DUMKAL COLLEGE

Department of Physics

Sample question papers for Mechanics (PHY-M-T-2)

Semester-III Total Marks: 40 Time: 2 Hours

Question Paper - Set 1

Instructions: Answer all questions. Marks are indicated against each question. Assume missing data if necessary and justify your assumptions.

Section A: Short Answer Questions (2 × 5 = 10 Marks)

(Answer any five questions. Each question carries 2 marks.)

1. Define inertial and non-inertial frames of reference.
2. What is the principle of conservation of energy?
3. Explain the difference between elastic and inelastic collisions.
4. Define torque and state its unit in SI.
5. What is Kepler's first law of planetary motion?
6. Define weightlessness and give one example.
7. What is Lorentz contraction in relativity?

Section B: Medium Answer Questions (5 × 4 = 20 Marks)

(Answer any five questions. Each question carries 4 marks.)

8. Explain Galilean invariance with an example.
9. Derive the work-energy theorem for a single particle system.
10. Find the moment of inertia of a thin rod rotating about one end.
11. Derive the expression for angular momentum conservation.
12. Derive the Bernoulli equation and explain its physical significance.
13. Explain the effect of gravitational potential on satellite motion.
14. Derive the Lorentz transformation equations.

Section C: Long Answer / Numerical Problems (1 × 10 = 10 Marks)

(Answer any one question. Each question carries 10 marks.)

15. Solve the two-body problem and derive the expression for reduced mass.
16. A pendulum of length 1.5 m is oscillating with a time period of 2.5 s. Find its angular frequency and maximum speed if the amplitude is 0.2 m.

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Question Paper - Set 2

Instructions: Answer all questions. Marks are indicated against each question. Assume missing data if necessary and justify your assumptions.

Section A: Short Answer Questions (2 × 5 = 10 Marks)

1. Define centre of mass and give an example.
2. State Newton's laws of motion.
3. What is potential energy? Give an example.
4. Define angular velocity and its relation with linear velocity.
5. What is the condition for simple harmonic motion?
6. State and explain Michelson-Morley experiment.
7. Define centrifugal force and give an example.

Section B: Medium Answer Questions (5 × 4 = 20 Marks)

8. Prove that a conservative force has a potential energy function.
9. Derive the expression for kinetic energy of rotation.
10. Explain the concept of gravitational field and its properties.
11. Derive the differential equation of damped oscillations.
12. Explain Kepler's third law with derivation.
13. What is time dilation? Derive the time dilation equation.
14. Discuss the concept of fictitious forces in non-inertial frames.

Section C: Long Answer / Numerical Problems (1 × 10 = 10 Marks)

15. Solve the equation of motion for a particle in a central force field and determine its trajectory.
16. A satellite is in a circular orbit at a height of 500 km above Earth. Calculate its orbital speed and time period.

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Semester-III Total Marks: 40 Time: 2 Hours

Question Paper - Set 3

Instructions: Answer all questions. Marks are indicated against each question. Assume missing data if necessary and justify your assumptions.

Section A: Short Answer Questions (2 × 5 = 10 Marks)

1. Define impulse and its relation with momentum.
2. State work-energy theorem.
3. What is the principle of equivalence in relativity?
4. Define elastic modulus and state its types.
5. What are geosynchronous and geostationary orbits?
6. Define Lagrange multipliers and its application.
7. Explain Doppler effect in relativity.

Section B: Medium Answer Questions (5 × 4 = 20 Marks)

8. Explain the conservation of angular momentum with examples.
9. Derive the expression for potential energy stored in a stretched wire.
10. Find the moment of inertia of a disk rotating about its central axis.
11. Explain the energy equation for planetary motion.
12. Discuss the concept of fictitious forces in rotating frames.
13. Derive the expression for Lorentz force on a moving charge.
14. Explain the Michelson-Morley experiment and its significance.

Section C: Long Answer / Numerical Problems (1 × 10 = 10 Marks)

15. Derive the equation of motion for a simple pendulum and find its time period.
16. A rocket of mass 300 kg is moving in space with an initial velocity of 500 m/s. It ejects gas at a rate of 2 kg/s with a relative velocity of 1000 m/s. Find its velocity after 10 seconds.

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Sample question papers for Mechanics (PHY-M-T-2)

Semester-III Total Marks: 40 Time: 2 Hours

Question Paper - Set 4

Instructions: Answer all questions. Marks are indicated against each question. Assume missing data if necessary and justify your assumptions.

Section A: Short Answer Questions (2 × 5 = 10 Marks)

(Answer any five questions. Each question carries 2 marks.)

1. Define Galilean transformation and state its significance.
2. What is the principle of conservation of momentum? Give an example.
3. State and explain the work-energy theorem.
4. Define centre of mass and write the expression for a two-particle system.
5. What are elastic and inelastic collisions? Explain briefly.
6. Define Poiseuille's equation and its application in fluid dynamics.
7. What is time dilation in Special Theory of Relativity?

Section B: Medium Answer Questions (5 × 4 = 20 Marks)

(Answer any five questions. Each question carries 4 marks.)

8. Derive the equation of motion for a rocket using the principle of momentum conservation.
9. Explain the concept of gravitational potential energy and derive its expression.
10. Discuss Kepler's laws of planetary motion and derive the second law.
11. Derive the expression for moment of inertia of a solid sphere about its diameter.
12. Explain Bernoulli's theorem and its applications in fluid mechanics.
13. Derive the relativistic velocity addition formula.
14. Explain Coriolis force and its effect in rotating frames.

Section C: Long Answer / Numerical Problems (1 × 10 = 10 Marks)

(Answer any one question. Each question carries 10 marks.)

15. A particle is moving under a central force field:

$$F = -\frac{k}{r^2}$$

16. Solve the differential equation for Simple Harmonic Motion (SHM) and find expressions for kinetic energy, potential energy, and total energy.