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:

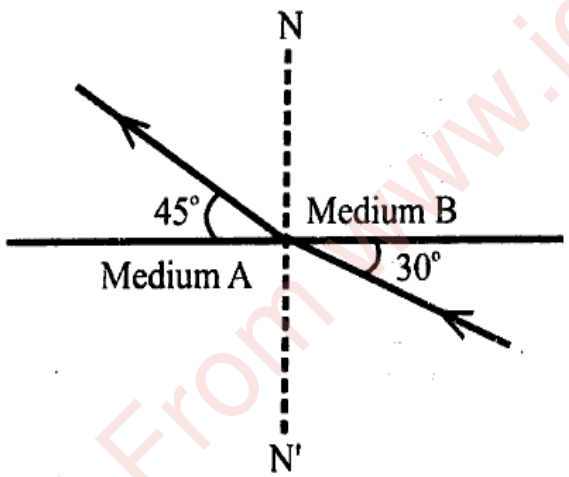
(a) 1

(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) $\frac{Sin45°}{Sin30°}$

(b) $\frac{Sin30°}{Sin45°}$

(c) $\frac{Sin45°}{Sin60°}$

(d) $\frac{Sin60°}{Sin45°}$

(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.

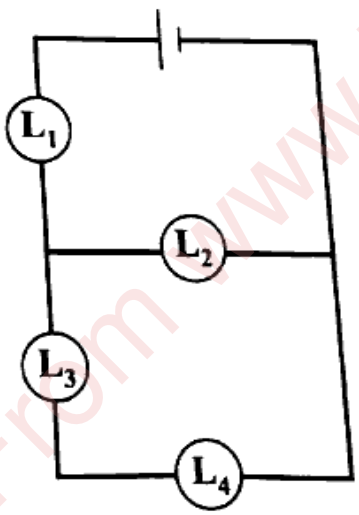
(a) (A) is true but (R) is false.

(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 ¼

(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:

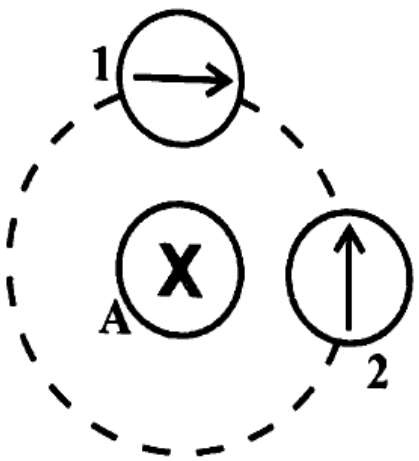
(a) $\frac{R_1 + R_2}{R_1 R_2}$

(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]

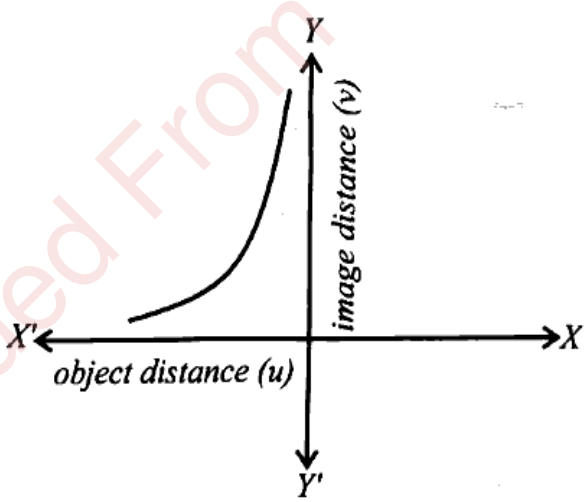
Case 2: Then she cuts one half of this potato again, but this time she needed effort E_2. If $E_1 > E_2$ then:

(a) In which case (1st or 2nd) 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**. A voltmeter is connected parallel across the **cell**. Current in the circuit is increased using the rheostat. [2]

(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.

