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.

SECTION A (40 Marks)

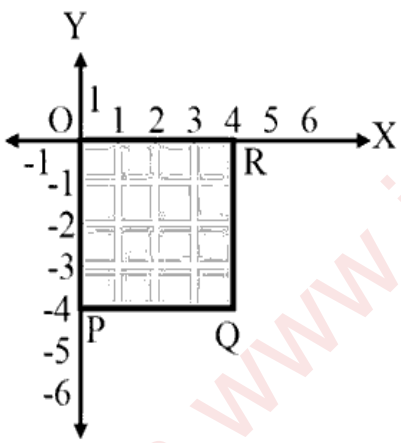
*(Attempt **all** questions from this **Section**.)*

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) **Centre of gravity** of the given square **PQRO** lies at:



(a) (2, –2)

(b) (3, –2)

(c) (–2, 2)

(d) (–2, 1)

(ii) An object is thrown vertically up. It reaches the highest point and then comes down. The work done by the **force of gravity** on the object is:

(a) positive for both the way up and way down

(b) negative for both the way up and way down

(c) negative for the way up and positive for the way down

(d) positive for the way up and negative for the way down

(iii) 10 eV is _____.

(a) 1.6×10^{-18} J

(b) 1.6×10^{-19} J

(c) 6.25×10^{19} J

(d) 6.25×10^{18} J

(iv) A crowbar of length 1.0 m has its fulcrum at a distance of 0.2 m from the load. The **mechanical advantage** of the crowbar is:

(a) 5

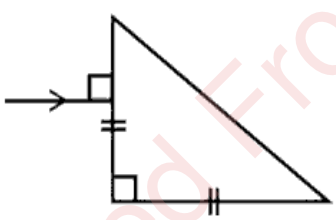
(b) 4

(c) 3

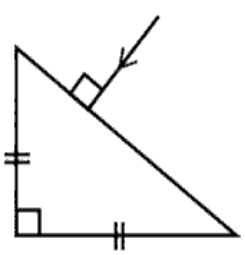
(d) 2

(v) Which of the following figures will depict deviation of a ray of light through 90° when it emerges out of the prism.

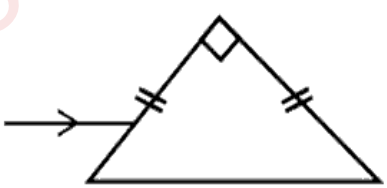
(a)



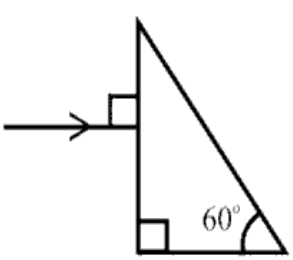
(c)



(b)



(d)



(vi) Which of the following values can represent the magnification of a **simple microscope**?

(a) +1

(b) –1

(c) +2

(d) –2

(vii) An object placed at a distance 30 cm in front of a lens produces clear inverted image at a distance 60 cm from the lens. If the object is placed at 60 cm from the lens, then it produces a clear inverted image at a distance of _____ from the lens.

(a) 20 cm

(b) 30 cm

(c) 60 cm

(d) 90 cm

(viii) **Assertion (A):** Quartz prism is used to study ultraviolet spectrum.

Reason (R): Quartz does not absorb ultraviolet radiations.

(a) Both (A) and (R) are true and (R) is the 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 and (R) is true.

(ix) The amplitude of a sound wave is **reduced** from 2 mm to 1 mm. The **intensity** of the sound will:

(a) become four times the initial

(b) remain the same

(c) become half of the initial

(d) become one fourth of the initial

(x) According to the **NEW** international convention, what is the colour coding for the live, neutral and earth wires in household circuits?

