MODEL TEST PAPER

Physics (Science Paper I)

Maximum Marks 80 *Time Allowed: Two hours*

General Instructions

- Answers to this Paper must be written on the paper provided separately.
- You will not be allowed to write during 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

(Attempt all questions from this Section.)

Question 1

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

i. The moment of a force about a pivot is maximum when the force acts:
   a. parallel to the lever arm
   b. perpendicular to the lever arm
   c. through the pivot
   d. at zero distance from the pivot

ii. A stone held at rest at the top of a tower possesses:
   a. kinetic energy only
   b. gravitational potential energy
   c. sound energy only
   d. no energy

iii. The chief energy conversion in a hydroelectric power plant is:
   a. chemical → heat → electrical
   b. gravitational potential → kinetic → electrical
   c. light → chemical → electrical
   d. electrical → kinetic → heat

iv. A greased inclined plane is used to raise the same load through the same height. Compared with the ungreased plane, its:
   a. velocity ratio increases
   b. efficiency decreases
   c. velocity ratio stays the same and efficiency increases
   d. mechanical advantage becomes zero

v. Which factor does NOT affect the angle of deviation through a prism of fixed angle?
   a. refractive index of glass
   b. colour of light
   c. physical size of the prism
   d. angle of incidence

vi. Light signals can remain confined inside suitable optical fibres mainly because of:
   a. diffuse reflection
   b. total internal reflection
   c. dispersion
   d. scattering

vii. A light ray travels obliquely from glass into air. If its angle of incidence is smaller than the critical angle, it:
   a. bends towards the normal
   b. bends away from the normal
   c. travels without changing direction
   d. is always totally internally reflected

viii. **Assertion (A):** A ray of light passing through a triangular glass prism generally deviates from its original direction.

   Reason (R): The two refracting faces of the prism are not parallel.
   a. A true, R false
   b. A false, R true
   c. both true; R explains A
   d. both true; R does not explain A

ix. Two sound waves have equal amplitude but frequencies 200 Hz and 400 Hz. The 400 Hz sound has:

a. greater loudness
b. higher pitch
c. lower pitch
d. greater speed in the same air

x. A 12 V battery is connected to two parallel branches: 4 Ω and 6 Ω in series in one branch, and 8 Ω alone in the other. Which relation is correct?

a. $I_4\Omega = I_6\Omega < I_8\Omega$
b. $I_4\Omega > I_6\Omega$
c. $I_8\Omega < I_6\Omega$
d. all three currents are equal

xi. Which electromagnetic radiation is commonly used in heat therapy for muscular pain?

a. radio waves
b. infrared radiation
c. ultraviolet radiation
d. gamma rays

xii. The magnetic field lines around a long straight current-carrying wire are:

a. parallel straight lines
b. concentric circles
c. ellipses along the wire
d. radial straight lines

xiii. Which sample has the highest heat capacity? (Specific heat capacities: water = 4200 J kg^{-1} K^{-1}; copper = 390 J kg^{-1} K^{-1}.)

a. 10 g water b. 4 g water
c. 100 g copper d. 5 g water

xiv. During melting of pure ice at 0 °C under normal atmospheric pressure, the heat supplied:

a. raises its temperature immediately
b. is used as latent heat of fusion
c. reduces its mass without melting
d. is entirely converted to sound

xv. Which of the following nuclear radiations carries no electric charge?

a. alpha b. beta
c. gamma d. cathode rays

Question 2

i. Complete the statements by choosing the correct answers from the brackets. [6]

a. In a ..... [Class I / Class III] lever, the mechanical advantage is always less than 1.
b. Satellites can detect thermal patterns on Earth using ..... [infrared radiation / gamma rays].
c. The SI unit of heat energy is the ..... [joule / watt].
d. The audible frequency range for a normal young human ear is approximately ..... [20 Hz–20,000 Hz / 200 Hz–200,000 Hz].
e. The resistivity of a pure metal generally ..... [increases / decreases] as its temperature rises.
f. The nuclear reaction mainly used for energy production in conventional nuclear power plants is ..... [fission / fusion].

