PHYSICS

(SCIENCE PAPER 1)

Maximum Marks : 80
Time Allowed: Two hours
Answers to this Paper must be written on the paper provided separately.
*You will **not** be allowed to write during the first **15** 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.

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

SECTION A (40 Marks)

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

***Question* 1**

Choose the correct answers to the questions from the given options. (Do not copy the questions, write the correct answers only.) **[15]**

(i) Clockwise moment produced by a force about a fulcrum is considered to be :

(a) Positive (b) Negative (c) Zero (d) None of these

Ans. (b) Negative

(ii) When the speed of a moving object is *doubled*, then its *kinetic energy* :

(a) remains the same (b) decreases (c) is doubled (d) becomes four times

Ans. (d) becomes four times

(iii) The energy conversion in a washing machine is from ..... .

(a) magnetic to electrical (b) electrical to mechanical

(c) electrical to magnetic (d) magnetic to electrical

Ans. (b) electrical to mechanical

(iv) Which of the following radiations suffer maximum deflection in a magnetic field ?

(a) Alpha radiations (b) Beta radiations

(c) Gamma radiations (d) X-radiations

Ans. (b) Beta radiations

(v) Speed of blue light in water is :

(a) more than green light (b) more than orange light

(c) more than violet light (d) more than red light

Ans. (c) more than violet light

(vi) A concave lens produces only ..... image.

(a) real, enlarged (b) virtual, enlarged (c) virtual, diminished (d) real, diminished

Ans. (c) virtual, diminished

(vii) When a body vibrates under a periodic force, the vibrations of the body are always :

(a) natural vibrations (b) damped vibrations

(c) forced vibrations (d) resonant vibrations

Ans. (c) forced vibrations

(viii) Two notes are produced from two different musical instruments, such that they have same loudness and same pitch. The produced notes differ in their :

(a) Waveform (b) Frequency (c) Wavelength (d) Speed

Ans. (a) Waveform

(ix) When a current I flows through a wire of resistance R for time t then the electrical energy produced is given by :

(a) I^2Rt (b) IR^2t (c) IRt (d) IRt^2

Ans. (a) I^2Rt

(x) Choose the correct relation for e.m.f. (ε) and terminal voltage V :

(a) $\varepsilon = V$ (always) (b) $V > \varepsilon$ (always)

(c) $V < \varepsilon$ (when the cell is in use) (d) None of these

Ans. (c) $V < \varepsilon$ (when the cell is in use)

(xi) If the strength of the current flowing through a wire is increased, the strength of the magnetic field produced by it :

(a) decreases (b) increases

(c) remains the same (d) first increases then decreases

Ans. (b) increases

(xii) Specific latent heat of a substance :

(a) is directly proportional to the mass

(b) is directly proportional to the change in the temperature

(c) depends on the material

(d) is inversely proportional to the mass

Ans. (c) depends on the material

(xiii) Specific heat capacity of a substance X is 1900 $Jkg^{-1}°C^{-1}$ means :

(a) Substance X absorbs 1900 J for 1°C rise in temperature.

(b) 1 kg of substance X absorbs 1900 J heat for 1°C rise in temperature.

(c) 1 kg of substance X absorbs 1900 J heat to increase the temperature.

(d) 1 kg of substance X absorbs 1900 J heat to cool down by 1°C.

Ans. (b) 1 kg of substance X absorbs 1900 J heat for 1°C rise in temperature

(xiv) When a ray of light travels normal to the given surface, then the angle of refraction is :

(a) 180° (b) 90° (c) 0° (d) 45°

Ans. (c) 0°

(xv) Small air bubbles rising up a fish tank appear silvery when viewed from some particular angle is due to the :

(a) reflection (b) refraction (c) dispersion (d) total internal reflection

Ans. (d) total internal reflection

Question 2

(i) (a) When does the nucleus of an atom tend to become radioactive ? **[3]**

Ans. When the number of neutrons tend to become more than the number of protons in the nucleus of an atom.

(b) Name a single pulley in which displacement of load and effort is not the same.

Ans. Single movable pulley.

