

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]

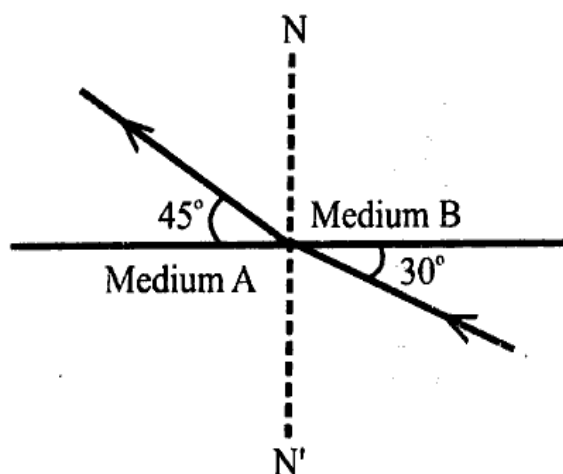
(Do not copy the questions, write the correct answers only.)

- (i) For a body to be in **dynamic equilibrium**, its:
- (a) momentum should be zero
 - (b) acceleration should be zero
 - (c) kinetic energy should be zero
 - (d) velocity should be zero
- (ii) The energy transformation taking place during **photosynthesis** in plants is:
- (a) heat to chemical
 - (b) chemical to light
 - (c) light to chemical
 - (d) chemical to heat

(iii) The **Velocity Ratio** (VR) of a block and tackle system of two pulleys with the **effort** in the **upward** direction is:

- (a) 1
- (b) 2
- (c) 3
- (d) 4

(iv) From the figure given below, the refractive index of medium **B** with respect to medium **A** (${}_A\mu_B$) is:



- (a) $\frac{\sin 45^\circ}{\sin 30^\circ}$
- (b) $\frac{\sin 30^\circ}{\sin 45^\circ}$
- (c) $\frac{\sin 45^\circ}{\sin 60^\circ}$
- (d) $\frac{\sin 60^\circ}{\sin 45^\circ}$

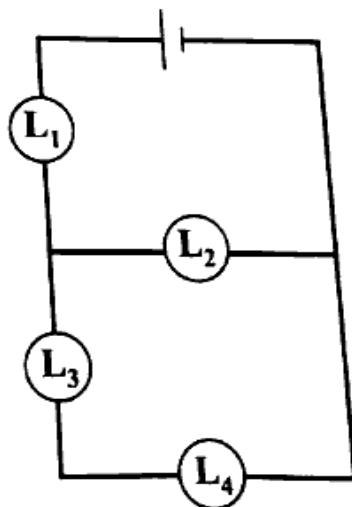
- (v) When a blackened bulb thermometer is moved beyond the red region of the visible spectrum, there is a rapid rise in the temperature. This is due to the presence of:
- (a) Infrared radiations
 - (b) Ultraviolet radiations
 - (c) X-rays
 - (d) Radio waves
- (vi) A fast-moving cyclist stops pedalling on reaching a hilly track. If he continues to move with the acquired energy, then assuming **no loss** of energy:
- (a) his kinetic energy remains constant at all times.
 - (b) his potential energy remains constant at all times.
 - (c) his total mechanical energy continuously increases.
 - (d) his total mechanical energy remains constant.
- (vii) The distance (V) of a virtual image formed by a lens of focal length 15 cm never exceeds a certain **finite** value, then this value will be:
- (a) less than 15 cm
 - (b) between 15 cm to 30 cm
 - (c) less than or equal to 30 cm
 - (d) less than or equal to 15 cm

(viii) **Assertion (A):** Tiny air molecules **scatter** blue light more than red light.

Reason (R): The **refractive index** of a medium is greater for blue light than red light.

- (a) (A) is true but (R) is false.
- (b) (A) is false but (R) is true.
- (c) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (d) Both (A) and (R) are true but (R) is not the correct explanation of (A).

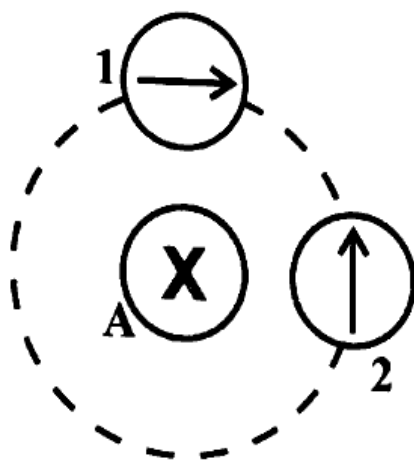
(ix) In the circuit given below, identify the lamp (L_1 , L_2 , L_3 or L_4) whose failure **would not** interrupt the power supply to the other lamps.



