Answer **eight** *ques*

PART I
[15 marks]

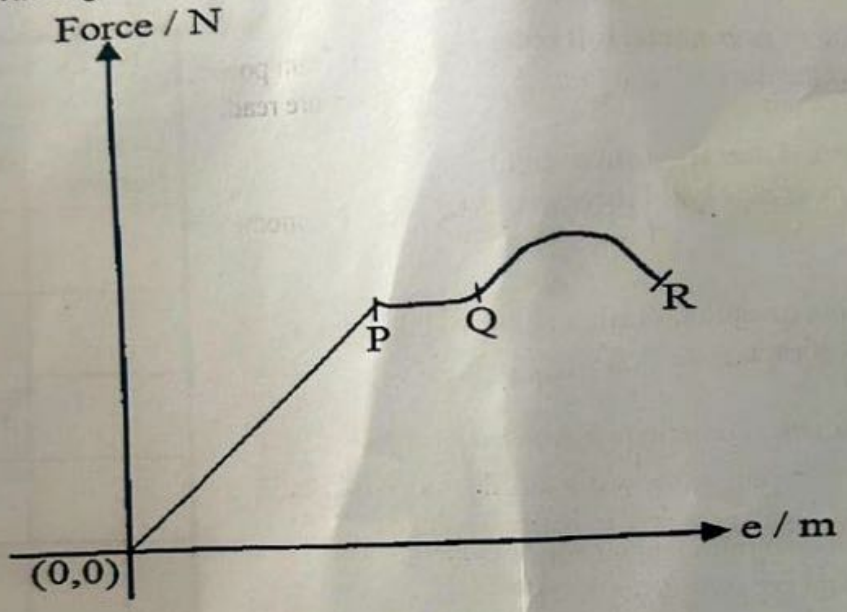
Answer any **five** *questions from this part.*

All *questions carry* **equal** *marks.*

1. State the physical quantities that have the same dimensions as **each** of the following quantities:
   (*a*) moment;
   (*b*) momentum;
   (*c*) Young's modulus. [3 marks]

2. State **three** applications of fiber optics in medicine. [3 marks]

3. The diagram below illustrates a force-extension graph of an elastic body.



Identify the parts labelled **P**, **Q** and **R**. [3 marks]

4. The horizontal distance between the points of projection and landing of a projectile in the same plane of projection is 767 m. If the speed of projection is 100 m s^{-1}, calculate the angle of projection.
   [$g = 10\ m\ s^{-2}$] [3 marks]

5. A satellite in its parking orbit moves with a speed of 3 km s^{-1}. Calculate the radius of its orbit.
   [$G = 6.67 \times 10^{-14}\ Nm^2\ kg^{-2}$, mass of the earth, $M_e = 5.97 \times 10^{27}$ kg] [3 marks]

6. A body of mass 0.5 kg is placed on a spring board causing a 10 cm compression of the spring. If the force constant of the spring is 100 N m^{-1}, calculate the height reached by the body when the spring is suddenly released.
   [$g = 10\ m\ s^{-2}$] [3 marks]

7. Give **three** evidences of the existence of an atom. [3 marks]

PART II
[45 marks]

Answer **three** *questions from this part.*
All *questions carry* **equal** *marks.*

8. (*a*) An inclined plane of length 5 m is used to raise a load of mass 60 kg through a height of 2 m. If the load is raised by a force of 300 N:
(i) sketch a diagram showing all forces acting on the load;
(ii) calculate the efficiency of the plane. [6 marks]

(*b*) (i) State **two** differences between *solid friction* and *viscosity*.
(ii) The stiffness of a wire is 5 N m^{-1}. If an extension of 0.3 m is produced by a force, **f**, calculate the magnitude of the force. [5 marks]

(*c*) A simple pendulum has a period of 4.2 s and 3.7 s when its length is shortened by 1 m, calculate the:
(i) original length of the pendulum;
(ii) acceleration due to gravity. [4 marks]

9. (*a*) A faulty thermometer reads 7 °C and 105 °C at the ice and steam points, respectively. If the thermometer reads 48 °C, calculate the accurate temperature reading. [3 marks]

(*b*) Define the following terms as they apply to liquid-in-glass thermometers:
(i) upper fixed point;
(ii) lower fixed point;
(iii) fundamental interval. [6 marks]

(*c*) State **three**:
(i) advantages of mercury over water as a thermometric liquid;
(ii) applications of thermal expansion in solids. [6 marks]

10. (*a*) (i) Explain *interference* of a wave.
(ii) State **two** differences between *transverse* and *longitudinal* waves.
(iii) List **four** examples of waves that can be plane polarized. [7 marks]

(*b*) A radio station broadcasts at a frequency of 250 kHz. If the speed of the wave is 3.0×10^8 m s^{-1}, calculate its wavelength. [3 marks]

(*c*) The displacement of a plane progressive wave is given by the equation $y = 10.5\sin(120\pi t - 0.5\pi x)$ where x and y are in meters and t in seconds, calculate the
(i) frequency ;
(ii) wave length;
(iii) speed;
of the wave. [5 marks]

11. (*a*) A 0.5 μF capacitor, 30 Ω resistor and a 0.05 H inductor are connected in series across a voltage source of e.m.f. 50 V_{rms}, $\frac{100}{\pi}$ Hz. Calculate the

(i) inductive reactance;

(ii) capacitive reactance;

(iii) impedance.

[6 marks]

(*b*) (i) State *Faraday's Law of electromagnetic induction.*

(ii) List the factors upon which the magnitude of an induced e.m.f. depends.

[5 marks]

(*c*) (i) Define *gravitational potential.*

(ii) State the *Newton's Law of Universal Gravitation.*

[4 marks]

12. (*a*) (i) The equation below represents a nuclear reaction process.

$$^{234}_{y}\text{Th} \longrightarrow ^{z}_{91}\text{Pa} + ^{0}_{-1}\text{e} + \text{energy}$$

Calculate the values of **y** and **z**.

(ii) A voltage of 30 kV is applied to an x-ray tube. Calculate the minimum wavelength of the x-ray produced.
[Plank's Constant = 6.6×10^{-34} Js; Speed of light = 3.0×10^{8} m s^{-1}]

[4 marks]

(*b*) (i) Explain the term *ionization energy.*

(ii) The energy required to separate a proton and an electron in the hydrogen atom is approximately 13.6 eV. Calculate the:

(α) orbital radius of the hydrogen atom;

(β) centripetal force that acts to keep the electron in orbit around the nucleus.
[e = 1.6×10^{-19} C. $(4\pi\varepsilon_o)^{-1} = 9.0 \times 10^{9}$ Nm C^{-2}, 1 eV = 1.6×10^{-19} J]

[7 marks]

(*c*) Give **two** reasons why an α-particle produces more ionization than a β-particle of the same kinetic energy.

[4 marks]

END OF PAPER