PHYSICS (Class XI) – 2024-25

Time Allowed: 3 hours   Maximum Marks: 70

General Instructions:

1. All sections are compulsory.
2. There is an internal choice in some questions.
3. Use of calculators is not allowed.
4. Use of logarithmic tables is not allowed.
5. Physical constants are given wherever necessary.

Section A (16 Marks)

(Each question carries 1 mark)

1. The dimensional formula for gravitational constant G is:
    (a) $[M^{-1}L^3T^{-2}]$ (b) $[M^1L^3T^{-2}]$ (c) $[M^{-1}L^2T^{-2}]$ (d) $[M^1L^2T^{-2}]$

2. A body is thrown vertically upwards. Its velocity at the highest point is:
    (a) Maximum   (b) Minimum   (c) Zero   (d) Constant

3. Which of the following is a vector quantity?
    (a) Speed   (b) Distance   (c) Acceleration   (d) Mass

4. Work done by a conservative force is:
    (a) Always positive   (b) Always negative   (c) Path dependent   (d) Path independent

5. The unit of power is:
    (a) Joule   (b) Newton   (c) Watt   (d) Pascal

6. What is the angle between force and displacement for maximum work done?
    (a) 0°   (b) 90°   (c) 180°   (d) 45°

7. Which of the following is a scalar product?
    (a) Cross product   (b) Dot product   (c) Vector product   (d) None of the above

8. The moment of inertia depends upon:
    (a) Mass only   (b) Shape and size   (c) Mass distribution   (d) Both (b) and (c)

(Assertion-Reasoning Questions: Choose the correct option A, B, C or D) (4 questions)

A: Assertion is correct, Reason is correct, and Reason is the correct explanation for the Assertion.

B: Assertion is correct, Reason is correct, but Reason is not the correct explanation for the Assertion.
C: Assertion is correct, Reason is incorrect.
D: Assertion is incorrect, Reason is correct.

9. Assertion: The escape velocity of a body is independent of its mass.
    Reason: The escape velocity depends only on the gravitational field strength of the planet.

10. Assertion: The surface tension of a liquid decreases with an increase in temperature.
     Reason: With an increase in temperature, the kinetic energy of the molecules increases.

11. Assertion: A perfectly inelastic collision is one in which kinetic energy is conserved.
     Reason: In a perfectly inelastic collision, the colliding bodies stick together.

12. Assertion: The time period of a simple pendulum is independent of the amplitude.
     Reason: For small amplitudes, the restoring force is directly proportional to the displacement.

Section B (10 Marks)

(Each question carries 2 marks)

13. State the principle of superposition of forces. Give one example.

14. Define kinetic energy and potential energy. Give the expressions for both.

15. A body of mass 5 kg is moving with a velocity of 10 m/s. Calculate its kinetic energy.

16. What is meant by elastic and inelastic collisions? Give one example of each.

17. Distinguish between streamline and turbulent flow. OR Define viscosity and state its SI unit.

Section C (21 Marks)

(Each question carries 3 marks)

18. Explain the concept of significant figures. How many significant figures are there in 0.00250?

19. Derive the equation of motion $v^2 = u^2 + 2as$ using graphical method.

20. State Newton's laws of motion.

21. Define work, energy and power. Give their SI units.

22. A force of 10 N acts on a body for 5 seconds. Calculate the impulse.

23. Define moment of inertia and radius of gyration. OR State the law of conservation of angular momentum. Give one example.

24. A body is projected with a velocity of 20 m/s at an angle of 30° to the horizontal. Find the time of flight. (g = 10 m/s²)

Section D (8 Marks)

(Each question carries 4 marks)

Case Study 1:

A ball is thrown vertically upwards with an initial velocity u. Neglecting air resistance, its motion is governed by the equations of motion.

25. (a) What is the maximum height reached by the ball?
   (b) What is the time taken to reach the maximum height?
   (c) What is the velocity of the ball when it returns to the ground?
   (d) Sketch a velocity-time graph for the motion of the ball.

OR

Case Study 1 (Alternative):

Two bodies A and B of masses 2 kg and 3 kg respectively are connected by a light inextensible string passing over a smooth pulley.

25. (a) Find the acceleration of the system.
   (b) Find the tension in the string.
   (c) If the bodies are released from rest, find the velocity of the bodies after 2 seconds.
   (d) Find the distance covered by each body in 2 seconds.

Case Study 2:

A simple pendulum consists of a bob of mass m suspended by a light inextensible string of length l.

26. (a) Derive an expression for the time period of a simple pendulum.
    (b) What are the factors affecting the time period of a simple pendulum?
    (c) How does the time period vary with the length of the pendulum?
    (d) How does the time period vary with the mass of the bob?

OR

Case Study 2 (Alternative):

A body is moving in a circular path of radius r with a constant speed v.

26. (a) What is the centripetal force acting on the body?
    (b) Derive the expression for the centripetal acceleration.
    (c) Give two examples of centripetal force in everyday life.
    (d) What is the direction of centripetal force?

Section E (15 Marks)

(Each question carries 5 marks)

27. State and explain Kepler's laws of planetary motion.

OR

27. Explain the different types of equilibrium of a rigid body with suitable examples.

28. What is a projectile? Derive expressions for the maximum height, horizontal range and time of flight of a projectile.

OR

28. Derive the expression for the escape velocity of a body from the surface of the earth.

29. Explain the concept of surface tension. Discuss the applications of surface tension.

OR

29. Explain the concept of thermal conductivity. Discuss the factors affecting thermal conductivity.

This question paper follows the specified format and includes internal choices as requested. The difficulty level is designed to be challenging, as per your specifications. Remember to adjust numerical values and specific details to fit your desired difficulty.