# ICSE SEMESTER 2 EXAMINATION

# SAMPLE PAPER - 5

# PHYSICS

# (SCIENCE PAPER 1)

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*Maximum Marks: 40*

*Time allowed: One and a half hours*

*Answers to this Paper must be written on the paper provided separately.*

*You will not be allowed to write during the first 10 minutes.*

*This time is to be spent in reading the question paper.*

*The time given at the head of this Paper is the time allowed for writing the answers.*

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*Attempt **all** questions from **Section A** and **any three** questions from **Section B**.*

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## SECTION A

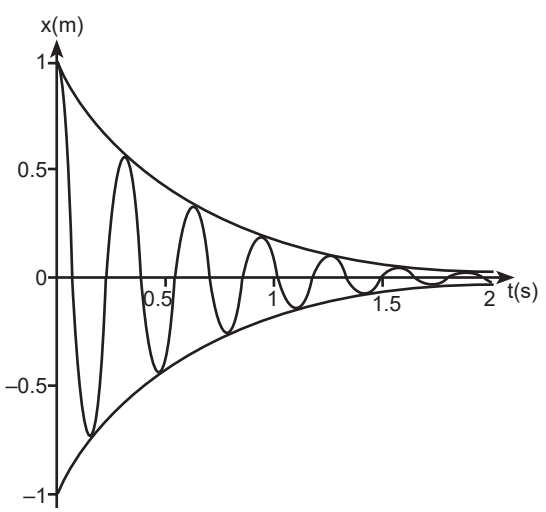
*(Attempt **all** questions.)*

## Section-A (Attempt all questions)

**Question 1.**

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

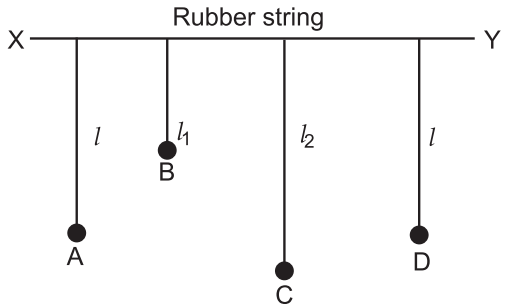
(i) Consider the following figure:




What kind of vibration the picture depicts?

(a) Forced (b) Free (c) Damped (d) Both (a) and (c)

(ii) Four pendulums A, B, C, and D are suspended from a piece of rubber string XY, as shown in figure. Pendulums A and D have same lengths of $l$. Pendulums B and C have lengths of $l_1$ and $l_2$, respectively.




Four pendulum A, B, C, and D

Which of the following will experience resonance when pendulum A is brought into vibration by setting its bob to one side normal to the length of XY ?

(a) B (b) C (c) D (d) Both (b) and (c)

(iii) The piston of a truck makes 'to and fro' motion at a frequency controlled by the speed of the vehicle. Is it possible that some part of the engine vibrate vigorously due to resonance? If so, what's the reason behind it?

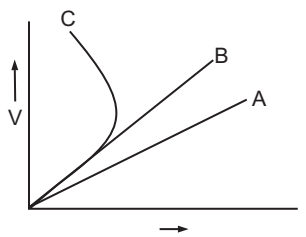
(a) It is not possible.

(b) It is possible only if the truck moves at maximum velocity of the truck.

(c) It is possible only if the truck moves with the same velocity of its engine parts.

(d) It is possible only if the truck's running velocity is such that vibration frequency of some parts matches with the natural frequency of the piston.

(iv) Which of the following trend in V-I graph will never be obtained when two resistors of resistance 2 Ω and 6 Ω are connected in parallel?




(a) Trend A (c) Trend B

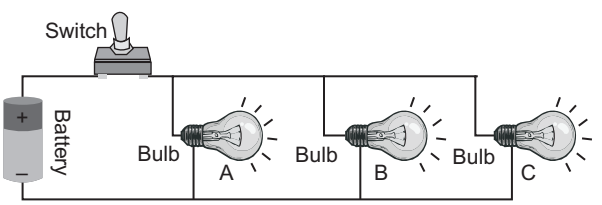
(b) Trend C (d) Both Trend A and B

(v) Which of the following is the approximate order of size of nucleus?

(a) $10^{-15}$ to $10^{-9}$ m (c) $10^{-15}$ to $10^{-14}$ m

(b) $10^{-24}$ to $10^{-15}$ m (d) $10^{-25}$ to $10^{-9}$ m

(vi) Three bulbs, A, B, and C are connected in parallels with a battery of 16 V and a switch, as shown in the figure below. Resistance of bulb A is twice of B but half of C. Answer the following questions?




