SEMESTER 2 EXAMINATION 2022

(PHYSICS)

SCIENCE PAPER 1

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**.*

The marks intended for questions are given in brackets [ ].

SECTION A

*(Attempt **all** questions from this section.)*

Question 1

Choose the correct answers to the questions from the given options. (Do not copy the question. Write the correct answer only.) **[10]**

(i) Free vibrations are :

(a) the vibrations under the influence of a periodic force

(b) the vibrations with larger amplitude

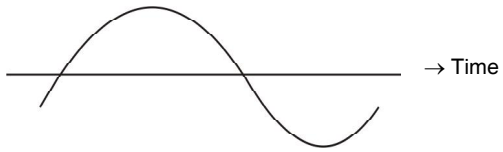
(c) the vibrations when the frequency continuously decreases

(d) the vibrations with a constant frequency and constant amplitude

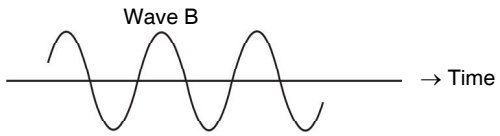
Ans. (d) the vibrations with a constant frequency and constant amplitude

(ii) The diagram below shows four sound waves. Which sound has the highest pitch ?

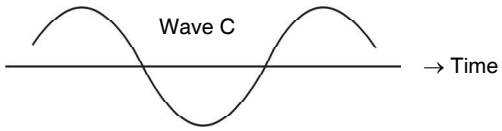
(a)



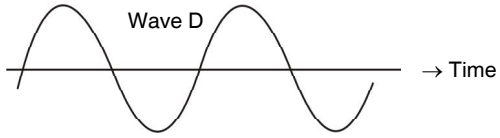
(b)



(c)



(d)



Ans. (b) [A sound wave with a higher frequency has a higher pitch].

(iii) The graph plotted for potential difference (V) against current (I) for ohmic resistors is :

(a) A curve passing through the origin

(b) A straight line not passing through origin

(c) A straight line passing through origin

(d) A circle centred at the origin

Ans. (c) [As per Ohm's law, current is directly proportional to potential difference]

(iv) A main switch in the main distribution board is present in :

(a) A live wire

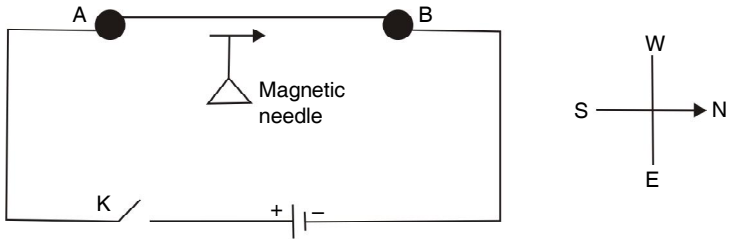
(b) A neutral wire

(c) A live as well as neutral wire

(d) An earth wire

Ans. (a) A live wire

(v) A conductor AB is kept along north south direction of the earth above a magnetic needle as shown below. When the key K is closed then :



(a) the needle will not show any deflection

(b) the needle will deflect towards east

(c) the needle will turn in the opposite direction, *i.e.* towards south

(d) the needle will deflect towards west

Ans. (d) the needle will deflect towards west

(vi) A coil wound around a piece of soft iron can become an electromagnet only when :

(a) the circuit is open (b) a magnetic compass is present in the vicinity

(c) a galvanometer is connected to the circuit (d) a current flows in the circuit

Ans. (d) a current flows in the circuit

(vii) If water absorbs 4000 joule heat to increase the temperature of 1 kg water through 1°C then the specific heat capacity of water is :

(a) 4 $Jkg^{-1}\ °C^{-1}$ (b) 400 $Jg^{-1}\ °C^{-1}$ (c) 4 $Jg^{-1}\ °C^{-1}$ (d) 4·2 $Jg^{-1}\ °C^{-1}$

Ans. (c) [Since specific heat capacity $C = \frac{Q}{m\Delta T} = \frac{4000}{1000 \times 1}\frac{J}{g°C}$]

(viii) Water is used in car radiators because :

(a) it is a good conductor of heat.

(b) it conducts heat faster as compared to the other substances and cools the engine quickly.

(c) its specific heat capacity is very low.

(d) its specific heat capacity is very high so it can cool the engine without a greater increase in its own temperature.

Ans. (d) its specific heat capacity is very high so it can cool the engine without a greater increase in its own temperature.