(c) State one advantage of this pulley.

Ans. It acts as a force multiplier.

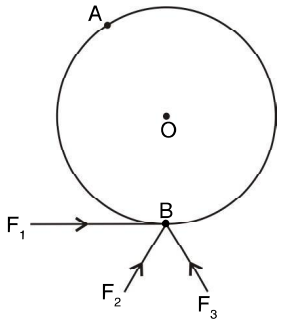
(ii) (a) What is the position of centre of gravity of a triangular lamina ? [2]

Ans. The point of intersection of the medians, *i.e.* the centroid is the centre of gravity of a triangular lamina.

(b) When this triangular lamina is suspended freely from any one vertex, what is the moment of force produced by its own weight in its rest position ?

Ans. Zero

(iii) The diagram shows wheel **O** pivoted at point **A**. Three equal forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$ act at point **B** on the wheel. [2]



(a) Which force will produce maximum moment about **A** ?

Ans. F_1

(b) Give a reason for your answer in (a).

Ans. The perpendicular distance of force F_1 from A is maximum.

(iv) (a) What should be the *angle* between the direction of force and the direction of displacement, for work to be negative ? [2]

Ans. 180°

(b) Name the physical quantity obtained using the formula U/h, where U is the potential energy and h is the height.

Ans. Force of gravity ($F = mg$) or weight

(v) Calculate the power spent by a crane while lifting a load of mass 2000 kg, at velocity of 1·5 ms^{-1}. ($g = 10\ ms^{-2}$) [2]

Ans. Given : $m = 2000$ kg, $v = 1{\cdot}5\ ms^{-1}$, $g = 10\ m/s^2$

Power spent = Force × velocity = $mg \times v = 2000 \times 10 \times 1{\cdot}5 = 30{,}000$ W = **30 kW**.

(vi) A metal foot ruler is held at the edge of a table. It is pressed at its free end and then released. It vibrates. [2]

(a) Name the vibrations produced.

Ans. Natural vibrations.

(b) State *one* way to increase the frequency of these vibrations.

Ans. To increase the frequency of these vibrations, the effective length of the ruler protruding out of the table should be decreased.

(vii) 'A geyser is rated 240 W = 220 V'. Explain the meaning of this statement. [2]

Ans. It consumes 240 J of electrical energy per second when connected to a power supply of 220 V mains.

Question 3

(i) (a) Is it possible for a concave lens to form an image of size two times that of the object ? Write *Yes* or *No*. [2]

Ans. No.

(b) What will happen to the focal length of the lens if a part of the lens is covered with an opaque paper ?

Ans. The focal length will remain the same, only the intensity of the image decreases.

(ii) (a) Which electrical component protects the electric circuit in case of excess current and which can also be used as a switch ? [2]

Ans. MCB (Miniature Circuit Breaker).

(b) Name the wire to which this electrical component is connected in an electric circuit.

Ans. Live wire.

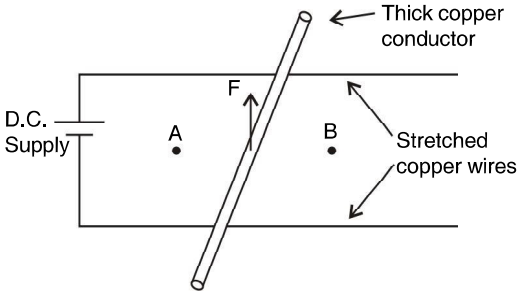
(iii) A copper conductor is placed over two stretched copper wires whose ends are connected to a D.C. supply as shown in the diagram. [2]

(a) What should be the magnetic poles at the points **A** and **B** lying on either side of the conductor to experience the force in the upward direction ?

Ans. A is north pole and B is south pole.

(b) Name the law used to find these polarities.

Ans. Fleming's left hand rule.



(iv) Thermal capacities of substances **A** and **B** are same. If mass of **A** is more than mass of **B** then : **[2]**

(a) Which substance will have more specific heat capacity ?

Ans. Substance B.

(b) Which substance will show greater rise in temperature if the same amount of heat is supplied to both ?

