hail storm.

(b) Heat energy is supplied at a constant rate to 600 g of ice at 0 °C. The ice is converted into water at 0 °C in 8 minutes. How much time will be required to raise the temperature of water from 0 °C to 100 °C? [1]
Specific latent heat of ice = 336 J/g,
specific heat capacity of water = 4.2 J/g K.

Ans.

Heat energy required to melt 600 g of ice at 0°C = mL = 600 x 336 = 201,600 J.
The heat energy is supplied in 8 minutes.
Heat energy supplied per minute = 201600/8 min = 25,200 J/min
Heat energy required to raise the temperature of water from 0°C to 100°C = m x c x rise in temperature = 600 x 4.2 x 100 = 252,000 J
Time required for this heat energy = Heat energy required/heat energy supplied = 252000 J/(25200 J/min) = 10 min

(ii) (a) Distinguish among at least four properties of α,β, and ɣ radiations. [2]

Ans.

Property	**α - particle**	**β - particle**	**ɣ - radiation**
Nature	Stream of positively charged particles	Stream of negatively charged particles	Highly energetic electromagnetic

			radiations
Speed	Nearly 10^7 m/s	About 90% of the speed of light or 2.7 x 10^8 m/s	3 x 10^8 m/s (in vacuum)
Charge	Positive charge (two times that of a proton) = + 3.2 x 10^{-19} C (or + 2 e)	Negative charge = - 1.6 x 10^{-19} C (or -e)	No charge
Effect of electric and magnetic fields	Less deflected but opposite to that of a beta particle	More deflected than alpha particles, but in a direction opposite to those of alpha particles	Unaffected
Penetrating power	Small 3 to 8 cm in air	Large Upto a few metres in the air	Very large Upto a few hundred metres in the air
Biological damage	Less damage	More damage	Immense damage

(b) List down sources of harmful radiation and types of harmful biological effects of Radiation. [1]

Ans. Sources of harmful radiations,

1. Radioactive fallout from the nuclear power plants.
2. Nuclear waste
3. Other sources such as cosmic radiation and X-rays.

Types of harmful biological effects of radiation are

1. Short-term recoverable effects like diarrhea, sore throat, loss of hair, nausea, etc.
2. Long term irrecoverable effects like leukemia and cancer, and
3. Genetic effects

(iii) (a) A certain nucleus P has a mass number 18 and atomic number 9. [2]

1. Find the number of neutrons.
2. Write the symbol for the nucleus P
3. The nucleus P loses (i) one proton, (ii) one β particle, (iii) one α particle. Write the symbol of the new nucleus in each case and express each change by a reaction.

Ans. For the nucleus P, A = 18, Z = 9.

1. Mass number A = number of protons + number of neutrons and atomic number Z = number of protons.
   Number of neutrons = A - Z = 18 - 9 = *9*

2. The nucleus P can be written as ${}^{18}_{9}P$.

3. (i) After the loss of 1 proton, the mass number and an atomic number of the nucleus ${}^{18}_{9}P$ will decrease by 1. The new nucleus will be ${}^{17}_{8}Q$. It can be written as
   ${}^{18}_{9}P \rightarrow {}^{17}_{8}Q + {}^{1}_{1}p$

   (ii) After the loss of one β particle, the mass number will remain the same, but the atomic number will increase by 1. The nucleus changes from ${}^{18}_{9}P$ to ${}^{18}_{10}R$. It can be expressed as
   ${}^{18}_{9}P \rightarrow {}^{18}_{10}R + {}^{0}_{-1}e$

   (iii) After the loss of one α particle, the mass number decreases by 4, and the atomic number decreases by 2. The nucleus ${}^{18}_{9}P$ changes to ${}^{14}_{7}S$. It can be expressed as ${}^{18}_{9}P \rightarrow {}^{14}_{7}S + {}^{4}_{2}He$

(Chapter name - Radioactivity**, Subtopic name -** Changes in the nucleus**, Bloom -** Understand**)**

(b) Distinguish between nuclear fission and nuclear fusion. [2]

Ans.

