PHYSICS

(SCIENCE PAPER – 1)

Maximum Marks: 80

Time allowed: Two hours

1. *Answers to this Paper must be written on the paper provided separately.*
2. *You will **not** be allowed to write during first **15** minutes.*
3. *This time is to be spent in reading the question paper.*
4. ***The time given at the head of this Paper is the time allowed for writing the answers.***

5. ***Section A is compulsory**. Attempt **any four** questions from **Section B**.*
6. *The intended marks for questions or parts of questions are given in brackets [ ].*

Instruction for the Supervising Examiner

Kindly read aloud the Instructions given above to all the candidates present in the Examination Hall.

This Paper consists of 16 printed pages.

SECTION A (40 Marks)

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

Question 1

Choose the correct answers to the questions from the given options. [15]

(Do not copy the questions, write the correct answers only.)

(i) A body is acted upon by two equal and opposite forces, that are **NOT** along the same straight line. The body will:

(a) remain stationary

(b) have only rotational motion

(c) have only rectilinear motion

(d) have both rectilinear and rotational motion

(ii) Which among the following is a **vector** quantity?

(a) work

(b) power

(c) energy

(d) moment of couple

(iii) What is the correct energy transformation during burning of a candle?

(a) heat → kinetic + potential

(b) heat → chemical + light

(c) chemical → heat + light

(d) mechanical → chemical + heat

(iv) When a ray of light passes from one optical medium to another, which of the following physical quantities does **NOT** change?

(a) Amplitude of the wave

(b) Frequency of the wave

(c) Wavelength of the wave

(d) Speed of the wave

(v) Which one of the following combinations is the correct **ascending order** of electromagnetic waves in terms of **wavelength**?

(a) gamma-rays, visible light, microwaves

(b) microwaves, visible light, gamma-rays

(c) gamma-rays, microwaves, visible light

(d) microwaves, gamma-rays, visible light

(vi) For a lever, a graph is plotted with load on Y-axis and effort on X-axis. Which of the following represents the **slope** of the graph?

(a) Mechanical advantage

(b) Velocity ratio

(c) 1 / Velocity ratio

(d) 1 / Mechanical advantage

(vii) For a real image formed by a convex lens, the ratio of **I : O = 2 : 5,** then the object is: *(I is the height of the image and O is the height of the object)*

(a) between O and F

(b) beyond 2F

(c) at F

(d) between F and 2F

(viii) A ray of light is incident normally on a face of an equilateral prism. The ray gets totally reflected at the second refracting surface. **The total deviation** produced in the path of the ray is:

(a) 30°

(b) 60°

(c) 90°

(d) 120°

(ix) In a closed circuit containing a bulb and a cell, the electromotive force ($\boldsymbol{\varepsilon}$) and the terminal voltage ($\boldsymbol{V}$) is related as.
*(Given **I** is current and **r** is internal resistance.)*

(a) $V = \varepsilon + Ir$

(b) $V = \varepsilon - Ir$

(c) $V = \varepsilon \div Ir$

(d) $V = \varepsilon \times Ir$

(x) A metal piece of mass 5 g has thermal capacity 2.5 JK^{-1}. If the mass of the metal is tripled, then its **specific heat capacity** will be:

(a) 7.5 JK^{-1}

(b) 2.5 JK^{-1}

(c) 1.5 $Jg^{-1}K^{-1}$

(d) 0.5 $Jg^{-1}K^{-1}$

(xi) **Assertion (A):** As the level of water in a tall measuring cylinder kept under running tap rises, the pitch of sound gradually increases.

Reason (R): Frequency of sound is inversly proportional to the length of the water column.

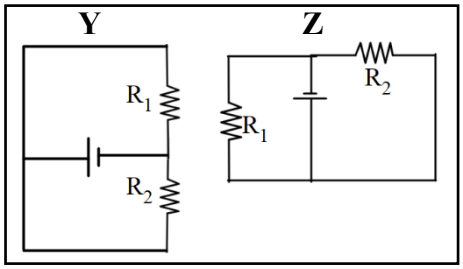
(a) Both (A) and (R) are true and (R) is correct explanation of (A).