(a) Live – red, Neutral – black, Earth – green

(b) Live – green, Neutral – yellow, Earth – black

(c) Live – brown, Neutral – blue, Earth – yellow

(d) Live – red, Neutral – blue, Earth – yellow

(xi) An alloy ***constantan*** has resistivity 5×10^{-7} Ω m at 25°C. If the temperature of this alloy is increased to 50°C then its **resistivity** will be:

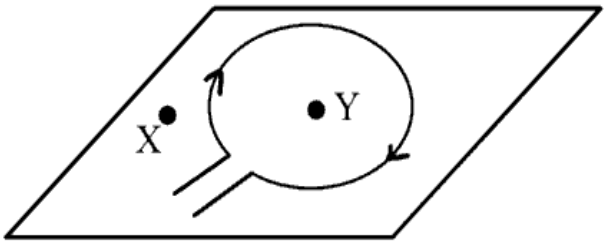
(a) 2.5×10^{-7} Ω m

(b) 5×10^{-7} Ω m

(c) 10×10^{-6} Ω m

(d) 20×10^{-6} Ω m

(xii) A current carrying circular loop is lying in a horizontal plane as shown in the diagram. Which of the following is the correct statement with respect to the direction of magnetic lines of force.



(a) upward at X and downward at Y

(b) downward at X and upward at Y

(c) upward at both X and Y

(d) downward at both X and Y

(xiii) For a body of mass ***m*** the relationship between the heat capacity ***(C')*** and specific heat capacity ***(c)*** is:

(a) $C' = mc$

(b) $C' = c/m$

(c) $C' = mc^2$

(d) $C' = m/c$

(xiv) A piece of a cake and a watermelon of the same mass are taken out of the freezer at the same time. Which of the following statement is correct?

(a) Cake and watermelon will attain the room temperature at the same time.

(b) Watermelon will attain the room temperature faster.

(c) Cake will attain the room temperature faster.

(d) Which one comes to the room temperature first, depends on the atmospheric pressure at that time.

(xv) During β emission the parent and daughter nuclei will be:

(a) isomers

(b) isotopes

(c) isotones

(d) isobars

Question 2

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

(a) The **ideal** mechanical advantage of a single movable pulley is _____ *[less than 1 / more than 1 / equal to 1]*.

(b) If different colours of light strike a rectangular glass block at same angle of incidence, then **maximum** lateral displacement will be shown by _____ *[Red / Green / Blue]* colour.

(c) **1 joule** equals to _____ *[0.24 / 0.48 / 4.2]* **calorie**.

(d) The hole in the **right side** of the socket is for connection to the _____ *[live / neutral / earth]* wire.

(e) The direction of the **induced current** in the coil of an AC generator is determined by _____ *[Fleming's left-hand rule / Fleming's right-hand rule / Clock Rule]*.

(f) In a nuclear reactor, the **fission** reaction is initiated by bombardment with _____ *[a proton / a neutron / an α particle]*.

(ii) Will the position of the centre of gravity change if a hollow sphere is **completely** filled with mercury? Give a reason for your answer. [2]

(iii) Calculate the minimum distance needed in water to hear the echo. [2]

(Speed of sound in water is 1500 ms^{-1}. Persistence of hearing is 0.1 s.)

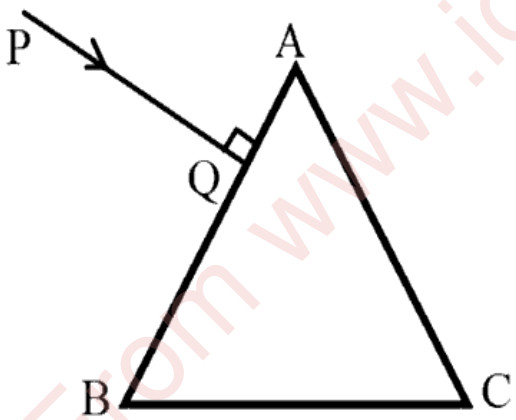
Question 3

(i) State the potential of the wire connected to the right hand side terminal of the **three pin plug** and also state its colour. [2]

(ii) State **two** properties of magnetic lines of force around a straight conductor carrying current. [2]

(iii) The heat capacity of a milk cooker is 450 J/K. Calculate the rise in the temperature when it absorbs 9000 J of heat. [2]

(iv) A ray of light **PQ** is incident normally on the face **AB** of an equilateral prism. The ray gets totally reflected from the surface **AC**. [2]

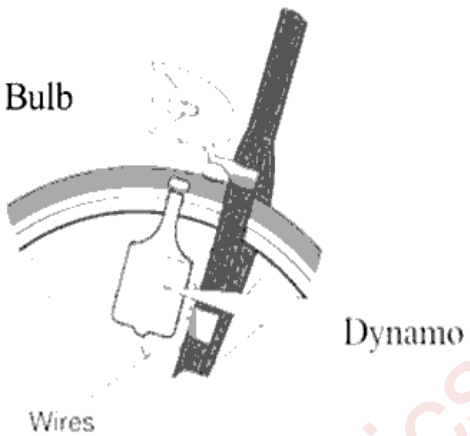


Calculate:

(a) the angle of deviation at **AC**.

