Disclaimer: This mock exam is only for practice. It was made by tutors in the Polytechnic Tutoring Center and is not representative of the actual exam given by the Academic Department.

1. A 20 kg block is hanging by a vertical spring that has spring constant 20 N/m. If the block is released from rest when the spring is unstretched, how much time does it take for the block travel a total distance of 100m in air? (Take g=10 m/s²)

2. An astronaut travels to a faraway planet, where he finds that the acceleration due to gravity on the planet's surface is 5.5 m/s². If the planet has the same radius as that of the earth, what is the escape speed for the planet?

3. In the picture on the right, the 4 kg block is pulled with a force of 21 N. What must the coefficient of static friction between the blocks be such that the 3 kg block does not separate? µk between the 3 kg block and the floor is 0.11.

4. A 2-ton space station is orbiting earth at a radius of 10000 km. How much energy does it take to change its orbit to a radius of 10500 km. Hint: take the difference between total energy, which is E(r) = KE(r) + U(r).

5. You are sitting at rest in a free-to-rotate chair while holding electric motor whose center of rotation is parallel and 1 m away from yours. The electric motor is connected to a 0.5 kg disk that has a diameter of 0.6 m. If the electric motor can spin the disk at an angular velocity of 200 rad/s, how fast will you be rotating when you turn on the electric motor? Assuming your moment of inertia is 8 kg m².

6. Friction exerts a torque of 1 Nm to a 20 kg spinning ball rotating at 20 rad/s. If the radius of the ball is 0.2 m, how long does it take for the ball to come to rest?

7. Marauder is currently known as the toughest car on the market. If a speeding Marauder running at 140km/h runs into a slow Marauder running at 20km/h to the same direction and result in a perfect elastic collision. What will be the difference in their speed after the collision?

8. A stationary horizontal disk-shaped platform is free to rotate about its center. The radius of the platform R = 1.6 m, and mass is 200 kg. A 43 kg boy jumps on the rim of the platform with the velocity 2.2 m/s tangential to the rim. What will be the angular speed of the platform with the boy?

9. A stone is thrown at an angle of 35° above the horizontal with an initial speed of 6.3 m/s. What will be the speed of the stone 0.12 seconds after it was thrown?
10. A cannonball was given an initial push up a 45° inclined track that is 1m long. It was sent into a projectile motion after rolling through the track without slipping. What is the minimum speed that the cannonball should be pushed in order to hit a target 100 meters away from when it lifts off? Hint: the ball is spinning when it leaves the track, and radius in fact does not matter in this problem.

11. A uniform plank of mass 22 kg and length 12 m rests horizontally on two supports S1 and S2. Support S2 is 3.2 m from the right end of the plank. What's the furthest distance from S2 that a 53 kg box can be placed without the plank tipping over?

12. Mass of 10kg is hanging onto 2m rope right next to a block. If the mass was pulled back 10° from the center and released from rest. How long does it take for the mass to hit the block?

13. A 1kg particle is at location \(2\hat{i} + 3\hat{j} + 5\hat{k}\) traveling in the direction \(7\hat{i} + 11\hat{j} + 13\hat{k}\). What is its angular momentum with respect to the origin in vector form?

14. A 5 kg ladder of uniform mass distribution is stationarily leaning against a frictionless wall. The ladder makes an angle \(\theta = 63°\) with the ground. Find the magnitude of the force exerted by the wall on the ladder.

15. Two 1-ton planets are rotating around each other in a circular orbit due to gravity. If the distance between them is 120 km, how long is the period of their rotation?