(ix) The heaviest nuclear radiation is :

(a) X-radiation (b) α-radiation (c) γ-radiation (d) β-radiation

Ans. (b) α-radiation

(x) To study the age of excavated material of archaeological significance, we study the rate of decay of an isotope of :

(a) Uranium (b) Cobalt (c) Carbon (d) Chlorine

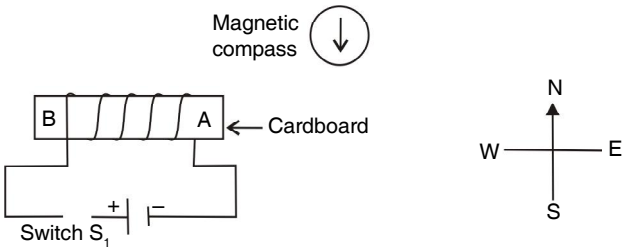
Ans. (c) Carbon

SECTION B

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

Question 2

(i) The diagram below shows a magnetic compass kept closer to a coil AB wound around a hollow cylindrical cardboard : **[3]**



(a) After studying the circuit and the magnetic compass carefully, state whether the switch S_1 is open or closed.

Ans. Switch S_1 is closed.

(b) How did you arrive at the conclusion in (a)?

Ans. Because if the switch S_1 is open, then there will be no current flowing in coil AB and thus there is no magnetic field around it and in that case needle of the magnetic compass should point in geographical N-S direction.

(c) What is the purpose of placing the magnetic compass in the above setup?

Ans. The purpose of placing the magnetic compass in the above set up is to detect the presence of magnetic field around coil AB.

(ii) (a) Give an important reason for copper to be used as a material for a calorimeter. **[3]**

Ans. Copper has a low specific heat capacity so the amount of heat energy taken by the calorimeter itself from the contents to acquire its temperature is very small.

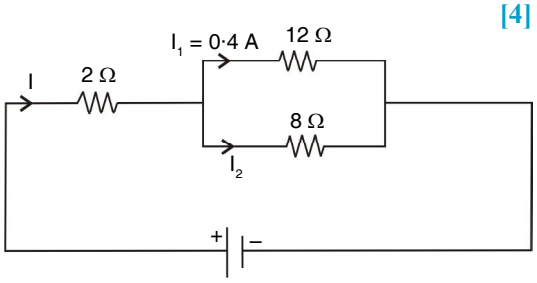
(b) Calculate the thermal capacity of 40 g of water. [Specific heat capacity of water $= 4200\ J\ kg^{-1}\ °C^{-1}$]

Ans. Thermal or heat capacity $C' = m \times C$

Given $m = 40$ g and $C = 4200\ J\ kg^{-1}\ °C^{-1} = 4{\cdot}2\ J\ g^{-1}\ °C^{-1}$

$C' = 40 \times 4{\cdot}2 = 168\ J\ °C^{-1}$

(iii) In the circuit diagram given alongside, calculate : **[4]**



(a) the external resistance of the circuit.

Ans. From the figure, 12 Ω resistance is connected in parallel to 8 Ω resistance. Let their equivalent resistance be R_p. R_p is connected in series to 2 Ω resistance

$$\text{Now } \frac{1}{R_p} = \frac{1}{8} + \frac{1}{12}$$

$$= \frac{5}{24} \text{ or } R_p = \frac{24}{5} = 4{\cdot}8\ \Omega$$

Total equivalent resistance of circuit $R_{ext} = 2 + R_p$

$= 2 + 4{\cdot}8 = 6{\cdot}8\ \Omega$

(b) the current I_2.

Ans. We know that in parallel combination of resistances, potential difference across each resistor is the same, *i.e.* $I_1 \times 12\ \Omega = I_2 \times 8\ \Omega$.

$$I_1 = 0{\cdot}4\ A$$

$$\therefore \quad 0{\cdot}4 \times 12 = I_2 \times 8$$

$$\text{or} \quad I_2 = 0{\cdot}6\ A$$

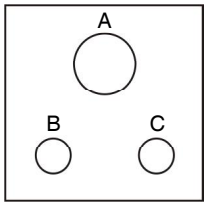
(c) the current I.

Ans. Total current $I = I_1 + I_2$

$= 0{\cdot}4 + 0{\cdot}6 = 1{\cdot}0$ A

Question 3

(i) Three wires with proper colour coding are connected to the three terminals of a three-pin socket. Match the colour of the wire with the proper terminals A, B and C of the socket. **[3]**



(a) Brown (b) Green (c) Light blue

Ans. We know that A is for earth wire, B is for neutral wire and C is for live wire. Thus,

(a) Brown → C (b) Green → A (c) Light blue → B

(ii) (a) Why does it become colder after a hailstorm than during or before the hailstorm ? **[3]**

Ans. The reason is that after the hailstorm, ice absorbs the heat energy required for its melting from the surroundings, so the temperature of the surroundings falls further down and we feel more cold.

(b) 'If two bodies have the same specific heat capacities, then they will always absorb the same amount of heat if their temperature increases by the same amount'. State whether the given statement is true or false.