(b) the angle of incidence at **BC**.

(v) The figure below shows a bicycle dynamo which is fitted to the tyre. When the wheels of the bicycle rotate, the spindle of dynamo attached to magnets rotate and the bulb glows. [2]

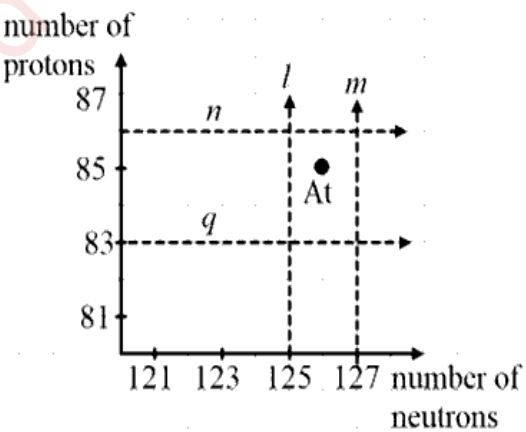


(a) Name the **phenomenon** that takes place when the bulb glows while the person rides the bicycle.

(b) What will be the effect on the brightness of the bulb when the rider **increases** the speed of the bicycle?

(vi) Define background radiation. Give one **internal** source of this radiation. [2]

(vii) Astatine *(At)* is a radioactive element. Study the graph given below showing the number of protons vs the number of neutrons of radioactive nuclei. [3]



(a) Identify the mass number of the nucleus Astatine *(At)*.

(b) Which line on the graph *(l, m, n, or q)* will never pass through the position of the daughter nuclei, regardless of **any number** of α, β, or γ emissions?

(c) Give a reason for your choice in (b).

SECTION B (40 Marks)

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

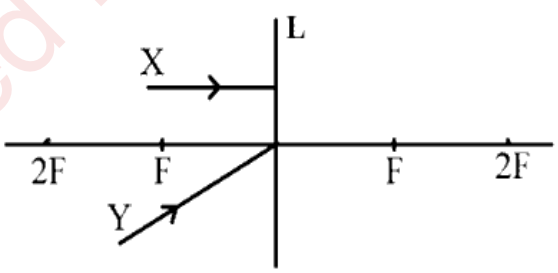
Question 4

(i) (a) A coin lies at the bottom of a beaker. Water is poured into the beaker upto a height of 8 cm. Calculate the shift seen in the position of the coin. [3]
(The refractive index of water is 4/3. The width of the glass wall of the beaker is negligible.)

(b) How will the **apparent depth** be affected if the temperature of water is increased?

(ii) Draw a ray diagram to invert the image **without deviation** of light using right angle isosceles prism. [3]

(iii) Answer the following with respect to a **concave lens (L)**. [4]



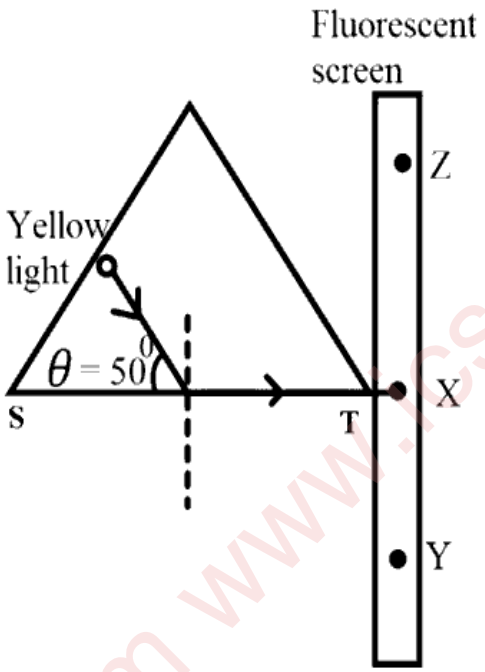
(a) **Describe** the path of the rays **X** and **Y** through the lens.

(b) Give one use of this lens.