- (a) L_1
- (b) L_2
- (c) L_3
- (d) L_4

- (x) **Equal** volumes of water are added to three cylindrical jars A, B and C of same height and radii r_A , r_B and r_C respectively with $r_B < r_A < r_C$. If you blow air into the mouth of these jars, which tube will produce the shrillest note?
- (a) A
 - (b) B
 - (c) C
 - (d) All will produce the notes of same shrillness
- (xi) A metallic wire is stretched in such a way that its new length becomes twice the original length. How does its **specific heat capacity** change?
- (a) becomes double
 - (b) becomes 4 times
 - (c) becomes $\frac{1}{4}$
 - (d) remains the same
- (xii) The **correct formula** to calculate the equivalent resistance of two resistors R_1 and R_2 when connected in **parallel**, is:
- (a) $\frac{R_1 + R_2}{R_1 R_2}$
 - (b) $\frac{R_1 R_2}{R_1 + R_2}$
 - (c) $\frac{R_1 - R_2}{R_1 R_2}$
 - (d) $\frac{R_1 R_2}{R_1 - R_2}$

- (xiii) The diagram below shows the top view of the Wire A shown by a cross (**X**), carrying current **into the plane** of the paper. Which of the compasses is **correctly** aligned with the magnetic field, produced by the current carrying wire?



- (a) Only 1 is aligned
 - (b) Only 2 is aligned
 - (c) Both 1 and 2 are aligned
 - (d) Both 1 and 2 are not aligned
- (xiv) Three substances A, B and C of **same mass** are present at their respective melting points. On heating, if they melt completely in 5 minutes, 7 minutes and 3 minutes respectively, then which substance has the highest specific latent heat?

(Assume heat is absorbed at the same rate)

- (a) Substance A
- (b) Substance B
- (c) Substance C
- (d) All the substances have same specific latent heat

- (xv) An atom of lithium contains 3 electrons, 3 protons and 4 neutrons.

Its **mass number** is:

- (a) 3
- (b) 4
- (c) 7
- (d) 10

Question 2

- (i) Complete the following by choosing the correct answers from the bracket:

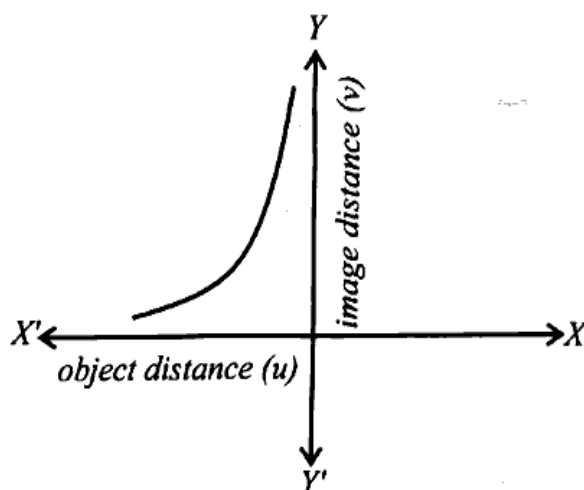
[6]

- (a) A car is moving in uniform circular motion. The direction of **friction** between the tyres and the path is _____ [*towards the centre / tangential to the path*].
- (b) When a ray of light passes from a **denser to a rarer** medium, its wavelength _____ [*decreases / increases*].
- (c) The **lid** of a calorimeter minimises heat loss by _____ [*convection / radiation*].
- (d) **Quality** of sound depends on its _____ [*amplitude / waveform*].
- (e) A substance whose **resistance** becomes almost negligible at a temperature near **absolute zero** is called a _____ [*semiconductor / superconductor*].
- (f) _____ radiation deviates **minimum** in a magnetic field. [*Alpha / Beta*].

- (ii) State *two* factors on which the position of **Center of Gravity** of a body depends. [2]
- (iii) Case 1: Lata cuts a potato into two halves, using a cutter which belongs to a **Class II** lever. She needed effort E_1 . [2]
- Case 2: Then she cuts one half of this potato again, but this time she needed effort E_2 . If $E_1 > E_2$ then:
- (a) In which case (1^{st} or 2^{nd}) was the potato closer to her hand applying the effort? (*Assume normal reaction of the surface of the potato is same in both cases*)
- (b) Give a reason for your answer in (a) above.