Ans. Both substances will show an equal rise in temperature.

(v) How is the *radioactivity* of a radio isotope affected if it undergoes a *chemical change* ? Give a reason for your answer. **[2]**

Ans. These is no change in radioactivity. It is because radioactivity is a nuclear phenomenon which is not affected by chemical changes.

SECTION B (40 Mark)

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

Question 4

(i) The diagram below shows the ray **OP** travelling through an *equilateral* prism of a certain material. **[2]**

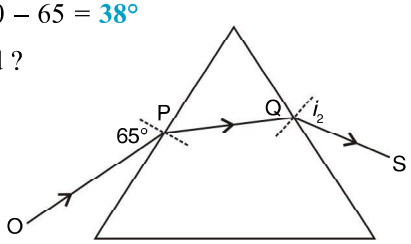
(a) Calculate the value of i_2, if the angle of deviation is 43°.

Ans. From $\delta = (i_1 + i_2) - A$,

$i_2 = \delta + A - i_2 = 43 + 60 - 65 = \mathbf{38°}$

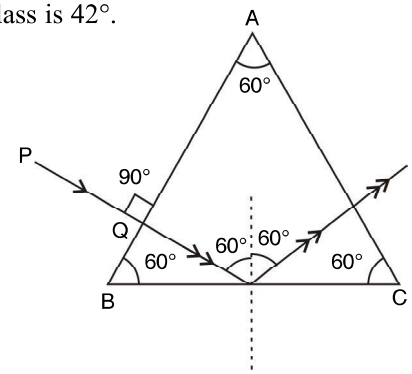
(b) What is the ray QS called ?

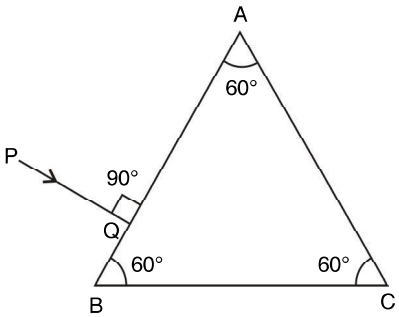
Ans. Emergent ray.



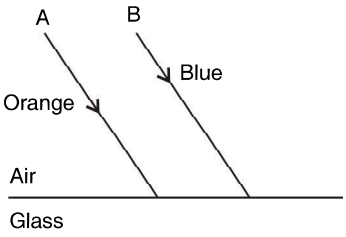
(ii) Copy the diagram given below and complete the path of the light ray **PQ**, as it emerges out of the prism by marking necessary angles. The critical angle of glass is 42°. **[3]**

Ans.



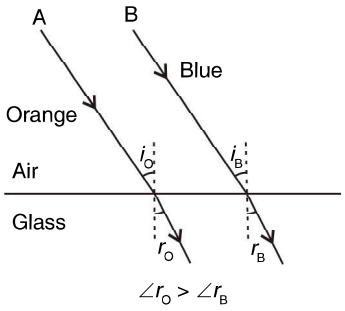


(iii) The diagram below shows two parallel rays **A** (Orange) and **B** (Blue) incident from air, on air-glass boundary. **[4]**



(a) Copy and complete the path of the rays **A** and **B**.

Ans.



(b) How do the speeds of these rays differ in glass ?

Ans. Orange light travels faster than blue light in glass.

(c) Are the two refracted rays in glass parallel ? Give a reason.

Ans. No, the two refracted rays inside the glass are not parallel. Due to their differing speeds in glass, orange light bends less while blue light bends more.

Question 5

(i) A convex lens of focal length 10 cm is placed at a distance of 60 cm from a screen. How far from the lens should an object be placed so as to obtain a real image on the *screen* ? **[3]**

Ans. Given $f = +10$ cm, $v = +60$ cm, $u = ?$

Using relation $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, we get $\frac{1}{10} = \frac{1}{60} - \frac{1}{u} \Rightarrow u = -12$ cm

Thus, the object should be placed at a distance of 12 cm in front of the lens.

