2021

PHYSICS

(Theory)

Full Marks : 70

Pass Marks : 21

Time : Three hours

All questions are compulsory.

The figures in the right margin indicate full marks for the questions.

Question Nos. 1 to 10, are "Very Short Answer" type questions carrying 1 mark each.

1. Give a physical quantity which has units but still be dimensionless. 1

2. What is a rigid body ? 1

3. The gravitational force between two bodies is 1 N if the distance between them is doubled, what will be the force between them ? 1

4. How are we able to break a wire by repeated bending ? 1

5. Define surface tension. 1

6. Draw the P-V curves of an ideal gas for two adiabatic processes connecting two isotherms. 1

7. State the law of equipartition of energy. 1

8. Name the two factors on which the degree of freedom of gas depends. 1

9. Why does sound travel faster in iron than in air ? 1

10. What is resonance ? 1

Question Nos. ***11*** to ***20,*** *are 'Short Answer Type-II' questions carrying* ***2*** *marks each.*

11. What is the difference between vector and scalar quantities ? 2

12. You are given an equation: $mv = Ft$, where m is mass, v is speed, F is force and t is time. Check the equation for dimensional correctness. 2

13. The displacement of a body is proportional to t^3, where t is time elapsed. What is the nature of acceleration-time graph of the body ? 2

14. What will be effect on the horizontal range of the body if the velocity of the body is doubled keeping the angle of projection constant ? 2

15. What is the difference between static and kinetic friction ? 2

16. How will you distinguish between a hard boiled egg and a raw egg by spinning it on a table top ? 2

17. Draw a labelled schematic diagram of Venturimeter for measuring the speed of flow of a liquid in a pipe. 2

18. Calculate the fall in temperature when a gas initially at 72°C is expanded suddenly to eight times its original volume. (Given, $\gamma = {}^5/_3$) 2

19. What are reversible and irreversible processes ? 2

20. A gas is filled in a cylinder fitted with a piston at a definite temperature and pressure. Explain on the basis of kinetic theory why on pulling the piston out, the pressure decreases. 2

Question Nos. 21 to 27 are 'Short Answer Type-I' questions carrying 3 marks each.

21. An automatic manufacturer claims that its super-deluxe sports car will accelerate from rest to a speed of 42 m/s in 8 second assuming that the acceleration is constant. 3

(a) Determine the acceleration of the car.

(b) Find the distance travel by the car in 8 second.

(c) Find the distance travel by the car in 8^{th} second.

OR

A boat is travelling at 3 m /s towards North in a river current travelling 4 m /s towards East. 3

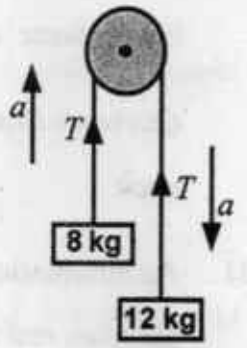
(a) What is the resultant velocity of the boat ?

(b) If the width of the river is 90 m wide, then how much time does it take to cross the river ?

(c) What distance downstream does the boat reach the opposite bank ?

22. Four particles of mass 1 kg, 2 kg, 3 kg and 4 kg are placed at the four vertices A, B, C and D of square of side 1 m. Find the position of centre of mass of the particle. 3

23. In the figure, two masses 8 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses and the tension in the string when the masses are released. 3



24. Derive an expression for the escape velocity of a body on the surface of earth. 3

OR

Derive an expression for the orbital velocity of a satellite of mass *m* is revolving around the earth at a height h from the surface of earth. 3

25. Obtain the relation for Young's modulus of elasticity of the material of a wire. 3

26. What are the forces acting on the body to fall under gravity in a liquid ? 3

OR

On what factors critical velocity depends ? 3

27. Give three points to distinguish between longitudinal and transverse waves. 3

OR

Write three points of difference between progressive waves and stationary waves. 3

Question Nos. ***28*** *to* ***30*** *are 'Long Answer Type' questions carrying* ***5*** *marks each.*

28. What are concurrent forces ? Prove that under the action of three concurrent forces $\vec{F}_1, \vec{F}_2$ and $\vec{F}_3$, a body will be in equilibrium when $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 0$.

1+4=5

OR

What is centripetal force ? Derive the expression for maximum speed of circular motion of a car on a level road. 1+4=5

29. State the principal of conservation of mechanical energy. Prove the principle of conservation of mechanical energy in the case of a freely falling body. 1+4=5

OR

What is an elastic collision ? Obtain the expression for velocities after collision when two bodies undergo perfectly elastic collision in one dimension. 1+4=5

30. Derive an expression for the total energy of a particle oscillates in simple harmonic motion.

5

OR

Derive the Newton's formula to find the speed of a longitudinal wave in an ideal gas and apply Laplace's correction.

5

*Question Nos. **31** to **34** are 'Multiple Choice Type' questions carrying **1** mark each. Choose the correct answer out of the four alternatives and **rewrite** the correct answer.*

31. If a particle moves 5 m in $+x$-direction, the displacement of the particle is –

(A) $5\hat{i}$

(B) $5\hat{j}$

(C) $-5\hat{j}$

(D) $5\hat{k}$ 1

32. A person lifts 5 kg potatoes from the ground floor to a height of 4m to bring it to first floor, the work done is

(A) 49 J

(B) 98 J

(C) 196 J

(D) 20 J 1

33. The height of geo-stationary satellite from the surface of earth is about

(A) 3,60,000 km

(B) 36,000 km

(C) 3,600 km

(D) 360 km 1

34. A real gas obeys Boyle's law at

(A) high temperature and high pressure

(B) high temperature and low pressure

(C) low temperature and low pressure

(D) low temperature and high pressure 1