Which bulb will have access to minimum amount of current?

(a) Bulb A (c) Bulb C

(b) Bulb B (d) None of these

(vii) Two wires X and Y of equal resistance is allowed to carry the current for equal time. If the ratio of current passing through wire X and wire Y is 1:3, what is the ratio of heat produced ($H_X$:$H_Y$) by them?

(a) 1:9 (c) 3:1

(b) 1:3 (d) 9:1

(viii) In electric lamp, electrical energy changes into which of type/types of energy?

(a) Mechanical energy and light energy

(b) Light energy and heat energy

(c) Heat energy and chemical energy

(d) Chemical energy and nuclear energy

(ix) What is nucleons?

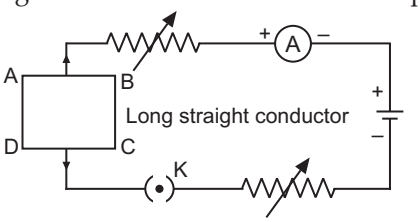
(a) Electrons that are orbiting nearest to the nucleus.

(b) Electrons that are orbiting farthest to the nucleus.

(c) Combination of neutrons and protons.

(d) A newly discovered particles.

(x) In the following picture the magnetic field line over a horizontal plane ABCD will be :




(a) Elliptical in shape

(b) Concentric circle

(c) Straight lines

(d) Concentric at the centre elliptical as to away

## Section-B (Attempt any three questions from this section)

**Question 2.**

(i) What change occur in the nucleus of a radioactive element when it emit :

(a) an alpha particle

(b) a beta particle

(c) gamma radiations

(ii) In the nuclear reaction given below, a nucleus X changes to another nucleus Y:

$$_{88}X^{226} \longrightarrow Y + \alpha + \text{Energy}$$

(a) What are the atomic and mass number of Y ?

(b) Name the gas formed when the α-particle acquires two electrons.

(c) What is the effect on the motion of the α-particle when it passes through a region containing a magnetic field ?

(iii) The temperature of a lead piece of mass 400 g rises from 20°C to 50°C when 1560 J of heat is supplied to it. Calculate:

(a) Heat capacity of lead piece

(b) Specific heat capacity of lead.

**Question 3.**

(i) State three factors on which a current induced in a conductor depends when placed in a Magnetic field?

(ii) (a) What are superconductors?

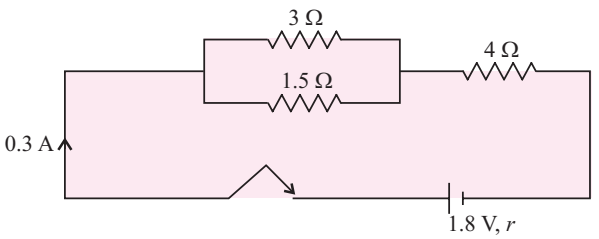
(b) Calculate the current drawn by an appliance rated 110 W, 220 V when connected across 220 V supply.

(c) Name a substance whose resistance decreases with the increase in temperature.

(iii) The diagram above shows three resistors connected across a cell of e.m.f. 1.8 V and internal resistance r. Calculate :

(a) Current through 3 Ω resistor.

(b) The internal resistance r.



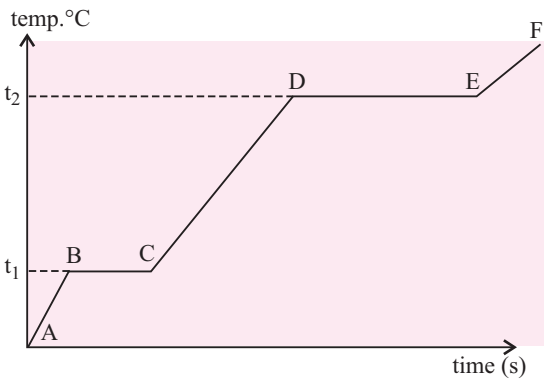

**Question 4.**

(i) (a) Define heat capacity of a substance.

(b) Write the SI unit of heat capacity.

(c) What is the relationship between heat capacity and specific heat capacity of a substance ?

(ii) The diagram below shows the change of phases of a substance on a temperature vs time graph on heating the substance at a constant rate.




(a) Why is the slope of CD less than slope of AB ?

(b) What is the boiling and melting point of the substance ?

(iii) A piece of ice of mass 60 g is dropped into 140 g of water at 50°C. **[4]**

Calculate the final temperature of water when all the ice has melted.

(Assume no heat is lost to the surrounding)

Specific heat capacity of water = 4.2 $Jg^{-1} K^{-1}$

Specific latent heat of fusion of ice = 336 $Jg^{-1}$

**Question 5.**

(i) (a) Which materials are used for making wires of standard resistance ?