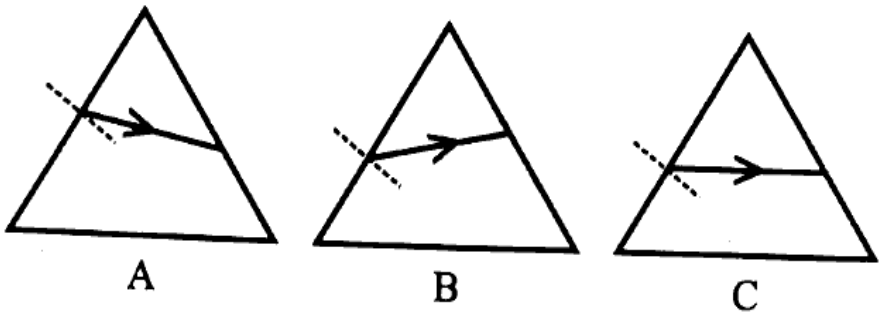
(v) In an **AC generator**, name the part which has the following functions: [2]

(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]



(a) the angle of incidence is maximum.

(b) the angle of incidence is minimum.

(c) 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]

(a) What is the product of the ratio $\frac{sini}{sinr}$ at the first surface and at the second surface?

(b) State whether the opposite surfaces are *parallel* or *not parallel*.

(c) How did you reach the conclusion in (b) above?

(ii) A type of glass block has a refractive index of 1.8. [3]

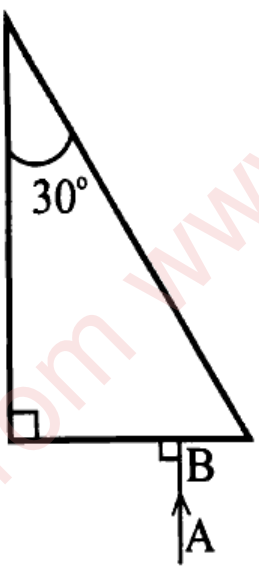
(a) Calculate the speed of light in this glass.

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

(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]

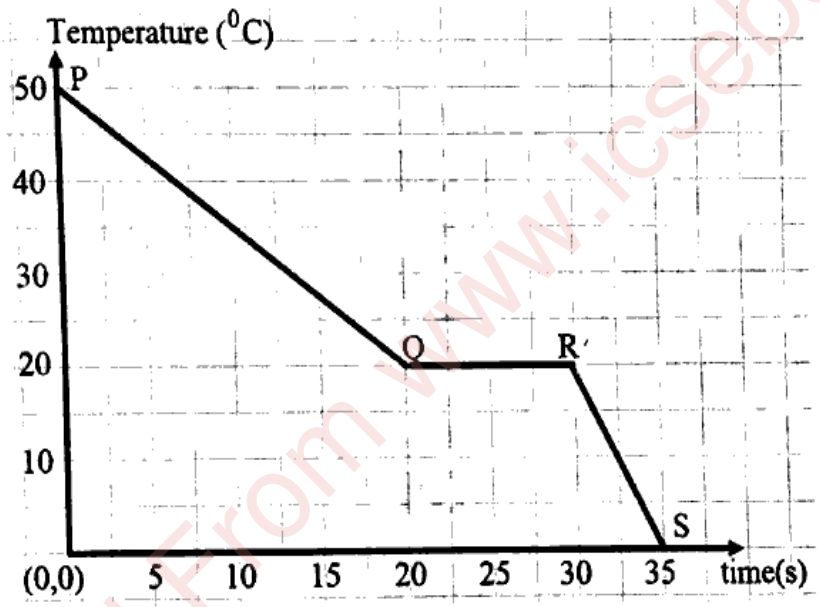
Calculate the *focal length* of the lens.

(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]



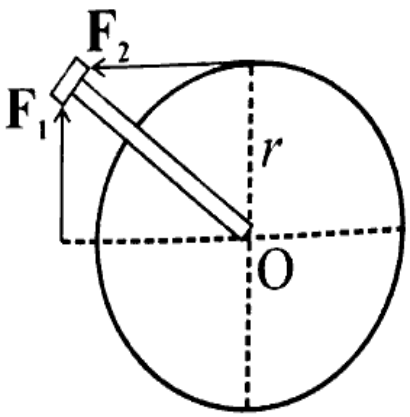
(a) State the freezing temperature of the liquid.