Nuclear Fission	**Nuclear Fusion**
In fission when neutrons are bombarded on a heavy nucleus, it splits into two nearly equal light fragments.	In fusion, at a very high temperature and high pressure, two light nuclei combine to form a heavy nucleus.
This reaction is possible at ordinary temperature and ordinary pressure.	This reaction is possible only at a very high temperature (10^7 K) and very high pressure.
In one fission reaction, nearly 190 MeV energy is released.	In one fusion reaction, nearly 24.7 MeV energy is released
For the same mass, the energy released in the fission process is less than that in the fusion process.	For the same mass, the energy released in the fusion process is much more than that in the fission process.
The fissionable substance is radioactive, so it gives out harmful radiation and it creates problems in the disposal of its waste.	The fusionable substance is not radioactive, so it does not give out any harmful radiation, and disposal of its waste is also not difficult.
A limited amount of fissionable substances is	The fusionable substance is found in

available in nature.	abundance.
The Fission process can be controlled. A nuclear reactor is based on a controlled fission reaction.	Fusion reactions cannot be controlled. This is why fusion reactors could not be constructed so far.
A nuclear bomb is based on an uncontrolled fission reaction.	A hydrogen bomb is based on the uncontrolled fusion reaction.

Question 6

(i) (a) Compare loudness and intensity of sound. Are they the same or different? [2]

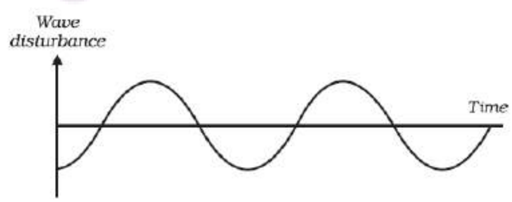
Ans.

- Loudness is a measure of the compression formed in the Eardrums. If a wave is loud, it means it has a large amplitude.
- On the other hand, intensity is the amount of disturbance reaching our ears. It is the amount of sound energy passing each second through a unit area.
- Hence, they are not similar.

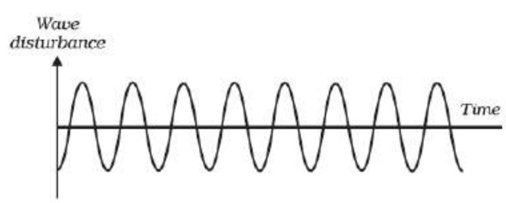
(b) Explain the difference between low-pitched and high-pitched sound using diagrams. [3]

Ans.

- How the brain interprets the frequency of an emitted sound is called the pitch.
- The faster the vibration of the source, the higher is the frequency and the higher is the pitch.
- Thus, a high pitch sound corresponds to more number of compressions and rarefactions passing a fixed point per unit time.
- Conversely, a low-pitched sound has a lesser frequency.



Wave shape for a low pitched sound



Wave shape for a high pitched sound

(c) What should be the minimum distance between the source and reflector in water so that the echo is heard distinctly? (The speed of sound in water = 1400 m/s) [2]

Ans.

Given,

Time period of persistence of ear for simple sound = 0.1 s.

Therefore, to hear the distinct echo of a simple sound, the minimum time taken by the sound to reach the listener after reflection should be 0.1 s.

Let d be the distance between source and reflector.

The time taken by sound to reach the listener after reflection = t

The sound will travel the total distance of 2d.

$$2d = v \times t$$
$$d = vt/2$$

Now, putting the values,

v = 1400 m/s

t = 0.1 s

We get,

d = 70 m

The minimum distance between the source and reflector in water so that the echo is heard distinctly should be 70 m.

(ii) (a) State whether the current is a scalar or vector? What does the direction of current convey? [1]

Ans.

Current is a scalar quantity. The direction of current conveys that the flow of electrons is opposite to the direction of flow of current.

(b) In a conductor, 6.25×10^{16} electrons flow from its end A to B in 2 s. Find the current flowing through the conductor ($e = 1.6 \times 10^{-19}$ C). [2]

Ans.

Given,
Number of electrons flowing through the conductor,
$n = 6.25 \times 10^{16}$ electrons
Time taken, $t = 2$ s
Given, $e = 1.6 \times 10^{-19}$ C
Let I be the current flowing through the conductor.
Then, $I = ne/t$
$I = \{ (6.25 \times 10^{16})(1.6 \times 10^{-19})\}/2$
$I = 5 \times 10^{-3}$ A or 5 mA