Ans. False. Heat absorbed Q = $mc\Delta t$. Even if c and Δt are the same, heat energy absorbed depends on the mass of a body. Thus bodies of different masses require different amounts of heat energy for the same rise in temperature even when specific heat capacity is the same.

(iii) A metal piece of mass 420 g at 80°C is dropped in 80 g of water at 20°C in a calorimeter of mass 84 g. If the final temperature of the mixture is 30°C then calculate the specific heat capacity of the metal piece. **[4]**

[Specific heat capacity of water = 4·2 $Jg^{-1}\ °C^{-1}$, Specific heat capacity of the calorimeter = 200 $Jkg^{-1}\ °C^{-1}$].

Ans. Let specific heat capacity of metal be C $Jg^{-1}\ °C^{-1}$

Heat energy given by the metal piece = $420 \times C \times (80 - 30)$

$= 21000C$ J ....(i)

Heat energy taken by the water = $80 \times 4{\cdot}2 \times (30 - 20) = 3360$ J

Heat energy taken by the calorimeter = $84 \times 0{\cdot}2 \times (30 - 20) = 168$ J

Total heat energy taken by the calorimeter and water

$= 3360 \text{ J} + 168 \text{ J} = 3528$ J ....(ii)

If there is no loss of heat energy,

heat energy given by the metal piece = Total heat energy taken by the calorimeter and water

or $21000\ C = 3528$

or $C = \dfrac{3528}{21000} = 0{\cdot}168\ Jg^{-1}\ °C^{-1}$

$= 168\ Jkg^{-1}\ °C^{-1}$

Question 4

(i) Rohit playing a flute and Anita playing a piano emit sounds of the same pitch and loudness. **[3]**

(a) Name one characteristic that is different for waves from the two different instruments.

Ans. Quality [It is that characteristic of sound which distinguishes the two sounds of the same loudness and pitch].

(b) If now the loudness of the sound from flute becomes four times that of the sound from piano, then write the value of the ratio $A_F : A_P$. (A_F – amplitude of sound wave from flute. A_P – amplitude of sound wave from piano).

Ans. Since loudness $\propto$ (amplitude)^2 or $L \propto a^2$

$$\therefore \frac{L_F}{L_P} = \frac{4}{1} = \frac{A_F^{\,2}}{A_P^{\,2}}$$

$$\text{or } \frac{A_F}{A_P} = \frac{2}{1} \text{ or } A_F : A_P = 2 : 1$$

(c) Define 'Pitch' of sound.

Ans. Pitch is that characteristic of sound by which an acute (or shrill) note can be distinguished from a grave (or flat) note of the same loudness and quality.

(ii) (a) Name two factors on which the force experienced by a conductor carrying current placed in a magnetic field depends. Also state how these factors affect the force. **[3]**

Ans. Force experienced by a conductor carrying current placed in a magnetic field depends on

(i) length of the conductor, and (ii) current flowing in the conductor.

F is directly proportional to both l and I, *i.e.*

$F \propto I$ and $F \propto l$.

F is given by $F = IBl$

(b) With the help of which rule can you determine the direction of force acting on a current carrying conductor placed in a magnetic field ?

Ans. The direction of force on a current carrying conductor placed in a magnetic field is obtained by the Fleming's left hand rule.

(iii) (a) What is nuclear energy ? **[4]**

Ans. Nuclear energy is the energy released in a nuclear change due to phenomenon such as radioactive decay, fission or fusion. The total sum of masses of product nuclei is always less than the total sum of masses of reactant nuclei and this loss in mass is converted into energy which is nuclear energy.

(b) After emission of a nuclear radiation, the atomic number of the daughter nucleus increases by 1. Identify the nuclear radiation.

Ans. β-emission :

$${}^{A}_{Z}P \rightarrow {}^{A}_{Z+1}Q + {}^{0}_{-1}e \text{ (Beta particle)}$$

(c) Write a nuclear reaction indicating the nuclear change mentioned in (b).

Ans. Example of β-emission is :

$${}^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

(d) What is the special name given to the parent and daughter nucleus when this radiation is emitted ?

Ans. The special name given to parent and daughter nucleus for this kind of radiation emission is 'Isobar'.

Question 5

(i) An appliance rated 440 W, 220 V is connected across 220 V supply. **[3]**

(a) Calculate the maximum current that the appliance can draw.

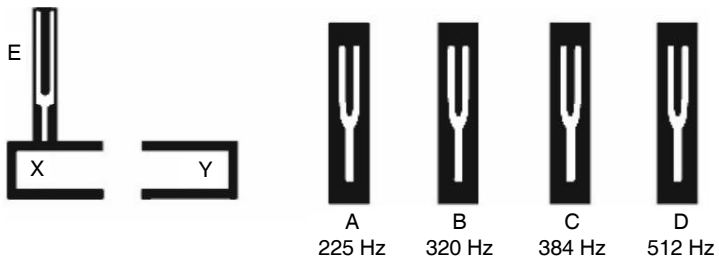
Ans. Given P = 440 W, V = 220 V

From relation $P = VI$ or $I = \frac{P}{V} = \frac{440}{220} = \mathbf{2A}$.