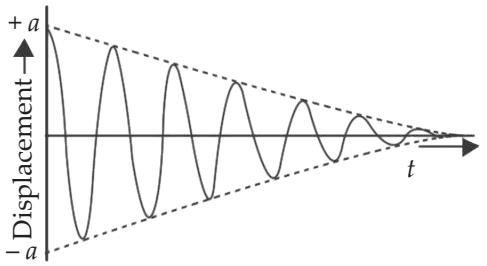
(b) Give reasons.

(ii) An electric kettle is rated 2.5 kW, 250 V. Find :

(a) Energy consumed in 2 hrs in KWh.

(b) The cost of running the kettle for two hours at 60 paise per unit.

(iii) The diagram below shows the displacement time graph for a vibrating body.




(a) Name the type of vibrations produced by the vibrating body.

(b) Given one example of a body producing such vibrations.

(c) Why is amplitude of the wave gradually decreasing?

(d) What will happen to the vibrations of the body after some time?

# Answers

## Section-A

**Answer 1.**

(i) (d) Both (a) and (c)

**Explanation :**

In damped vibration the amplitude reduces with time due to some external resistive force. Thus it is both forced and damped vibration.

(ii) (c) D

**Explanation :**

The vibrations produced in pendulum A will act as forced vibration to other pendulums through the rubber string XY. The pendulums B and C will remain in the state of forced vibrations while the pendulum D will come in the state of resonance. Because the natural frequency of pendulum D is equal to that of pendulum A (both pendulums A and D have the same length), energy will only be exchanged between the pendulums A and D. As a result, resonance will occur in pendulum D only.

(iii) (d) It is possible only if the truck's running velocity is such that vibration frequency of some parts matches with the natural frequency of the piston.

**Explanation :**

Resonance will occur only if the truck's running velocity is such that vibration frequency of some parts matches with the natural frequency of the piston.

(iv) (b) Trend C

**Explanation :**

Whether the resistances are connected in series or parallel. It will be a straight line. So trend C will not appear.

(v) (c) $10^{-15}$ to $10^{-14}$ m

**Explanation :**

The nucleus of an atom can be found at the centre of an atom whose size is of the order of $10^{-15}$ to $10^{-14}$ m and it consists of protons and neutrons where both proton and neutron are charged particles.

(vi) (c) Bulb C

**Explanation :**

As bulbs are in parallel connection, the only thing that will determine accessible current is resistances of the bulb. As bulb C has highest resistance, it will carry less current.

(vii) (a) 1:9

**Explanation :**

Heat produced, (H) = $I^2Rt$. Here R and $t$ are constant.

Thus, $H_X/H_Y = (I_X/I_Y)^2 = 1/9$.

Thus the ratio of heat produced ($H_X$:$H_Y$) = 1:9.

(viii) (b) Light energy and heat energy

**Explanation :**

In electric lamp, electrical energy gets converted into light energy and heat energy. The bulb is heated, as a result of this heat energy.

(ix) (c) Combination of neutrons and protons.

**Explanation :**

The nucleons are the major constituents of the nucleus, which are protons and neutrons. The total number of nucleons in the nucleus is referred to as the element's mass number, and it is represented by the letter A.

(x) (b) Concentric circle

**Explanation :**

Magnetic field lines around a straight current carrying conductor are in the form of concentric circle.

## Section-B

**Answer 2.**

(i) (a) Emission of an α-particle :

$$^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$$

(α-particle)

The resulting nucleus has 2 protons and 2 neutrons (total 4 nucleons) less than the original (or parent) nucleus.

E.g. $$^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

(α-particle)

(b) Emission of β-particle :

$$^{A}_{Z}X \longrightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}e$$

(β-particle)

The resulting nucleus has same number of nucleons.

In this mass number remains same but atomic number increased by one.

E.g. $$^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

(c) Gamma Emission :

$$^{A}_{Z}X \longrightarrow {}^{A}_{Z}X + \gamma$$

(Excited state of nucleus) (Gamma radiations)

There is no change in mass number (A) and atomic number (Z) of the nucleus in gamma emission.

(ii) $${}_{88}X^{226} \longrightarrow Y + \alpha + \text{Energy}$$

(a) Atomic number of Y is 86 and mass number is 222.

(b) The gas formed is Helium (He).

(c) When the α-particle passes through a region containing a magnetic field, it gets deflected.