ii. State the class of lever represented by each action:

a. bending the forearm at the elbow using the biceps;
b. balancing the head on the neck. [2]

iii. Calculate the force that produces a moment of 20 N m about a pivot when its perpendicular distance from the pivot is 20 cm. [2]

Question 3

i. A concave lens forms a virtual image of an object placed in front of it. State

a. the nature of the image and
b. its position relative to the lens and principal focus. [2]

ii. a. Give one advantage of connecting household appliances in parallel.
b. Which wire is connected to the metal body of an appliance for safety? [2]

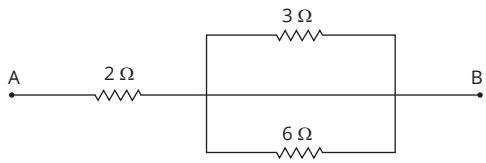
iii. Two pendulums suspended from the same support have different lengths. One is set into vibration.

a. What happens to the amplitude of the second pendulum when their lengths are made equal?
b. Name the phenomenon. [2]

iv. Explain the physical meaning of:

a. the heat capacity of a body is 60 J K^{-1};
b. the specific heat capacity of lead is 130 J kg^{-1} K^{-1}. [2]

v. Determine the equivalent resistance between points A and B in the given circuit. [2]



vi. State two safety precautions that reduce a person's exposure to harmful ionising radiation. [2]

vii. A transformer is connected to an alternating-current supply.

a. Name the principle on which it works.

b. Explain briefly how an alternating current in the primary coil produces an induced emf in the secondary coil.

c. Why will it not work with a steady direct current? [3]

Section B (40 Marks)

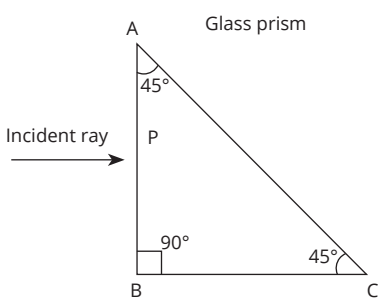
(Attempt any four questions from this section)

Question 4

i. a. State the two conditions necessary for total internal reflection.

b. Explain why a diamond appears brilliant due to repeated internal reflection. [3]

ii. A ray enters normally through the vertical face AB of the right-angled isosceles glass prism shown. The critical angle of glass is 42°. Copy and complete the ray path until it emerges. Mark the angle of incidence at the sloping face and state why the ray reflects there. [3]



iii. a. A fish in water is observed from air. Does it appear deeper or shallower than its actual position? Give a reason.

b. A coin is at an actual depth of 12 cm in water (refractive index 4/3). Calculate its apparent depth when viewed nearly normally from air. [4]

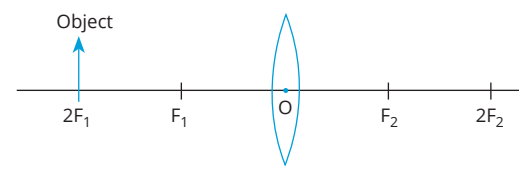
Question 5

i. a. State Snell's law for refraction.

b. Explain why a ray changes direction on passing obliquely between transparent media of different optical densities.

c. Give one condition under which it passes undeviated. [3]

ii. The following diagram shows an object at $2F_1$ in front of a convex lens. Copy the diagram and construct two principal rays to locate the image. State its size and nature. [3]



iii. A lens of focal length 20 cm forms a real, inverted image at a distance of 60 cm from the lens.

a. Identify the lens.

b. Calculate the object distance using the lens formula and Cartesian signs.

c. Calculate the magnification and describe the image size. [4]

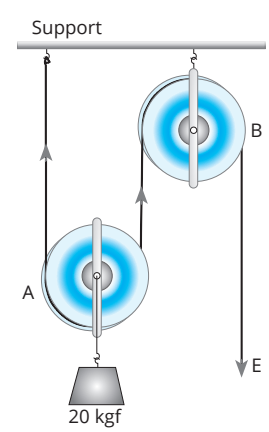
Question 6

i. The pulley arrangement shown is ideal.