(b) Both (A) and (R) are true and (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

(xii) In the given circuits **Y** and **Z**, the resistors, $\mathbf{R_1}$ and $\mathbf{R_2}$, are connected in:



(a) series in both the circuits

(b) parallel in both the circuits

(c) parallel in **Y** and series in **Z**

(d) series in **Y** and parallel in **Z**

(xiii) A radioactive element **P** emits one α-particle and transforms to a new element **Q**. What will be the position of the element **Q** in the **periodic table**?

(a) One group to the left of **P**

(b) One group to the right of **P**

(c) Two groups to the right of **P**

(d) Two groups to the left of **P**

(xiv) Each of the substances given below is supplied with same amount of heat. Which one will attain the **highest** temperature?

Substance	Lead	Aluminium	Copper	Iron
Specific heat capacity (cal/g^{o}C)	0.031	0.21	0.095	0.115

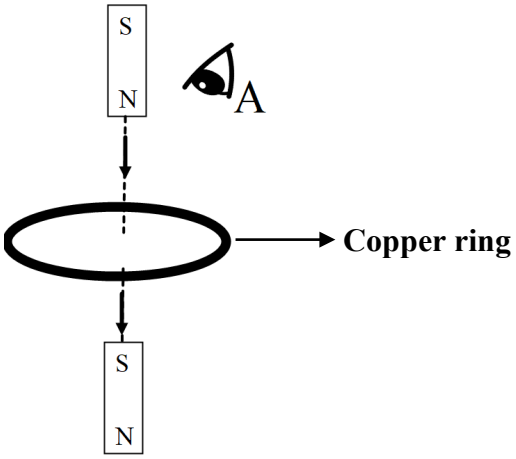
(a) Aluminium

(b) Copper

(c) Iron

(d) Lead

(xv) The following figure shows a small bar magnet falling freely through a copper ring. For the observer at **A**, the **direction of the induced current** will be:



(a) clockwise when magnet is above and below the ring

(b) anticlockwise when magnet is above and below the ring

(c) anticlockwise when magnet is above the ring and clockwise when the magnet is below the ring

(d) clockwise when magnet is above the ring and anticlockwise when the magnet is below the ring

Question 2

(i) Complete the following by choosing the correct answers from the bracket: [6]

(a) In uniform circular motion the **centrifugal force** acts _____ *[towards the centre / away from the centre / along the tangential direction]*.

(b) Refractive index of a medium is **independent** of _____ *[temperature / angle of incidence / wavelength of light]*.

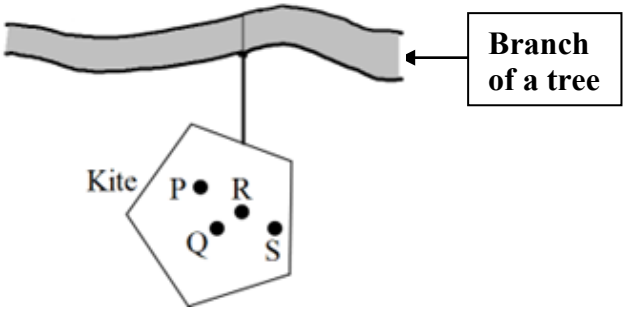
(c) Heat absorbed during **change of phase** depends on _____ *[mass / change in temperature / specific heat capacity]* of the substance.

(d) Emf of a cell is _____ *[greater than / less than / equal to]* the terminal voltage when the cell is in **open circuit**.

(e) In a step-up transformer the **turns ratio** is _____ *[more than 1 / less than 1 / equal to 1]*.

(f) The nuclear radiation with **lowest** ionizing power is _____ *[α / β / γ]*.

(ii) A **non-uniform** kite is hanging freely from the branch of a tree as shown. Study the figure and answer the following: [2]

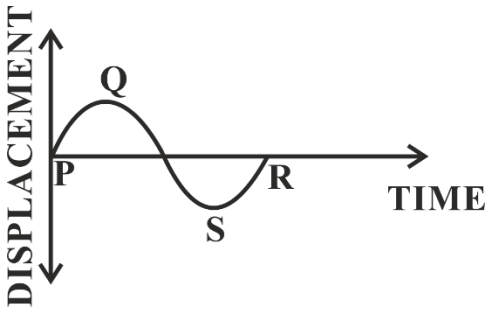


(a) **Fill in the blank.**

_____ (**P, Q, R** or **S**) is the most probable position of its centre of gravity.

(b) Support your answer to (a) with a reason.