(ii) (a) A coin kept inside water ($\mu = \frac{4}{3}$) when viewed from air in a vertical direction appears to be raised by 3·0 mm. Find the depth of the coin in water. **[3]**

Ans. Given $\mu = \frac{4}{3}$, shift = 3·0 mm

Let 'd' be the real depth of coin in water.

Using $\mu = \frac{\text{Real depth}}{\text{Apparent depth}}$, we get Apparent depth $= \frac{\text{Real depth}}{\frac{4}{3}} = \frac{3}{4}d$

Shift = Real depth – Apparent depth

$\Rightarrow 3 = d - \frac{3}{4}d \Rightarrow 3 = \frac{1}{4}d$ or $d =$ **12 mm**

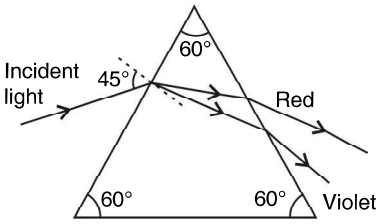
(b) How is the critical angle related to the refractive index of a medium ?

Ans. $\sin C = \frac{1}{\mu}$, where C is critical angle and μ is refractive index.

(iii) (a) Infrared radiations are used in warfare. Explain with reason, why ? **[4]**

Ans. Infrared radiations are used as signals during war as they are not visible and they are not absorbed much in the medium. They are scattered less by the earth's atmosphere because of their long wavelength and hence they can penetrate deep inside the atmosphere, even during night, mist or fog.

(b) A ray of light is incident at 45° on an equilateral prism in the diagram given alongside.



1. Name the phenomenon exhibited by the ray of light when it enters and emerges out of the prism.

Ans. When light enters the prism, it suffers dispersion *i.e.* light splits into different colours. On striking the next interface, each ray gets refracted.

2. State the cause of the above phenomenon mentioned by you.

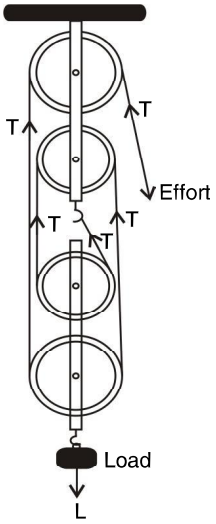
Ans. Dispersion of white light takes place because light of different wavelengths travel with different speeds in a medium; refraction takes place because the speed of light changes on going from one medium to another.

Question 6

(i) A block and tackle system of pulleys has *velocity ratio* 4. **[3]**

(a) Draw a labelled diagram of the system indicating clearly, the direction of the load and the effort.

Ans.



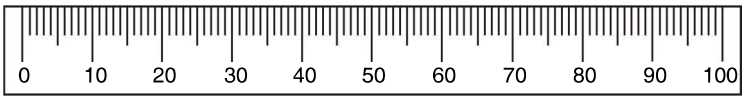
(b) What is the value of the mechanical advantage of the given pulley system if it is an ideal pulley system ?

Ans. From the figure, Load L = 4T and E = T

$$\therefore \text{ Mechanical advantage} = \frac{\text{Load L}}{\text{Effort E}} = \frac{4\,T}{T} = 4$$

(ii) A **metre** scale of weight 50 gf can be balanced at 40 cm mark without any weight suspended on it. **[3]**

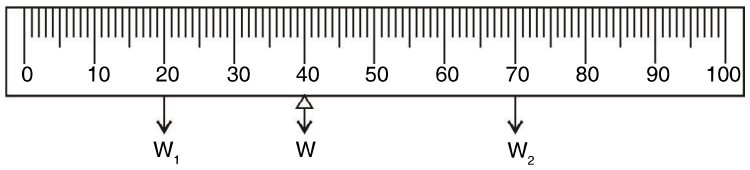
(a) If this ruler is cut at its centre then state which part [0 to 50 cm or 50 to 100 cm] of the ruler will weigh more than 25 gf.



Ans. Given : The scale is balanced at 40 cm mark.

Also W = 50 gf

Let W_1 gf weight of scale is acting at 20 cm and W_2 gf weight is acting at 70 cm mark and $W_1 + W_2 = 50$.