(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?

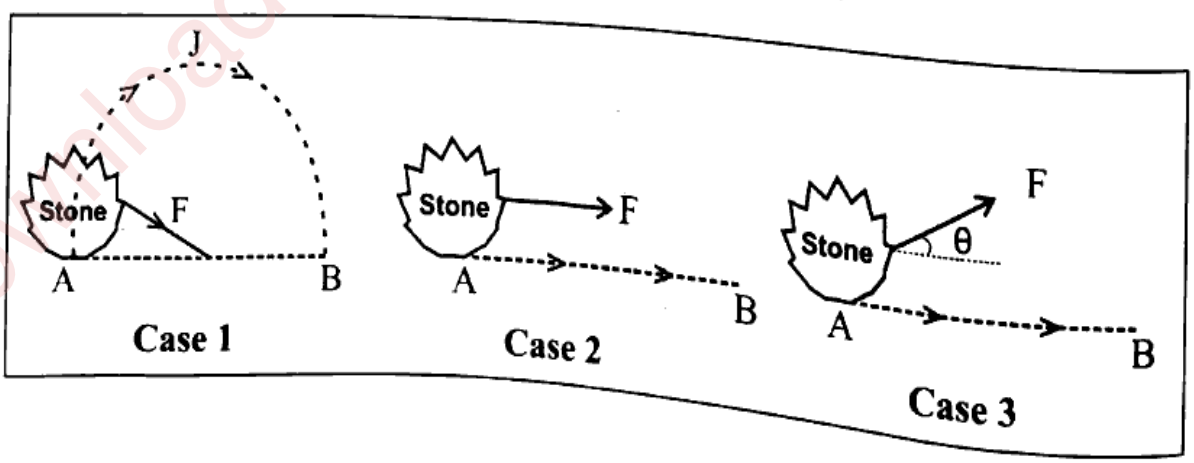
(b) Is the wheel in **equilibrium**? *(Yes or No)*

(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, $\theta < 90^o$ and AB = 20 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 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**. In an **ideal situation** calculate the ratio of: [3]

(a) the efforts in the two cases.

(b) the potential energy gained by the loads in the two cases.

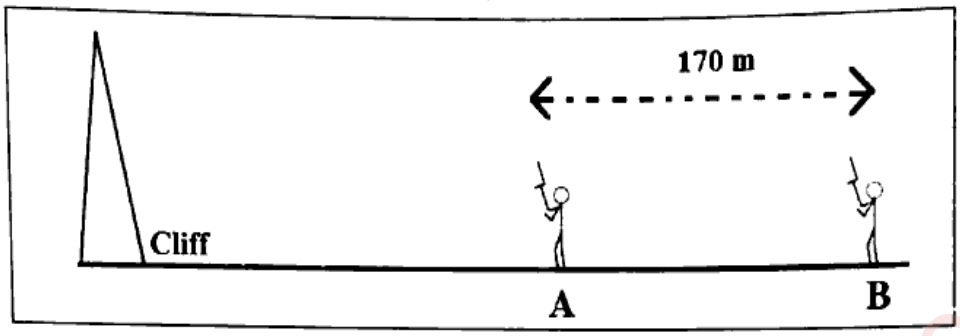
(c) the efficiencies in the two cases.

(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. [4]

(The speed of sound in air is 340 m/s.)