(iii) The displacement-time graph of a sound wave produced by a vibrating wire is shown below. [2]



(a) How will you adjust the tension in the wire, to **reduce** the length of **PR**?

(b) Which characteristic of sound is affected by the reduction in the length of **PR**?

Question 3

(i) A ray of light enters a rectangular glass slab submerged in water at an angle of incidence 55°. Does this ray undergo **total internal reflection** when it moves from water to glass? Justify your answer. *(The critical angle for glass-water interface is 54°.)* [2]

(ii) According to the **NEW** colour convention which colour of wire is connected to: [2]

(a) the metal body of the appliance

(b) the switch of the appliance?

(iii) (a) Which of the two, *alternating current* or *direct current*, produces a varying magnetic field when it flows through a conductor? [2]

(b) State the frequency of the alternating current supply in India.

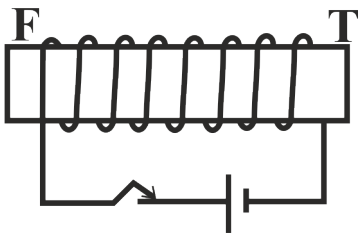
(iv) Calcuate the amount of heat absorbed by 200 g of paraffin wax to melt completely at its melting point. [2]

[Specific latent heat of fusion of paraffin wax = 146 Jg^{-1}]

(v) Copper wire is wound around a **steel** bar **FT**. Current is allowed to pass through the coil for some time and then the bar is removed. [2]

(a) Draw **only** the magnetised bar **FT** and mark its poles.

(b) Trace **two** magnetic lines of force around **FT** clearly indicating the direction.

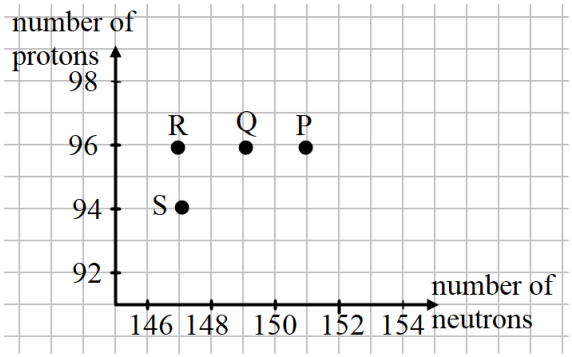


(vi) A current flows through a metallic conductor for a **long period** of time. State the change you would expect in its: [2]

(a) Resistance

(b) Resistivity

(vii) Curium is a radioactive element with the symbol $^{247}_{96}Cm$ named in honour of Madam Curie. The graph of **number of protons** vs **number of neutrons** for some elements are shown below: [3]



(a) Which point on the graph indicates the element *Cm*?

(b) Which point on the graph indicates daughter nucleus after *Cm* undergoes radioactive decay of 1 α followed by 2 β?

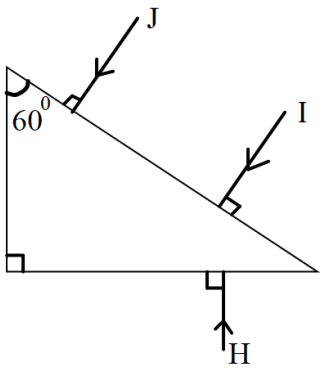
(c) State the mass number of the daughter nucleus.

SECTION B (40 Marks)

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

Question 4

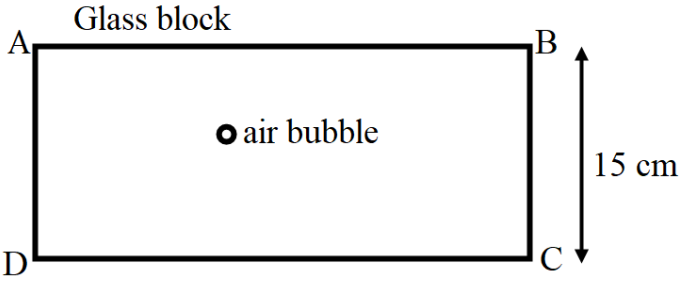
(i) [3]



(a) Out of the three rays (**I, J, H**) shown in the diagram, which ray will suffer **Total Internal Reflection** while inside the prism? *(Critical angle of the prism is 42^o.)*

(b) Copy the diagram to complete the path of the ray which you have named in (a) till it comes out of the prism.