$\therefore$ $W_1 \times 20 = W_2 \times 30$ or $\frac{W_1}{W_2} = \frac{3}{2}$

$\therefore$ $W_1 = 30$ gf and $W_2 = 20$ gf

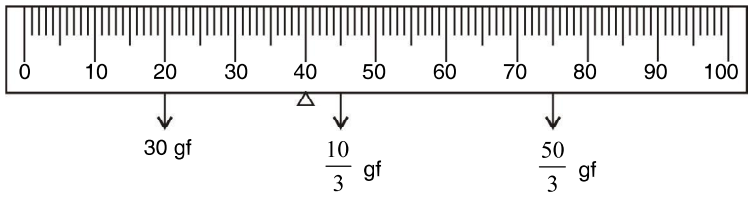
Thus the 0 to 50 cm part will weigh more than 25 gf.

(b) What minimum weight placed on this metre ruler can balance this ruler when it is pivoted at its centre ?

Ans. Weight of part 40 to 50 cm is $\frac{20}{60} \times 10 = \frac{10}{3}$ gf.

$\therefore$ Weight of the remaining part of 50 to 100 cm $= 20 - \frac{10}{3} = \frac{50}{3}$ gf.

Now the diagram shows that



For balance at centre, moments of both sides should be equal.

$30 \times 30 + \frac{10}{3} \times 5 = \frac{50}{3} \times 25 + W \times 50$ or $50\ W = 90 + \frac{50}{3} - \frac{1250}{3}$ or $W =$ **10 g**

(iii) A car mass 120 kg is moving at a speed 18 km/h and it accelerates to attain a speed of 54 km/h in 5 seconds. Calculate : **[4]**

(a) the work done by the engine.

Ans. Initial speed $u = 18$ km/h $= 5$ ms^{-1}

Final speed $v = 54$ km/h $= 15$ ms^{-1}

$\therefore$ Work done by the engine = Increase in kinetic energy $= \frac{1}{2} m (v^2 - u^2) = \frac{1}{2} \times 120 (15 \times 15 - 5 \times 5)$

$= 12{,}000$ J $= 12$ kJ

(b) the power of the engine.

Ans. Power $= \frac{\text{Work done}}{\text{Time taken}} = \frac{12{,}000}{5} = 2400$ W or 2·4 kW

Question 7

(i) (a) Which characteristic of sound is affected due to the larger surface of a school bell ? **[3]**

Ans. Loudness

(b) Calculate the distance covered by the Ultrasonic wave having a velocity of 1·5 kms^{-1} in 14 s, when it is received after reflection by the receiver of the SONAR.

Ans. Distance = Speed × Time = 1·5 kms^{-1} × 14 s = **21 km**

(ii) (a) Complete the following nuclear changes : **[3]**

$^{238}_{92}P \rightarrow -Q + {}^{4}_{2}He \rightarrow -R + {}^{0}_{-1}e$

Ans. $^{238}_{92}P \rightarrow {}^{234}_{90}Q + {}^{4}_{2}He \rightarrow {}^{234}_{91}R + {}^{0}_{-1}e$

(b) Name the nuclear radiation which has the highest ionizing power.

Ans. Alpha radiations.

(iii) We are able to see the T.V. channels clearly when we set T.V. on *auto-tuning*. **[4]**

(a) Which *phenomenon* led to the clear visibility of the channels, due to auto-tuning?

Ans. Resonance.

(b) Define the above phenomenon mentioned by you.

Ans. When the frequency of the externally applied periodic force on a body is equal to its natural frequency, the body readily begins to vibrate with increased amplitude. This phenomenon is known as resonance.

(c) Give *any one* more example of this phenomenon.

Ans. Resonance between two pendulums of equal length suspended from the same string. When one pendulum is displaced to oscillate, the other pendulum picks up its vibration and starts oscillating as well.

Question 8

(i) (a) Define specific resistance. **[3]**

Ans. Specific resistance of a material is the resistance of a wire of that material of unit area of cross-section and of unit length.

(b) What happens to the specific resistance of a conductor if its length is doubled ?

Ans. There will be no change in specific resistance as it is a characteristic property of a substance.

