

2022
PHYSICS

Total marks : 70

Time : 3 hours

General instructions:

- i) *Approximately 15 minutes is allotted to read the question paper and revise the answers.*
- ii) *The question paper consists of 30 questions. All questions are compulsory.*
- iii) *Marks are indicated against each question.*
- iv) *Internal choice has been provided in some questions.*

N.B: *Check to ensure that all pages of the question paper is complete as indicated on the top left side.*

1. The number of significant figures in 0.007 m^2 is 1
(a) 1 (b) 3 (c) 4 (d) 7

2. A body is moving unidirectionally under the influence of a source of constant power. Its displacement in time 't' is proportional to 1
(a) $t^{1/2}$ (b) t (c) $t^{3/2}$ (d) t^2

3. The force of gravitation is 1
(a) repulsive (b) electrostatic
(c) conservative (d) non-conservative.

4. If the temperature of a wire is doubled, Young's modulus of elasticity will 1
(a) be doubled (b) become four times
(c) remain same (d) decrease.

5. In an isothermal process. 1
(a) internal energy of the gas increases
(b) internal energy of the gas decreases
(c) internal energy remains unchanged
(d) internal energy becomes zero.

6. Does every physical constant have dimensions? Give reason. 1

7. Define unit vector. 1

8. What is a couple? 1

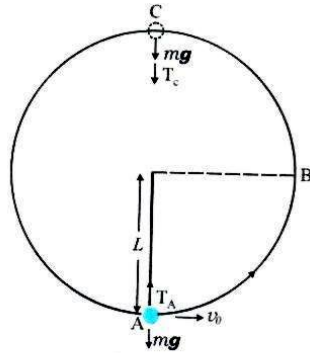
9. Write the expression for coefficient of viscosity. What effect does temperature have on viscosity of liquids? 1

10. State the first law of thermodynamics. 1
11. a. Dimensionally derive an expression for the time period of a simple pendulum considering the period of oscillation of the pendulum depends on its length (l), mass of bob (m) and acceleration due to gravity (g).
Or 2
- b. Check the equation $s = ut + \frac{1}{2}at^2$ is dimensionally correct or not.
The symbols have their usual meaning.
12. Show that the velocity of uniform motion of an object is equal to the slope of position-time graph. 2
13. a. Find the vector product of two vectors $a = 3\hat{i} - 4\hat{j} + 5\hat{k}$ and $b = -2\hat{i} + \hat{j} - 3\hat{k}$.
Or 2
- b. The angular speed of a motor wheel is increased from 1200rpm to 3120rpm in 16 seconds. Calculate the angular acceleration of the wheel.
14. State any two Kepler's law of planetary motion. 2
15. Give two postulates of kinetic theory of an ideal gas. 2
16. a. What are damped and undamped oscillations?
Or 2
- b. Mention any two characteristics of stationary waves.
17. a. A ball is thrown vertically upwards with a velocity of 20 m/s from the top of a multistorey building. The height of the point from where the ball is thrown is 25.0m from the ground. How high will the ball rise and how long will it be before the ball hit the ground?
Take $g=10\text{m/s}^2$.
Or 3
- b. A cyclist starts from the center O of a circular park of radius 1Km reaches the edge P of the park, then cycles along the circumference and returns to the center along QO, if the round trip takes 10 minutes. What is the net displacement average velocity and average speed of the cyclist?
18. Prove that the coefficient of limiting friction is equal to the tangent of angle of repose. 3

19. Define momentum. Prove that the momentum of an isolated system is conserved. 3
20. a. Raindrop falls under the influence of the downward gravitational force and the opposing resistive force. Consider a drop of mass 1.00g falling from a height 1.00Km. It hits the ground with a speed of 50.0 m/s.
a) What is the work done by the gravitational force?
b) What is the work done by the unknown resistive force?

Or

- b. A bob of mass m is suspended by a light string of length L . It is imparted by a horizontal velocity v_0 at the lowest point A such that it completes a semi-circular trajectory in the vertical plane with the string becoming slacked only on reaching the topmost point C as shown in the figure. Obtain an expression for v_0 and the speeds at point B and C. 3



21. State and prove the work energy theorem for a variable force. 3
22. Define moment of inertia. Hence, state the theorem of parallel and perpendicular axes. 3
23. a. Define acceleration due to gravity. Show that the value of acceleration due to gravity on the surface of the earth does not depend upon the mass of the object. 3
Or
b. Obtain an expression for the orbital speed of a satellite when it is placed at a distance 'h' from the surface of the earth.
24. State Wein's displacement law. What is the most significant feature of the black body radiation? On what factors does it depend? 3
25. a. Derive an expression for work done during adiabatic process. 3
Or
b. Derive the expression for efficiency of a Carnot's heat engine.

26. Define mean free path. Obtain an expression for the mean free path of n particles. 3
27. Define simple harmonic motion. Obtain an expression for the velocity and acceleration of SHM. 3
28. a. Using the velocity-time graph, derive the three kinematic equations for uniformly accelerated motion. 5
Or
b. What is rectangular resolution of vector? Explain how a vector can be resolved into x-y components.
29. a. Define angle of contact. Derive an expression for the ascent of a liquid in a capillary tube. 5
Or
b. State and prove Pascal's law. Explain the principle of a hydraulic lift.
30. a. State and explain Newton's formula for the speed of sound in air. What correction did Laplace apply to it? 5
Or
b. Explain the formation of standing waves in a closed organ pipe and the different modes of vibration.