(ii) A rectangular glass block of refractive index 1.5 has an air bubble trapped inside it as shown in the diagram. When seen from the surface **AB,** it **appears** to be 4 cm deep. [3]



(a) Calculate the **actual depth** of the air bubble from the surface **AB**.

(b) For which colour of light, blue or yellow, the apparent depth will be **greater**?

(c) Turning the glass block upside down, **DOES NOT** change the apparent depth of the air bubble. State **True** or **False.**

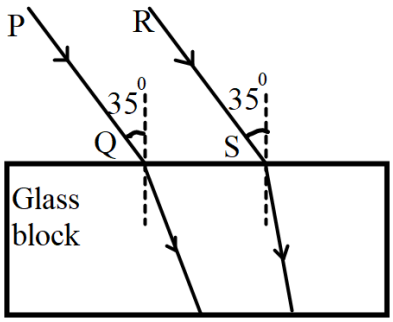
(iii) (a) An object is placed at **2F** position of a convex lens. Draw a ray diagram showing the formation of the image. [4]

(b) How will the size of the image change if we, **ONLY** replace the lens in the above arrangement with another lens of a **greater focal length**?

Question 5

(i) An object is placed in front of a concave lens at a distance of 45 cm from it. If its image is formed at a distance of 30 cm from the lens, calculate the focal length of the lens. [3]

(ii) Two rays **PQ** and **RS** are incident on a rectangular glass block as shown in the diagram. Observe the diagram and answer the questions that follow. [3]



Which of these two rays will:

(a) have **greater** lateral displacement on emerging out of the block?

(b) travel with **greater** speed in the block?

(c) scatter **more** in the atmosphere?

(iii) (a) Name the **radiations**: [4]

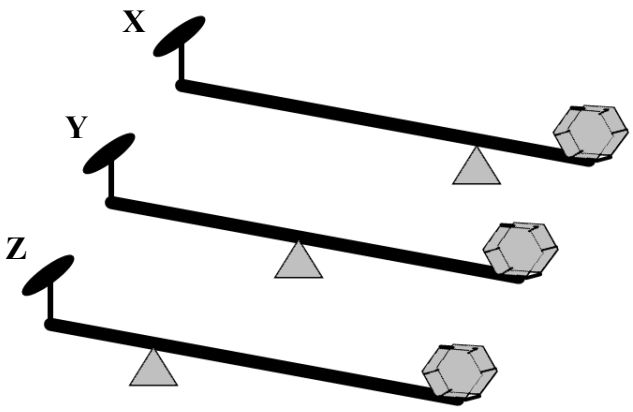
1. for which a quartz prism is used to study the spectrum.
2. which are used in remote sensing devices.
3. which are used in traffic signals in India.

(b) Name **one** property **common** to all electromagnetic radiations.

Question 6

(i) Akash takes a **uniform** meter scale and suspends a weight of 2 N at one end **'X'** and a weight of 5 N on the other end **'Y'**. He then balances the ruler horizontally on a knife edge placed at 70 cm from **X**. Draw a diagram of the arrangement and calculate the weight of the ruler. [3]

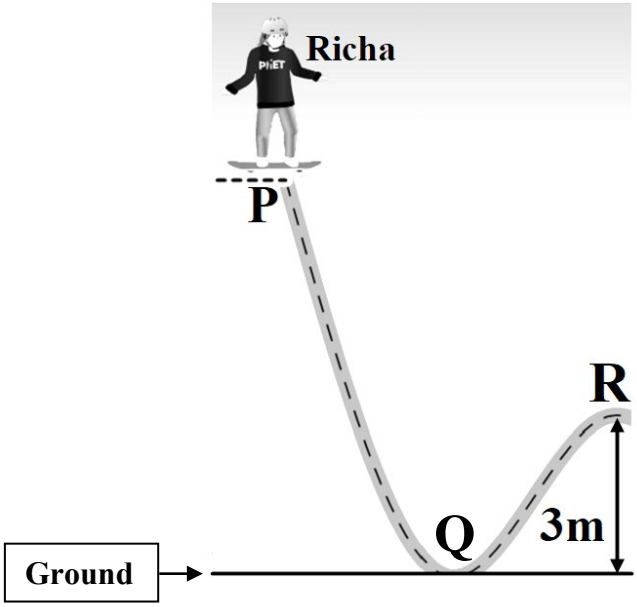
(ii) Three levers **X, Y, Z** of **equal lengths** are shown in the diagram. [3]