(c) Name a substance whose specific resistance remains almost unchanged with the increase in its temperature.

Ans. Manganin.

(ii) (a) Which nuclear radiation will travel undeviated in an electric field ? **[3]**

Ans. Gamma radiations.

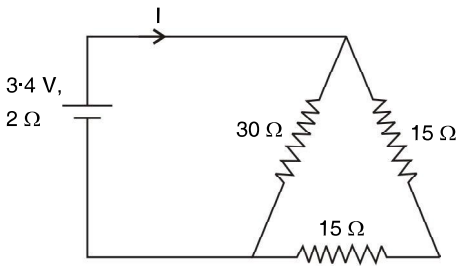
(b) How can one stop the radiations escaping from a nuclear reactor in a nuclear power plant ?

Ans. By creating walls of concrete or lead around the plant.

(c) Name *one* internal source of background radiation.

Ans. Radium, potassium (K-40) present inside our body.

(iii) Find the value of current **I** drawn from the cell. **[4]**



(a) Calculate the current **I**.

Ans. 15 Ω resistances are in series; hence R_s = 30 Ω

R_s is in parallel with 30 Ω resistor.

∴ Equivalent resistance R of triangle, $\frac{1}{R_p} = \frac{1}{30} + \frac{1}{30}$

⇒ R_p = 15 Ω

Total resistance of circuit, $R_{eq.} = R_p + r = 15 + 2 =$ **17 Ω**

Now, current $I = \frac{V}{R_{eq.}} = \frac{3{\cdot}4}{17} =$ **0·2 A**

(b) Calculate the terminal voltage.

Ans. Terminal voltage $V = \varepsilon - Ir = 3{\cdot}4 - 0{\cdot}2 \times 2 =$ **3·0 V**

Question 9

(i) Calculate the total amount of heat energy required to **melt** 200 g of ice at 0°C to water at 100°C. **[3]**

(Specific latent heat of ice = 336 J g^{-1}, specific heat capacity of water = 4·2 J $g^{-1}°C^{-1}$)

Ans. Heat energy required to change 200 g ice to water (Q_1) = mL = 200 × 336 = 67200 J

Heat energy required to heat 200 g water from 0° to 100°C (Q_2) = m.c.t. = 200 × 4·2 × 100 = 84000 J

∴ Total amount of heat energy required = $Q_1 + Q_2$ = **151200 J** or **151·2 kJ**

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

Ans. It states : Heat energy lost by a hot body = Heat energy gained by a cold body.

(b) Name the material used for making a calorimeter.

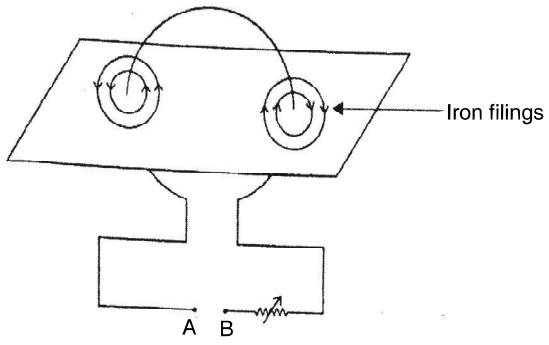
Ans. Copper

(c) Write *one* characteristic property of the material chosen for making a calorimeter.

Ans. It should be conducting and should possess low specific heat capacity.

(iii) The diagram below shows a cardboard on which iron filings are kept. A write bent in the form of a loop is

seen passing through the cardboard. When current flows through it the iron filings arrange themselves as shown below. **[4]**



(a) State the polarities of the *battery* at *A* and *B*.

Ans. A is positive and B is negative

(b) State the effect on the magnetic field if an iron rod is held along the axis of the coil.

Ans. Strength of the magnetic field increases.

(c) State one way to :

1. Change the polarity of the *coil*.

Ans. By changing the direction of the current *i.e.* reversing the polarities at A and B.

2. *Decrease* the strength of the magnetic field around the coil.

Ans. By decreasing the amount of current flowing in the coil i.e. increasing the resistance in the rheostat.