(c) Calculate its power if the focal length of this lens is 20 cm.

Question 5

(i) The diagram given below shows a triangular prism of a certain material with fluorescent screen placed adjacent to it. The yellow light ray striking the surface **ST** of the prism shows a fluorescent spot at point **X**. [3]



(a) Calculate the **critical angle** of the material of the prism for yellow colour.

(b) To move the fluorescent spot towards **Y**, the value of θ should be _____ *(>50, <50 or = 50).*

(c) Which direction will the florescent spot move if yellow light is replaced with indigo light? *(towards **Y** or towards **Z**)*

(ii) An object is placed at a distance of 10 cm from a convex lens of focal length 20 cm. [3]

(a) Find the position of the image.

(b) What is the nature of the image?

(iii) (a) Name the electromagnetic radiations which are used for **sterilising water** in a water purifier. [4]

(b) State any one property of the radiations mentioned by you in part (a).

(c) Why are the danger signals red in colour?

Question 6

(i) A **uniform metre ruler** is balanced horizontally on a knife edge placed at 60 cm mark when a mass ***m*** is suspended from 75 cm mark. **Draw** the diagram of the arrangement. State with reason *(through mathematical steps)* whether the mass of the scale *is greater than, less than or equal to the mass* ***m***? [3]

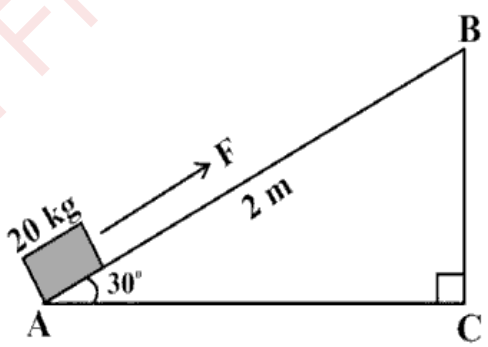
(ii) State the energy conversions taking place: [3]

(a) during photosynthesis

(b) in a thermocouple

(c) during bursting a cracker

(iii) An inclined plane makes an angle of 30° with the horizontal as shown in the figure. A box of mass 20 kg is taken from point **A** to point **B** along the inclined plane of length 2 m. [4]

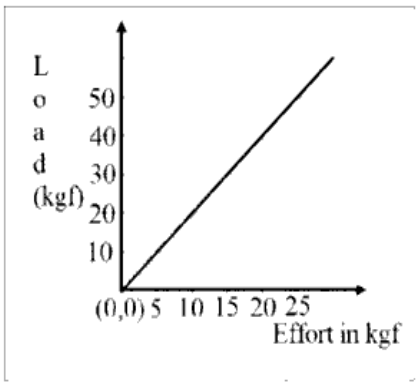


(a) Calculate the potential energy gained by the box.

(b) If 10 J of work is done against friction, in moving the box from **A** to **B** then calculate the force **F** needed to pull the block from **A** to **B**. *[g = 10 ms^{-2}]*

Question 7

(i) The graph shows load against effort for a lever with load and effort on the **same side** of the fulcrum. [3]



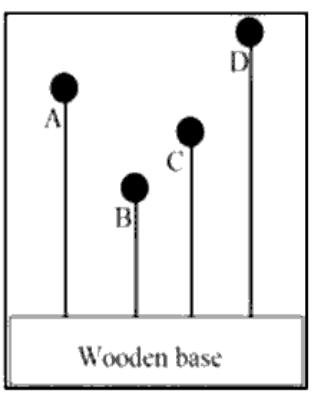
(a) Which attribute of the load vs effort graph must be calculated to determine the mechanical advantage?

(b) Which class does this lever belong to? How did you arrive at this conclusion?

(ii) (a) A man fires a gun and hears its echo after 3 s. The man then moves 80 m towards the hill and fires his gun again. This time he hears the echo after 2.5 s. Calculate the speed of the sound. [3]

(b) State **one** reason of using ultrasonic waves in SONAR.