(a) Which class of lever do these belong to?

(b) Among these (**X, Y** or **Z**) which one will give the **maximum** mechanical advantage? Justify your answer.

(iii) [4]



Richa weighing 40 kgf leaves point **P** on her skateboard and reaches point **Q** on the ground with velocity 10 ms^{-1}. Calculate:

(a) the kinetic energy of Richa at point **Q**.

(b) the vertical height of point **P** above the ground. *(Use **g** as 10 m/s^2 and neglect friction)*

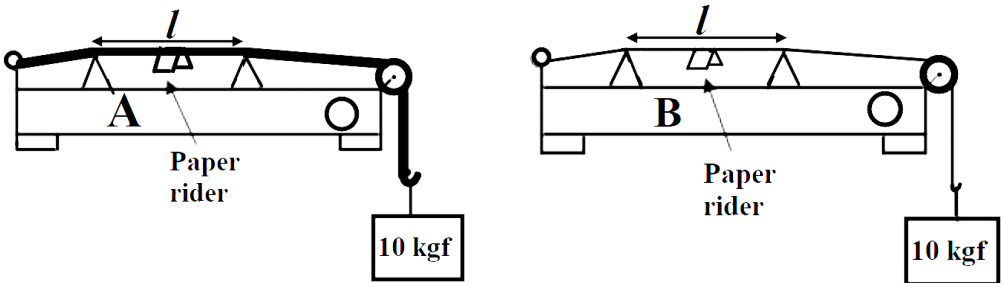
(c) the kinetic energy of Richa at point **R.** ***(****While moving from **Q** to **R**, she loses 500 J of energy against friction.)*

Question 7

(i) Draw a block and tackle system of pulleys with **velocity ratio equal to 3**. [3]

(ii) A submarine in the sea, sends ultrasonic ping and a stopwatch is started simultaneously. The stopwatch stops on receiving the reflected wave from an obstacle and reads **1 minute 40 seconds**. Calculate the distance of the obstacle from the submarine. *(Speed of sound in water 1500 ms^{-1}.)* [3]

(iii) The diagrams given below show two sound boxes **A** and **B** with wires of **same** length ***(l)*** and tension *(10 kgf)* but **different** cross-sectional areas. Simultaneously, vibrating tuning forks of frequency 300 Hz are placed on the boxes **A** and **B**. The paper rider falls off in case of **B** but not in case of **A**. [4]

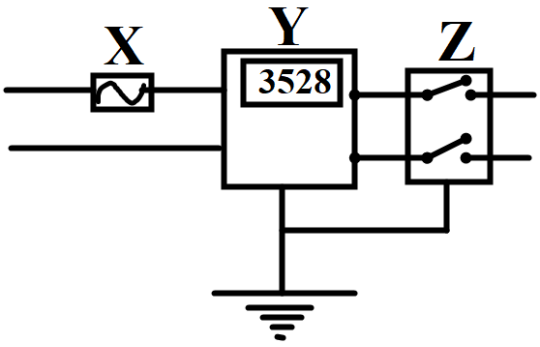


(a) **Name** and **explain** the phenomenon responsible for the falling off of the paper rider in **B**.

(b) The wire **A** resonates with a tuning fork of frequency ***'f'***. Is ***'f'*** *greater than, less than or equal to* 300 Hz? Justify your answer.

