PHYSICS (Code No. 042) Class XI

Time Allowed: 3 hours Maximum Marks: 70

General Instructions:

1. All questions are compulsory.
2. There are five sections in this question paper.
3. Section A contains 16 questions of 1 mark each.
4. Section B contains 5 questions of 2 marks each, with one question having an internal choice.
5. Section C contains 7 questions of 3 marks each, with one question having an internal choice.
6. Section D contains 2 case-study based questions of 4 marks each, with an internal choice in each.
7. Section E contains 3 questions of 5 marks each, with an internal choice in each.
8. Use of calculators is not allowed.
9. A list of physical constants is provided for use in calculations.
10. (For Visually Impaired Students: Suitable alternative questions/modifications will be provided as per the guidelines)

SECTION A (1 mark each)

1. Which of the following is a fundamental unit in SI system? (a) Newton (b) Joule (c) Second (d) Watt
2. The dimensional formula for acceleration is _____.
3. A body moving with uniform velocity has _____ acceleration.
4. State the principle of conservation of linear momentum.
5. What is the work done when a force of 5N displaces a body by 2m in its direction?
6. Define power. Give its SI unit.
7. What is the condition for equilibrium of concurrent forces?
8. Give one example of a conservative force and one example of a non-conservative force.
9. Define center of mass.
10. State Kepler's second law of planetary motion.
11. What is the SI unit of stress?
12. Define surface tension.
13. What is latent heat?
14. State the zeroth law of thermodynamics.
15. Define simple harmonic motion (SHM).
16. What is the difference between transverse and longitudinal waves?

SECTION B (2 marks each)

17. Distinguish between scalar and vector quantities. Give two examples of each.

18. A body is projected with a velocity of 20 m/s at an angle of 30° with the horizontal. Calculate its horizontal range. ($g = 10\ m/s^2$)
19. State and explain Newton's second law of motion. Derive the equation F = ma from it.
OR
Derive the expression for the kinetic energy of a body of mass m moving with velocity v.
20. Explain the terms stress and strain. Define Young's modulus of elasticity.
21. Define thermal conductivity. Write the expression for heat transfer by conduction.

SECTION C (3 marks each)

22. Derive the equations of motion for a body moving with uniform acceleration using graphical method.
23. A body of mass 5 kg is moving with a velocity of 10 m/s. A force of 20 N acts on it for 5 seconds in the direction of motion. Calculate the final velocity of the body.
24. Explain the concept of potential energy. Derive the expression for potential energy of a spring.
25. Derive an expression for the escape velocity of a body from the surface of the Earth.
OR
Explain the variation of acceleration due to gravity with altitude and depth.
26. State Pascal's law. Explain its application in hydraulic lift.
27. Define specific heat capacity. Explain the method of mixtures to determine the specific heat capacity of a solid.
28. What is a simple pendulum? Derive an expression for the time period of a simple pendulum.

SECTION D (4 marks each)

29. **Case Study Based Question:** A ball is thrown vertically upwards with an initial velocity u. Neglecting air resistance:
(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) Plot a graph showing the variation of velocity with time.

OR

Consider a simple pendulum executing SHM. The total energy of the pendulum is constant and is the sum of kinetic and potential energies.

(a) What is the total energy of a simple pendulum executing SHM?
(b) At what point in its motion is the kinetic energy maximum and what is the value of

potential energy?

(c) At what point in its motion is the potential energy maximum and what is the value of kinetic energy?

(d) Describe the energy transfer in the oscillations.

30. **Case Study Based Question:** A block of mass m rests on a rough inclined plane. The coefficient of static friction between the block and the plane is μ.

(a) Draw a free body diagram showing all the forces acting on the block.

(b) Write the expressions for the forces acting along and perpendicular to the inclined plane.

(c) Derive an expression for the maximum angle of inclination ;, `or which the block remains at rest.

(d) If the angle of inclination is increased beyond ;,Â v† B v–ÆÂ † Vâ Fò F†R lock?

OR

Consider the concept of a projectile motion on a banked road.

(a) Explain why a car is able to negotiate a banked curve without skidding.

(b) Draw the free-body diagram of the car on the banked curve.

(c) Derive the formula for the optimum speed of a car on a banked road.

(d) What is the effect of friction on the optimum speed?

SECTION E (5 marks each)

31. State and explain the principle of superposition of waves. Explain the phenomenon of beats and derive an expression for the beat frequency.

OR

Explain the Doppler effect in sound. Derive an expression for the apparent frequency when the source is moving towards a stationary observer.

32. Describe the alpha-particle scattering experiment and explain how it led to Rutherford's model of the atom. State the limitations of Rutherford's model.

OR

Explain Bohr's model of the hydrogen atom. Derive the expression for the radius of the nth orbit of the electron in the hydrogen atom.

33. Explain the different modes of heat transfer. Describe the phenomenon of thermal expansion in solids, liquids and gases. Explain anomalous expansion of water.

OR

State the first law of thermodynamics. Explain different thermodynamic processes – isothermal, adiabatic, reversible and irreversible processes.

(Note: This is a sample question paper and the actual question paper may vary slightly.)