Question 3

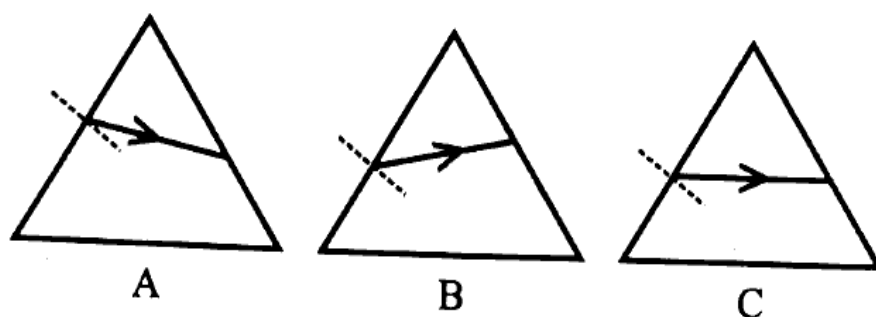
- (i) The graph below shows the variation of **image distance (v)** with the **object distance (u)** when an object is kept in front of a lens. [2]



- (a) Identify the type of **lens** used.
- (b) What would be the **magnification** (*more than 1 / less than 1 / equal to 1*) if the object is placed between F and $2F$ of the above lens?

- (ii) A resistance R is connected across a cell with a switch and a rheostat in **series**. [2]
A voltmeter is connected parallel across the **cell**. Current in the circuit is increased using the rheostat.
- (a) How will the voltmeter reading change? (*increase / decrease / remain the same*)
- (b) Justify your answer stated in (a) above.
- (iii) (a) Define *natural vibrations*. [2]
- (b) How is this vibration different from *damped vibrations* in terms of their amplitudes?
- (iv) A metal piece of **thermal capacity** 40 JK^{-1} , absorbs 800 J of heat. [2]
Calculate the rise in the temperature of this metal piece.
- (v) In an **AC generator**, name the part which has the following functions: [2]
- (a) intensifies the magnetic field.
- (b) maintains electrical contact between the rotating parts and the external circuit.
- (vi) Give two differences between **nuclear fission** and **nuclear fusion**. [2]

- (vii) A monochromatic ray strikes the surface of identical prisms (A, B and C) at different angles of incidence. The diagram below shows their refracted rays. Study the path of these refracted rays and identify in which of the diagrams: [3]



- the angle of incidence is maximum.
- the angle of incidence is minimum.
- the angle of incidence is equal to the angle of emergence.

SECTION B (40 Marks)

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

Question 4

- (i) A ray of light enters a glass block from air and comes out from the opposite surface. If the angle of **refraction** at the first surface is **not** the same as the angle of **incidence** at the second surface, then: [3]
- What is the product of the ratio $\frac{\sin i}{\sin r}$ at the first surface and at the second surface?
 - State whether the opposite surfaces are *parallel* or *not parallel*.
 - How did you reach the conclusion in (b) above?

[3]

(ii) A type of glass block has a refractive index of 1.8.

(a) Calculate the speed of light in this glass.

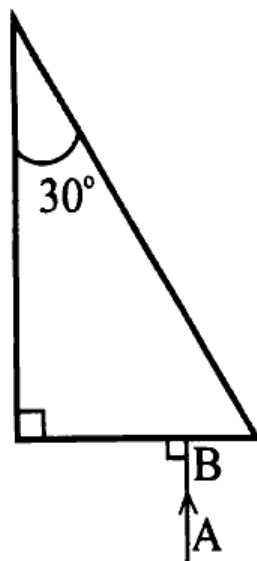
(Given speed of light in air $3 \times 10^8 \text{ ms}^{-1}$)

(b) If the width of this block is **doubled**, then what will be the speed of light in the block?

(iii) (a) Name the electromagnetic radiation used to detect fake currency.

[4]

(b) Redraw the diagram given below and complete the path of the light ray **AB** through the glass prism till it emerges out of the prism. Critical angle of the glass is 42° .



