

Physics Problem Set

1. Momentum and Speed

An object's speed triples.

- (a) By what factor does its momentum change?
- (b) By what factor does its kinetic energy change?

2. Gravitational Acceleration Change

- (a) If the Earth's mass doubles and the radius remains constant, how does the acceleration due to gravity at the surface change?
- (b) If the Earth's radius doubles and the mass remains constant, by what factor does the acceleration due to gravity at the surface change?

3. Projectile Motion

A ball is thrown horizontally with an initial velocity of 20 m/s from a height of 45 m.

- (a) How long does it take for the ball to hit the ground?
- (b) What is the horizontal distance traveled by the ball?

4. Oscillation of a Guitar String

A guitar string midpoint undergoes simple harmonic motion with a frequency of 140 Hz.

- (a) Calculate the angular frequency.
- (b) If the maximum displacement is 1.3 mm, what is the maximum speed of the midpoint?

5. Energy and Friction

A block slides along a horizontal surface with an initial velocity of 6.5 m/s. The coefficient of kinetic friction is 0.2.

- (a) How far will the block slide before coming to rest?
- (b) What is the work done by friction?

6. Rotational Dynamics

A solid cylinder rolls down a ramp inclined at 30° without slipping.

- (a) Derive an expression for the cylinder's linear acceleration.
- (b) If the ramp length is 5 m, what is the cylinder's speed at the bottom?

7. Satellite Dynamics

A satellite orbits Earth at a height of 295 km.

- (a) What is the ratio of the gravitational acceleration at this altitude to that on the surface?
- (b) Calculate the orbital speed of the satellite.

8. Energy Conservation

A spring with a spring constant of 200 N/m is compressed by 0.5 m.

- (a) Calculate the potential energy stored in the spring.
- (b) If the spring releases this energy to launch a 2 kg mass horizontally, what is the resulting speed?

9. Pendulum Period

A pendulum of length 2.5 m swings with small oscillations.

- (a) Calculate its period.
- (b) How does doubling the length affect the period?

10. Circular Motion and Forces

A car drives around a circular track of radius 200 m at a constant speed of 25 m/s.

- (a) What is the magnitude of the centripetal force if the car's mass is 1500 kg?
- (b) How much work is done by the centripetal force over one full revolution?