(a) Calculate:

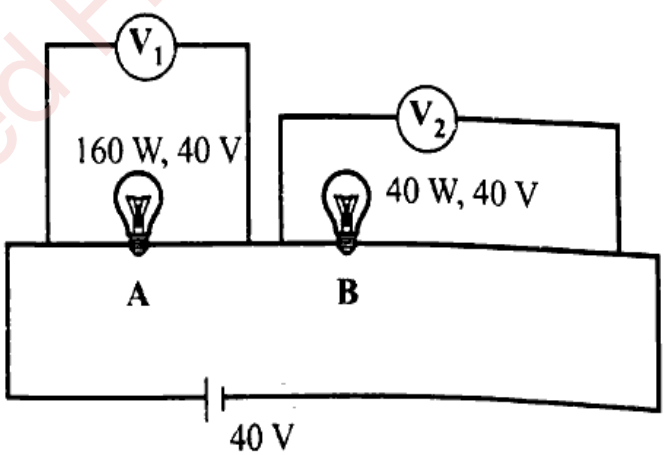
1. the distance of the person **B** from the cliff.

2. 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

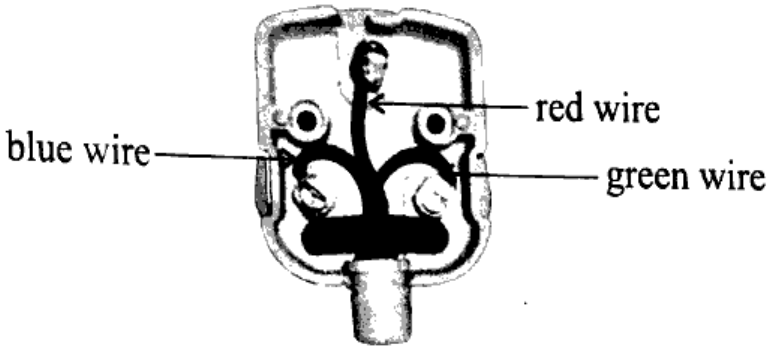
(i) Bulb **A** rated 160 W, 40 V and Bulb **B** rated 40 W, 40 V are connected as shown in the diagram. [3]



(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]

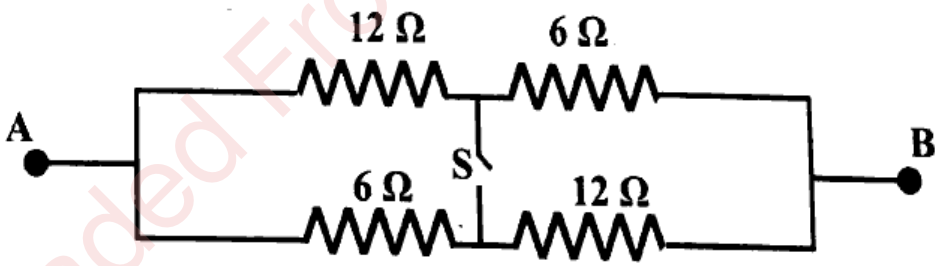


(a) Identify the **fault** in the above *connection*.

(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]

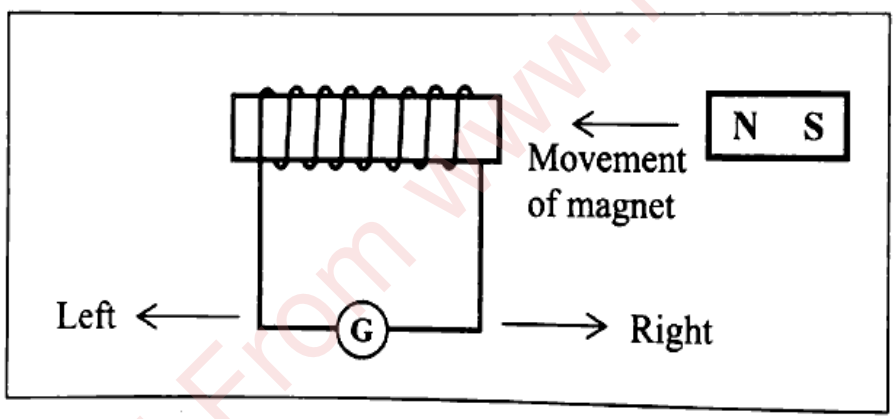
Calculate:

(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) $^{24}_{11}Na$ 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 $^{24}_{11}Na$.

2. Write the equation for this radioactive decay.