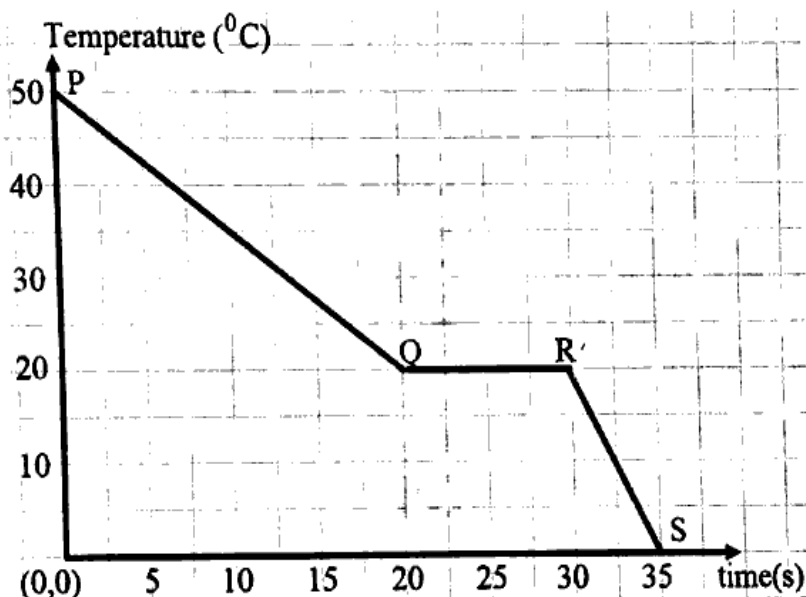
Question 5

(i) An object placed in front of a convex lens, forms an image of **same size** on a **screen**. Moving the object 12 cm **closer** to the lens results in the formation of a **real** image which is **three times** the size of the object.

[3]

Calculate the *focal length* of the lens.

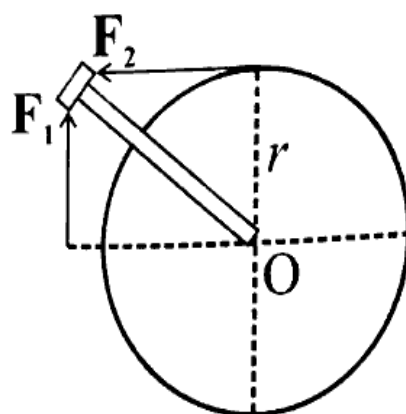
- (ii) (a) Atmospheric temperature after a hailstorm is **greater** than the temperature during the hailstorm. State **True** or **False**. [3]
- (b) Which **thermal physical quantity** of a frying pan changes by making its base heavier?
- (c) State the principle of Calorimetry.
- (iii) The given graph represents the **cooling curve** of a liquid. [4]



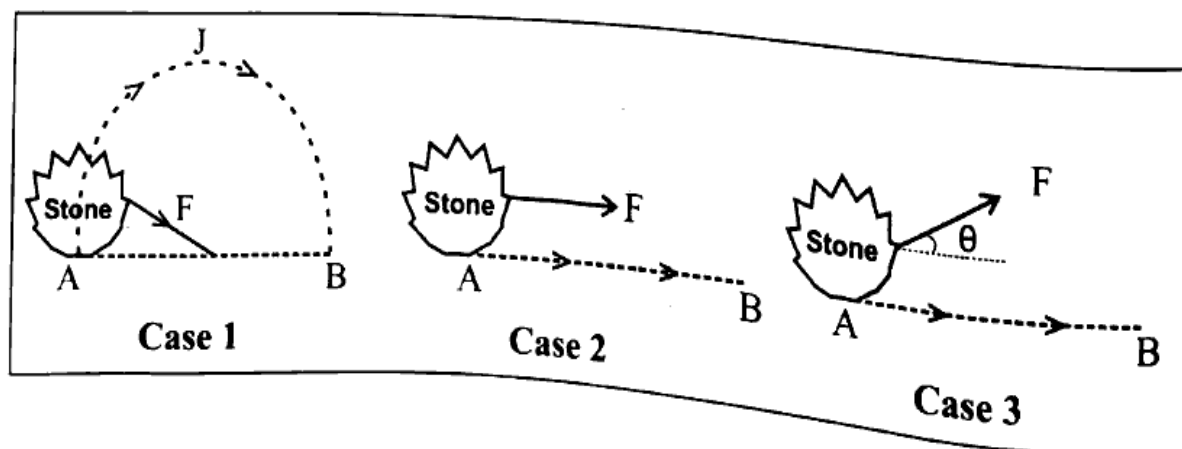
- (a) State the freezing temperature of the liquid.
- (b) Name the phase change happening at the region QR.
- (c) In which state (*solid / liquid*) does the above substance liberate heat at a faster rate? Justify.