(iii) (a) Heat capacity of lead piece

$$= \frac{\text{Heat supplied}}{\text{Rise in temperature}} = \frac{1560}{(50° - 20°)}$$

$$= 52 \text{ J/°C}$$

(b) Specific heat capacity of lead

$$= \frac{\text{Heat supplied}}{\text{Mass} \times \text{Rise in temperature}}$$

$$= \frac{1560}{(400) \times (50° - 20°)}$$

$$= 0.13 \text{ J/g°C}$$

**Answer 3.**

(i) Three factors on which a current induced in a conductor placed in a magnetic field depends are :

(a) Number of turns of the conductor. Greater the number of turns more is the current in it.

(b) Area of cross section of the conductor. Greater the area of cross section of the conductor more is the current induced in it.

(b) Rate of change of magnetic flux linked with the conductor. Greater the magnetic lines of flux cut by the motion of a conductor more is the current induced in it.

(ii) (a) Superconductors are substances with zero resistance at very low temperatures.

(b) P = 110 W, V = 220 volt

Current $$I = \frac{P}{V} = \frac{110}{220} \text{ A} = 0.5 \text{ A}$$

(c) For semiconductors such as silicon, germanium, resistance decreases with the increase in temperature.

(iii) (a) Equivalent resistance of 3Ω and 1.5Ω in parallel,

$$R_1 = \frac{3 \times 1.5}{3 + 1.5} \Omega = 1\Omega$$

Potential difference, across $R_1$

$$\Rightarrow \quad V_1 = IR_1$$
$$= 0.3 \times 1 = 0.3V$$

$\therefore$ Current through 3Ω resistor,

$$I_1 = \frac{V_1}{3} = \frac{0.3}{3} = 0.1A$$

(b) Total external resistance of the circuit, R = 1 + 4 = 5Ω

$$\because \quad E = I(R + r)$$
$$\Rightarrow \quad 1.8 = 0.3(5 + r)$$
$$\Rightarrow \quad \frac{1.8}{0.3} = 5 + r$$
$$\Rightarrow \quad 6 = 5 + r$$
$$\therefore \quad r = 6 - 5 = 1 \ \Omega$$

**Answer 4.**

(i) (a) Heat capacity of a body is the amount of heat energy required to raise its temperature by 1 Kelvin.

(b) SI Unit of heat capacity is joule per Kelvin ($JK^{-1}$).

(c) Heat capacity = Mass × Specific heat capacity

(ii) (a) The slope of CD is less than slope of AB because specific heat capacity of liquid phase of same material can be different from that of solid phase of same material.

(b) Boiling point is $t_2$°C and melting point is $t_1$°C.

(iii) Let final temperature of water = $x$°C

| **Ice** | **Water** |
|---|---|
| $m_1 = 60$ g | $m_2 = 140$ g |
| $T_1 = 0$°C | $T_1 = 50$°C |
| $T_2 = x$°C | $T_2 = x$°C |
| Rise in temp. | fall in temp. |
| $(\Delta T) = (x - 0)$°C $= x$°C | $(\Delta T) = (50 - x)$°C |

$$\text{Heat gained by ice} = m_1L + m_1c\Delta T$$
$$= (60 \times 336 + 60 \times 4.2 \times x)\ J$$
$$\text{Heat lost by water} = m_2c\Delta T$$
$$= 140 \times 4.2 \times (50 - x)\ J$$

Applying, the principle of mixtures,

$$140 \times 4.2 \times (50 - x) = 60 \times 336 + 60 \times 4.2 \times x$$

$$\Rightarrow \quad 4.2\,(7000 - 140x - 60x) = 60 \times 336$$

$$\Rightarrow \quad 7000 - 200x = \frac{60 \times 336}{4.2} = \frac{60 \times 336}{42} \times 10 = 4800$$

$$\Rightarrow \quad 200x = 2200$$

$$\Rightarrow \quad x = 11\text{°C}$$

$\therefore$ Final temperature of water = 11°C

**Answer 5.**

(i) (a) Alloys such as manganin, constantan etc., are used for making wires of standard resistance

(b) Since the resistance of these materials remain almost unaffected with the change in temperature, it is used for making wires of standard resistance.

(ii) Given : Power = 2·5 kW, V = 250 V

$$\text{Energy in KWh} = P \times t = 2{\cdot}5\ kW \times 2\ h$$
$$= 5\ kWh$$

$\therefore$ Cost $= 0{\cdot}60 \times 5$

$= ₹\ 3$

(iii) (a) The diagram shows damped vibrations.

(b) A tuning fork vibrating in air.

(c) The amplitude of the wave decreases due to frictional force which the surrounding medium exerts on the vibrating body.

(d) After some time the amplitude gradually decreases and finally stops.

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