

QP Code: D133756		Total Pages: 2	Name:
		Register No.	
THIRD SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025			
(CUFYUGP)			
PHY3CJ 201/APH3CJ201: Mechanics 1			
2024 Admission onwards			
Maximum Time :2 Hours		Maximum Marks :70	
Section A			
All Questions can be answered. Each Question carries 3 marks (Ceiling: 24 Marks)			
1	What is impulse? State Impulse-momentum theorem.		
2	Calculate the recoil velocity of a rifle of mass 3 kg, when it fires a bullet of mass 5gm horizontally with a speed of 300 m/s relative to the ground.		
3	The total momentum of a system equals the total mass times the velocity of the center of mass. Comment on this statement.		
4	Define angular velocity. How will you find the direction of angular velocity of a rotating object?		
5	Deduce the relation between angular velocity and linear velocity.		
6	When calculating the moment of inertia of an object, can we treat all its mass as if it were concentrated at the center of mass of the object? Justify your answer.		
7	A tangential force is applied to a body to make it rotate about its own axis. How does the quantities force and torque are related? Comment of the relation between the directions of force and torque.		
8	State and explain Newton's law of gravitation. Why the gravitational force is categorized as a central force?		
9	What is gravitational potential energy. On which factors do it depends?		
10	Give the equation which relates the gravitational potential and density. Plot the Laplacian of gravitational potential against the density.		
Section B			
All Questions can be answered. Each Question carries 6 marks (Ceiling: 36 Marks)			
11	From Newton's second law of motion, arrive at the law of conservation of momentum.		
12	Explains why only external forces can affect the motion of an extended object.		
13	The angular position of a flywheel of diameter 0.36 m is given by $\frac{0.2}{t^3} \text{ rad} / \text{s}^3$. (i) Find the distance that a particle on the flywheel rim moves from $t_1 = 2.0 \text{ s}$ to $t_2 = 5.0 \text{ s}$. (ii) Find the average angular velocity over that interval. (iii) find the average angular acceleration between $t_1 = 2.0 \text{ s}$ and $t_2 = 5.0 \text{ s}$.		
14	Derive the expression for the rotational kinetic energy of a rigid body.		

15	Show that the angular acceleration of a rotating rigid body is directly proportional to the sum of the torque components along the axis of rotation.
16	The engine of a rocket in outer space, far from any planet, is turned on. The rocket ejects burned fuel at a constant rate; in the first second of firing, it ejects $1/120$ of its initial mass m_0 at a relative speed of 2400 m/s. What is the rocket's initial acceleration?
17	A wheel rotates from rest with constant angular acceleration. If it rotates through 8.00 revolutions in the first 2.50 s, how many more revolutions will it rotate through in the next 5.00 s?
18	What do you mean by an extended object? How will you calculate the gravitational potential energy of an extended object?

Section C**Answer any ONE. Each Question carries 10 marks (1x10=10 Marks)**

19	Discuss the theory of rocket propulsion based on momentum considerations. Deduce the relation between the speed gain and mass of the rocket and mass of the fuel.
20	(i) Derive the expression for the total kinetic energy of a rigid body that has both translational and rotational motions. (ii) Ignoring the effect of rolling friction, obtain the general expression for the velocity of center of mass of a body rolling from a height "h" without slipping.