Question 6

- (i) The diagram shows a wheel with a handle. Two forces, F_1 and F_2 of equal magnitudes are acting on the handle as shown in the diagram. [3]



- (a) Which force produces **negative** moment?
- (b) Is the wheel in **equilibrium**? (*Yes or No*)
- (c) Justify your answer stated in (b).
- (ii) (a) Name the unit of work done, used in **subatomic** scale. [3]
- (b) To which class of lever does a **pair of scissors** belong?
- (c) A stone is tied to a string and displaced from **A** to **B** by application of constant force **F** in three different ways as shown in the diagram below. Arrange the three cases in **ascending order** of the work done by the force. (*Given AJB is a semi-circle, $\theta < 90^\circ$ and $AB = 20\text{ m}$*)



- (iii) A ball of mass 20 g falls from a height of 45 m. It rebounds from the ground to a height of 40 m. Calculate: [4]

- (a) the initial potential energy of the ball.
- (b) the speed of the ball at which it hits the ground.
- (c) the loss in kinetic energy on striking the ground.

$[g = 10 \text{ m/s}^2]$

Question 7

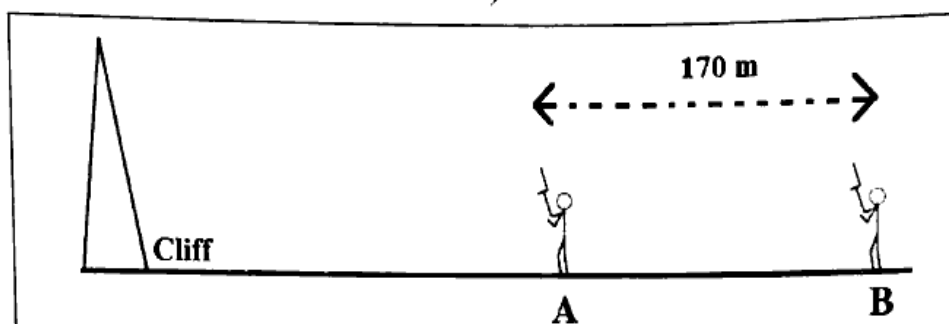
- (i) To lift a load of 30 kgf, Suhas uses a single fixed pulley, while Radha uses a single movable pulley. The **displacement of efforts** in both the cases are **equal**. [3]

In an **ideal situation** calculate the ratio of:

- (a) the efforts in the two cases.
- (b) the potential energy gained by the loads in the two cases.
- (c) the efficiencies in the two cases.

- (ii) (a) One end of a plastic foot ruler is held tightly at the edge of a table and the other end is plucked. Name the vibrations produced in the ruler. [3]
- (b) Now the ruler is pushed inside partially and plucked again from its free end. State **with a reason** whether the frequency of vibration increases or decreases.

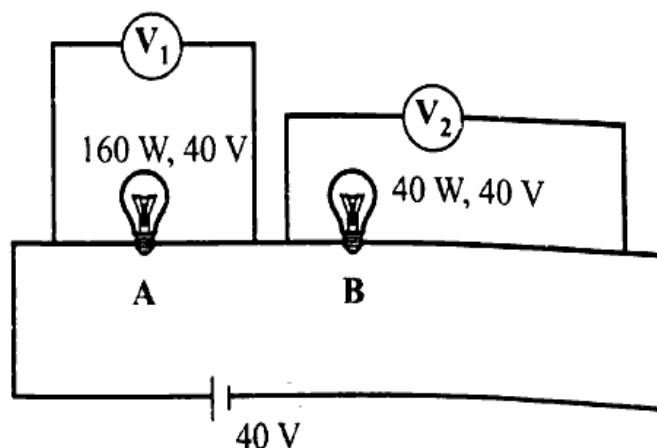
- (iii) Two persons **A** and **B** are standing in front of a cliff in the same line 170 m apart as shown in the diagram. Person **B** fires the gun and hears the echo in 3 s. Then the person **A** standing in front of the person **B** fires the gun.
(The speed of sound in air is 340 m/s.) [4]



- (a) Calculate:
- the distance of the person **B** from the cliff.
 - the **minimum** time in which **B** hears the gunshot fired by **A**.
- (b) Fill in the blank. The echo is softer (less loud) than the original sound due to the **decrease** in _____ of the wave. (*amplitude / frequency*)