a. Identify pulleys A and B.

b. State the purpose of pulley B.

c. Calculate the effort needed to raise the 20 kgf load. Neglect friction and pulley weight. [3]



ii. a. A wrench of length 20 cm is turned by a force of 2 N acting at right angles. Calculate the moment of force.

b. State the principle of moments.

c. A uniform metre rule balances with moments of 3 N m clockwise and 3 N m anticlockwise. Is it in rotational equilibrium? Explain. [3]

iii. A body of mass 10 kg is dropped from rest at a height of 5 m. Neglect air resistance and take $g = 10\ m\ s^{-2}$.

a. Calculate its initial potential energy.

b. Find its kinetic energy at a height of 2 m.

c. Calculate its kinetic energy immediately before reaching the ground. [4]

Question 7

i. A pendulum makes 4 complete oscillations per second. An observer fires a gun and hears the echo after the pendulum completes 6 oscillations. If the speed of sound is $340\ m\ s^{-1}$, calculate [3]

a. the time interval and

b. the distance of the reflecting cliff.

ii. A nucleus has 84 protons and 128 neutrons. It emits an alpha particle and then a beta-minus particle.

a. Find the proton and neutron numbers after alpha emission.

b. Find the proton and neutron numbers after beta-minus emission.

c. State the change in atomic and mass numbers during gamma emission. [3]

iii. a. Name the phenomenon used in tuning a radio receiver to a station.

b. Define this phenomenon.

c. Distinguish loudness from pitch by identifying the wave property governing each.

d. State the unit used to express sound level. [4]

Question 8

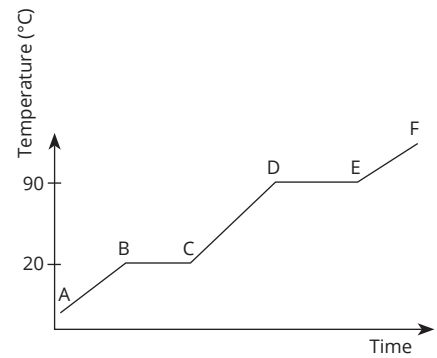
i. A sample of ice at a temperature below 0 °C is heated steadily until steam forms at 100 °C. Sketch a labelled temperature–time graph and identify the two horizontal portions. Explain why the temperature remains constant during each change of state. [3]

ii. The heating curve of another pure substance is shown.

a. State its melting point.

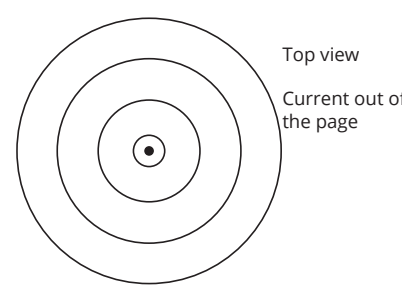
b. State its boiling point.

c. Explain what occurs along the horizontal section BC. [3]



iii. a. For a circular coil viewed from the front, current flows anticlockwise. State the magnetic polarity of the face towards you and describe one way to strengthen the magnetic field at its centre.

b. The figure shows a top view of a straight wire carrying current out of the page. Copy it and show arrows on the circular magnetic field lines. Name the rule used. [4]



Question 9

i. a. Name the charge carriers responsible for current in a metal.

b. Which wire should be connected to the metallic body of an electric geyser?

c. In which wire should a fuse be connected? [3]

ii. a. Complete the nuclear fission equation by giving the atomic number of barium and mass number of krypton:

$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{144}_{(\ )}Ba + {}^{(\ )}_{36}Kr + 3{}^{1}_{0}n + \text{energy}.$

b. Which of alpha, beta and gamma radiations has the highest ionising power?

c. State one difference between nuclear fission and nuclear fusion. [3]

iii. A battery of emf 12 V and internal resistance 2 Ω is connected to resistors of 4 Ω and 6 Ω in series, as shown. Calculate:

a. the current in the circuit,

b. the terminal potential difference of the battery,

c. the potential difference across the 6 Ω resistor, and

d. the electrical energy dissipated in the 4 Ω resistor in one minute. [4]