(b) Calculate the resistance of the appliance.

Ans. From relation $P = \frac{V^2}{R}$ or $R = \frac{V^2}{P} = \frac{(220)^2}{440} = \mathbf{110\ \Omega}$.

(ii) The diagram below shows a vibrating tuning fork E mounted on a sound box X. When the vibrating tuning forks A, B, C and D are placed on the sound box Y one by one, it is observed that a louder sound is produced when the tuning fork B is placed on Y. **[3]**



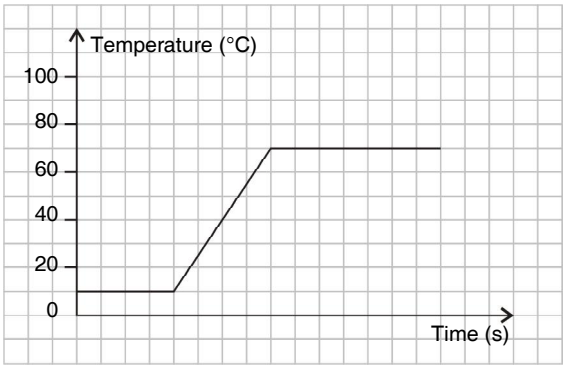
(a) What is the frequency of tuning fork E ?

Ans. Frequency of tuning fork E, f_E = Frequency of tuning fork B, f_B = 320 Hz

(b) Why does B produce a louder sound ?

Ans. Tuning fork B produces a louder sound because of resonance.

(iii) (a) From the graph of heating curve given alongside, state the melting point and boiling point of the substance. **[4]**



Ans. Melting point is 10°C.

Boiling point is 70°C.

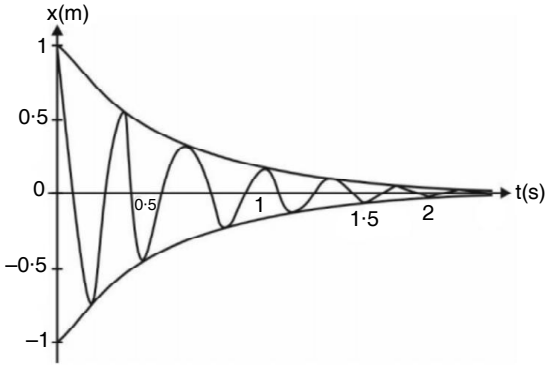
(b) Complete and rewrite the following nuclear reaction by filling the blanks.

$^{235}U \rightarrow {}_{90}Th + {}^{4}_{2}He$

Ans. $^{235}_{92}U \rightarrow {}^{231}_{90}Th + {}^{4}_{2}He$

Question 6

(i) Study the given figure alongside and answer the following : **[3]**



(a) What type of vibration does the above figure represent ?

Ans. Damped vibrations.

(b) State one reason for which the amplitude of the vibration decreases with time.

Ans. Amplitude of vibration decreases with time because of the presence of resistive forces and energy is lost in doing work against these forces.

(c) Write an example of natural vibrations.

Ans. When the bob of a simple pendulum is displaced slightly from its mean (or rest) position, it starts vibrating with its natural frequency.

(ii) A certain beam of α-particles, β-particles and γ-radiations travel through a region of electric field produced between two oppositely charged parallel plates A(+) and B(–). **[3]**

(a) Which of the above three has the maximum speed ?

Ans. γ-radiations have the maximum speed.

(b) Which one deviates the most from its original path ?

Ans. β-particles deviate the most from their original path.

(c) Which one does not deviate at all when passing through a region of electric or magnetic field ?

Ans. γ-radiations do not deviate at all.

(iii) If a wire of resistance 2 Ω gets stretched to thrice its original length : **[4]**

(a) Calculate the new resistance of the wire.

Ans. Given R = 2 Ω

$R = \rho\frac{l}{a}$, where ρ = specific resistance, l = length and a is the area of cross-section.

If the wire is stretched from l to $3l$, area a is reduced to $\frac{a}{3}$ (since volume remains constant)

$R' = \frac{\rho 3l}{a/3} = 9\rho\frac{l}{a}$

$\therefore$ R increases by nine times, *i.e.* $R' = 2 \times 9 = 18\ \Omega$

(b) What happens to the specific resistance of the wire ?

Ans. Specific resistance of the wire remains the same as it is a characteristic property of the material of wire and is not affected by length and area.