Question 8

(i) The diagram shows wiring in a meter room of a building. [3]

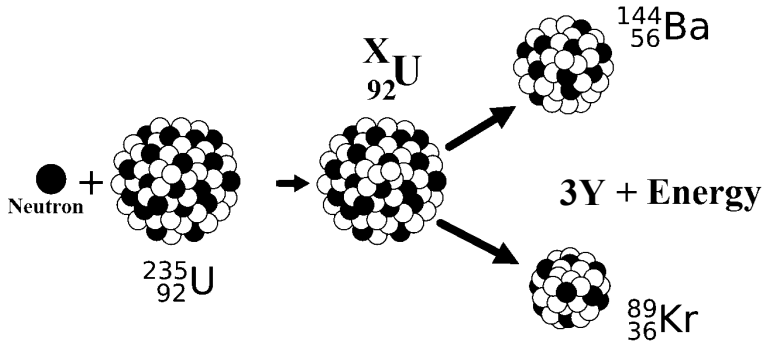


(a) What is the current rating of device **X**?

(b) What is the difference between the switch **Z** shown in the diagram and the switches you use to operate different appliances at home?

(c) What is the unit of the physical quantity displayed in **Y**?

(ii) Study the diagram given below and answer the questions that follow: [3]

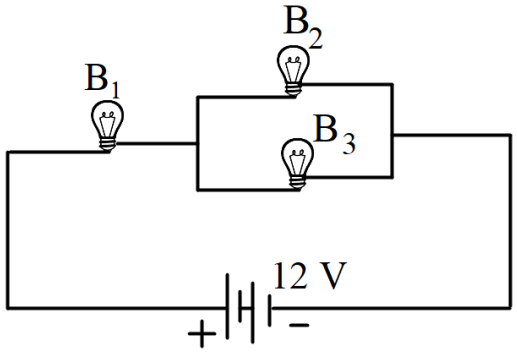


(a) Name the process depicted in the diagram.

(b) What is the value of **X**?

(c) Identify **Y**, the missing product of the reaction.

(iii) [4]



Three identical bulbs $\mathbf{B_1}$, $\mathbf{B_2}$, and $\mathbf{B_3}$ each of power rating 18 W, 12 V are connected to a battery of 12 V.

(a) Calculate:

1. the resistance of each bulb
2. the current drawn from the cell

(b) If the bulb $\mathbf{B_3}$ is removed from the circuit, then will the brightness of the bulb $\mathbf{B_1}$ *increase, decrease or remain the same*?

Question 9

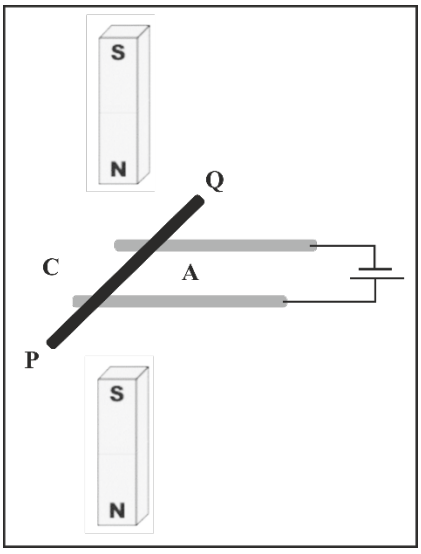
(i) 30 g of ice at 0°C is used to bring down the temperature of a certain mass of water at 70°C to 20°C. Find the mass of water. *[Specific heat capacity of water = 4.2 $Jg^{-1}°C^{-1}$ and specific latent heat of ice = 336 Jg^{-1}.]* [3]

(ii) (a) A certain amount of heat will warm 1 g of material **X** by 10°C and 1 g of material **Y** by 40°C. Which material has **higher** specific heat capacity? [3]

(b) Which material, **X** or **Y**, would you select to make a calorimeter?

(c) The specific heat capacity of a substance remains the **same** when it changes its state from solid to liquid. State **True** or **False.**

(iii) A copper rod **PQ** carrying current is kept in a magnetic field as shown in the diagram. [4]



(a) The copper rod **PQ** will move towards **C**. State **True** or **False**.

(b) **Name** the law used to determine the direction of motion of **PQ**.

(c) What will be the effect on the force experienced, if the rod **PQ** is replaced by another copper rod of **same** length but of **greater** cross-sectional area?

(d) Justify your answer in (c).