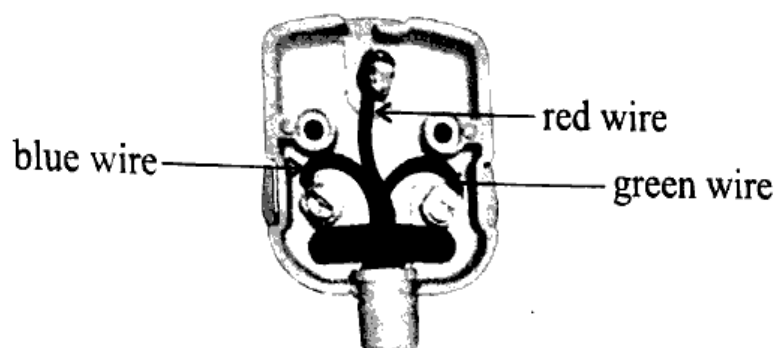
Question 8

- (i) Bulb **A** rated 160 W, 40 V and Bulb **B** rated 40 W, 40 V are connected as shown in the diagram. [3]

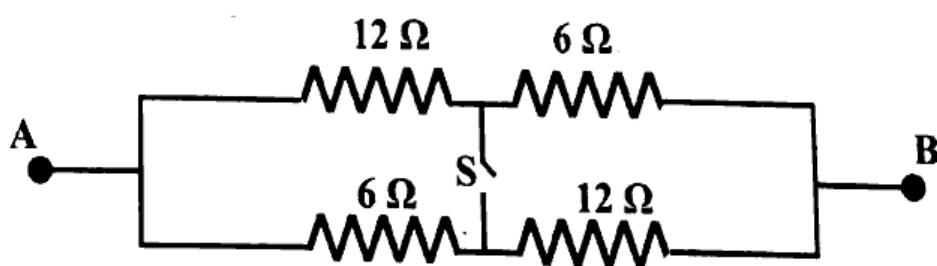


- (a) Calculate the ratio $V_1 : V_2$.
- (b) If the bulb **A** fuses, the current in the circuit remains the same.
State **True** or **False**.

- (ii) The reverse side of a three-pin plug with **incorrect** connection of wires is shown in the diagram below. [3]



- (a) Identify the **fault** in the above *connection*.
- (b) Mention a risk factor involved, if the user operates the appliance without correcting it.
- (c) Will the appliance function in the present situation? (*Yes or No*)
- (iii) In the combinations of resistors shown below, calculate: [4]



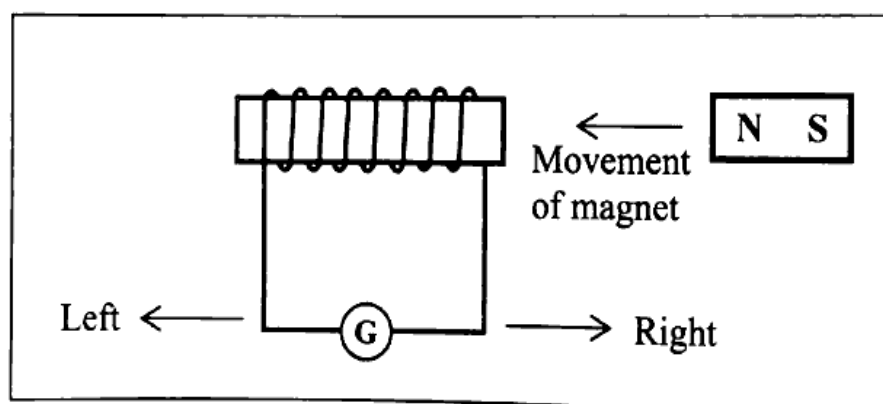
- (a) the resistance across AB when the switch S is open.
- (b) the resistance across AB when the switch S is closed.

Question 9

- (i) An electric iron rated 1100 W, 220 V is operated for 5 hours. [3]

Calculate:

- (a) the **minimum** rating of the fuse required.
 - (b) the energy consumed in **kWh**.
 - (c) the cost of the energy consumed, if the rate is ₹ 10 per unit.
- (ii) When the magnet as shown in the diagram, is moved towards the coil at a speed of 5 ms^{-1} , the galvanometer shows a certain deflection to the right. [3]



How will the **direction** and **magnitude of deflection** change when the **coil** also moves with a speed of 5 ms^{-1} :

- (a) in the direction of the motion of the magnet?
- (b) in the opposite direction of the motion of the magnet?

- (iii) (a) 1. Which **element** is used in the lining of the special aprons worn by workers in nuclear power plants? [4]
2. Why is this element preferred?
- (b) ${}^{24}_{11}\text{Na}$ emits a nuclear radiation which **does not alter** the mass number but is **deflected** by a magnetic field.
1. Name the type of nuclear radiation emitted by ${}^{24}_{11}\text{Na}$.
2. Write the equation for this radioactive decay.