



TKN/KS/16/5758

Bachelor of Science (B.Sc.) Semester-I (C.B.S.)

Examination

**PHYSICS (PROPERTIES OF MATTER AND
MECHANICS)**

Compulsory Paper—I

Time—Three Hours]

[Maximum Marks—50

N.B. :— (1) **ALL** questions are compulsory.

(2) Draw neat diagrams wherever necessary.

Given : $g = 9.8 \text{ m/sec}^2$

Density of water = 1 gm/cm^3

Periodic time of earth = $8.64 \times 10^4 \text{ sec.}$

EITHER

1. (A) (i) Obtain an expression for time period of torsional pendulum. 3
(ii) A wire of length 1 m and diameter 1 mm is clamped at one end. Calculate the torque required to twist the end by 90° , if modulus of rigidity of material of wire is $2.8 \times 10^{10} \text{ N/m}^2$. 2

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1

(Contd.)



- (B) Derive an expression for the depression of the loaded end of a cantilever of circular cross section. 5

OR

- (C) Assuming the relations :

$$K = \frac{\gamma}{3(1-2\sigma)} \text{ and } \eta = \frac{\gamma}{2(1+\sigma)},$$

obtain the relation between γ , K and η . 2½

- (D) What do you mean by Angle of twist and angle of shear ? Obtain the relation between them. 2½

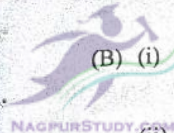
- (E) Find the work done in stretching a wire of cross-sectional area 1 sq.mm. and 2 m long through 0.1 mm

Give that, Young's Modulus of material of wire,
 $\gamma = 2 \times 10^{11} \text{ N/m}^2$. 2½

- (F) Derive an expression for restoring couple per unit twist of the cylinder. 2½

EITHER

2. (A) Derive the Poiseuille's Equation for steady flow of a liquid. State the assumptions made for deriving the equation. 5



(B) (i) Explain any two applications of Bernoulli's Theorem with suitable diagram. 3

(ii) A spherical steel ball of diameter 6 mm and density $7.26 \times 10^3 \text{ kg/m}^3$ falls with a terminal velocity of 0.24 m/s through glycerin at 25°C contained in a glass vessel.

Find the coefficient of viscosity of glycerin at 25°C .

Give that, density of glycerin, $\sigma = 1.25 \times 10^3 \text{ kg/m}^3$.

2

OR

(C) What do you mean by Reynold's number ? Give its physical significance. $2\frac{1}{2}$

(D) Derive an expression for terminal velocity of a spherical body. $2\frac{1}{2}$

(E) Calculate the mass of water flowing in 10 minutes through a tube 0.1 cm in diameter and 40 cm long under a constant pressure head of 20 cm of water. Given, coefficient of viscosity of water, $\eta = 8.2 \times 10^{-3} \text{ poise}$. $2\frac{1}{2}$

(F) State the Stoke's law of viscosity and prove it by method of dimensions. $2\frac{1}{2}$

3. (A) (i) What is angle of contact ? State the characteristics of angle of contact. 3

(ii) A bubble of diameter 8 mm is formed in the air, the surface tension of soap solution is 30 dyne/cm. Calculate the excess pressure inside the bubble. 2

(B) What is spherical polar co-ordinate system ? Obtain component of velocity and acceleration in polar co-ordinate system. 5

OR

(C) Obtain an expression for surface tension of a liquid by capillary rise method. $2\frac{1}{2}$

(D) Show that, under isothermal condition, the surface energy of a liquid is equal to its surface tension. $2\frac{1}{2}$

(E) A bullet of mass 500 gm is fired from a gun at an angle 45° N axis with a velocity 500 m/sec towards north. Calculate :

(i) The horizontal component of Coriolis acceleration,

(ii) The Coriolis force acting on bullet. $2\frac{1}{2}$



(F) State and explain limitations of Newton's laws of motion. $2\frac{1}{2}$

EITHER

4. (A) (i) Show that, the total angular momentum is constant if the resultant torque acting on the system is zero. 3

(ii) Calculate the radius of gyration of a solid sphere rotating about its diameter if its radius is 5.0 cm. 2

(B) What is elastic and inelastic collision ? Discuss the phenomenon of collision in one dimension between two particles when collision is perfectly elastic :

(i) When colliding particles have same mass.

(ii) When one of the colliding particles is initially at rest. 5

OR

(C) Obtain an expression for velocity of a single stage rocket by considering the weight of it. $2\frac{1}{2}$

(D) State and prove theorem of perpendicular axis. $2\frac{1}{2}$



(E)

Two particles each of mass 2 kg are moving with velocities $2\vec{i} + 4\vec{j}$ m/s and $5\vec{i} + 6\vec{j}$ respectively. Calculate the kinetic energy of the system relative to the center of mass. $2\frac{1}{2}$

(F) Derive the expression for moment of inertia of a solid sphere about its diameter. $2\frac{1}{2}$

5. Attempt any TEN (1 mark each) : $1 \times 10 = 10$

(i) Define Poisson's ratio. State its limiting values.

(ii) What is neutral axis ?

(iii) What is bulk modulus ?

(iv) What is velocity gradient ? State its SI unit.

(v) Calculate the critical velocity of a liquid flowing through a capillary tube of radius 0.5 cm. Given : $\eta = 10^{-3}$ Ns/m², $\rho = 10^3$ kg/m³, $K = 1000$.

(vi) State the effect of temperature on viscosity of liquids.

(vii) Write any two applications of phenomenon of surface tension.

(viii) What is Coriolis force ?



(ix) Find the polar co-ordinates corresponding to Cartesian co-ordinates (1, 1).

(x) State the relation between Torque and Moment of Inertia.

(xi) State the law of conservation of linear momentum of a particle.

(xii) A torque of 1 Nm is applied to a wheel of mass 10 kg and radius of gyration 50 cm. What is the resultant angular acceleration ?