

B. Sc. Semester I (Honours) Examination, 2020 (CBCS)

Subject: Physics

Paper: CC-II

Time: 2 Hours

Full Marks: 40

Candidates are required to give their answers in their own words as far as practicable.

Answer any eight of the following questions (All questions carry equal marks): 5×8=40

1. (a) Calculate the rate of rotation of the plane of oscillation of a pendulum at latitude 30° .
(b) A uniform chain of total length 'a' is placed on a horizontal frictionless table so that a length 'b' of the chain dangles over the side. Find out the time 't' to require for the chain to slide off the table in terms of 'a', 'b' and 'g', where 'g' is acceleration due to gravity.

2. (a) Find the work done in moving a particle once around a circle C in the xy plane, if the circle has centre at the origin and radius 3 unit and if the force field is given by

$$\mathbf{F} = (2x - y + z) \mathbf{i} + (x + y - z^2) \mathbf{j} + (3x - 2y + 4z) \mathbf{k}$$

- (b) A rocket of mass 1000 kg is ready for vertical takeoff. The exhaust velocity of its fuel is 4.5 km/sec. Find the minimum rate of its fuel ejection so that the rocket weight just balanced.

3. (a) Prove that if the net external torque acting on a particle is zero, the angular momentum will remain unchanged.

- (b) Find the centre of mass of a solid hemisphere of radius 'a'.

4. Calculate the moment of inertia of a thin spherical shell (hollow sphere) about a diameter. Hence find the moment of inertia about a tangent.

5. (a) Define stability of equilibrium.

- (b) A force \mathbf{F} acts tangentially at the highest point of a sphere of mass 'm' kept on a rough horizontal plane. If the sphere rolls without slipping, find the acceleration of the centre of the sphere.

6. (a) A cube made up of aluminium of side 0.1m is subject to a shearing force of 100N. The top surface of the cube is displaced by 10^{-4} m with respect to the bottom. Calculate the modulus of rigidity.

- (b) Water flows through a capillary tube of length 60.2 cm and internal radius 5.2×10^{-2} cm. If 40 cc of water is collected in 5 mins with constant head of height 0.4m, then calculate the coefficient of viscosity of water.

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7. (a) State and prove Kepler's second law.

(b) Under the influence of a central force at any point on the perimeter, a particle moves in a circular orbit which passes through that point. Find the law of force.

8. (a) What factor govern the sharpness of resonance?

(b) Show that the energy of vibration of a damped harmonic oscillator decreases exponentially with time.

9. (a) The proper life time of an unstable particle is equal to t_0 . What is the distance traversed by the particle till its decay in the laboratory frame where its life time is 't'.

(b) Calculate the speed of an electron having kinetic energy 2 MeV and rest mass energy 0.512 MeV.

10. What do you mean by relativistic Doppler Effect? Derive an expression for the transverse Doppler Effect.