(iii) The diagram below displays four solid plastic balls attached to wires, all mounted on a wooden base. When a person shakes the wooden base back and forth at a steady pace, the balls begin to vibrate as well. It is noted that while all the balls vibrate, only one of them vibrates vigorously. [4]

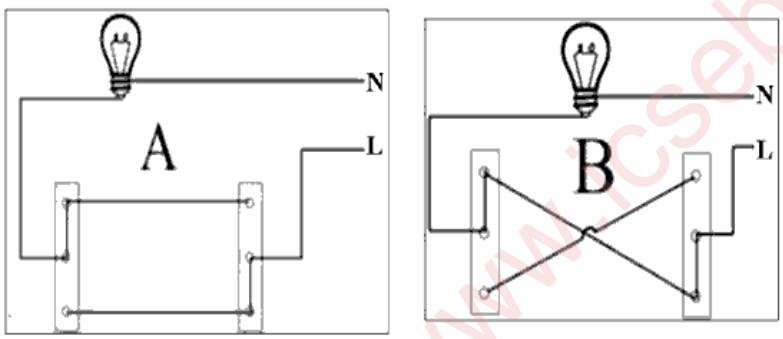


(a) Explain why only one ball vibrates vigorously.

(b) If f_A, f_B, f_C, and f_D are the natural frequencies of vibration of the wires, then arrange them in the increasing order of their frequencies and **justify**.

Question 8

(i) The diagram given below shows a bulb connected by dual control switches. [3]
Observe the diagrams and answer the questions that follow.

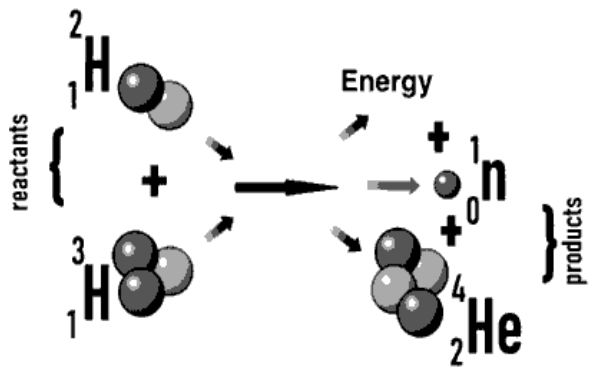


(a) Which switch can successfully turn the bulbs **ON** or **OFF**? (Circuit **A**, Circuit **B**, or both)

(b) At present, in which circuit is the bulb glowing?

(c) If the **L** and **N** wires are swapped in the circuit (your answer to (b)), will the circuit still function?

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



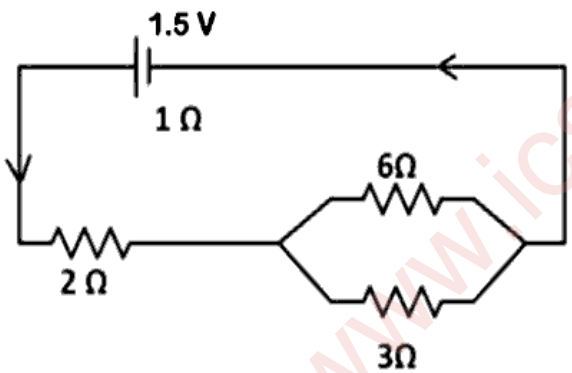
(a) Name the nuclear process displayed in the diagram.

(b) Is it possible to conduct this process at room temperature?

(c) Mass of reactants _____ mass of the products.

[Fill in the blank using <, > or =]

(iii) A cell of e.m.f 1.5 V and internal resistance 1 Ω is connected to two resistors of resistances 6 Ω and 3 Ω in parallel and a resistor of resistance 2 Ω in series as shown in the diagram. [4]



Calculate the current through:

(a) 2 Ω resistor

(b) 6 Ω resistor

Question 9

(i) A spirit lamp supplying heat at a rate of 50 W is used to melt 0.025 kg of ice at 0°C taken in a container. If all the ice in the container is melted in 168 s, then what is the specific latent heat of fusion of ice? [3]

(The heat capacity of the container is negligible.)

(ii) (a) State the principle of calorimetry. [3]

(b) Why should the surface of the calorimeter be polished?

(c) Why should the calorimeter be made of a material of **low** specific heat capacity?

(iii) A student wants to design a **device** to connect a bulb rated 10 W, 22 V, to the mains 220 V, so that the bulb operates at its rated voltage. [4]

(a) Name the device he uses.

(b) **State** the principle involved in the working of this device.

(c) When the bulb is connected to the output of the device, calculate:

1. Current drawn

2. Resistance of the bulb