2024

PHYSICS

(Theory)

Full Marks : 70

Pass Marks : 21

Time : Three hours

All the 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. Write the dimensional formula of pressure. 1

2. Define dimension of a physical quantity. 1

3. Calculate the angular velocity of the minutes hand of a clock. 1

4. The centripetal acceleration on a satellite of mass M is A. If the satellite is at a distance R from the centre of the earth, find the angular speed of the satellite. 1

5. Define unit vector. 1

6. At what height above earth's surface, value of 'g' is same as in a mine 100 Km deep ? 1

7. What happens to the change in internal energy of gas during isothermal expansion ? 1

8. State the law of equipartition energy. 1

P.T.O.

9. Can the temperature of the gas be increased by keeping its pressure and volume constant ? 1

10. Define degree of freedom. 1

Question Nos. 11 to 20 are " Short AnswerType II" questions carrying 2 marks each.

11. What is trajectory motion ? Give the expression of horizontal range of a projectile motion. 2

12. Define : (i) Coefficient of friction

(ii) Angle of friction 1+1=2

13. Two bodies of masses M and m (M> m) are allowed to fall freely from the same height. If air resistance for each body is same, then will both the bodies reach the earth simultaneously or not ? Give reason for your answer. 2

14. A motor cyclist loops a vertical loop of diameter 50m, without dropping down even at uppermost point. What is the minimum speed at lowest and highest points of the loop ? 2

15. If the ice on the polar caps of the earth melts, how will it effect the duration of the day ? 2

16. Show that the coefficient of volume expansion of gases is inversely proportional to the absolute temperature. 2

17. Define : (i) Reversible process

(ii) Irreversible process 1+1=2

18. If an electric fan be switched on in a closed room, will the air of the room be cooled ? If not, why do we feel cold ? 2

19. Four molecules of a gas have speeds 2, 4, 6 and 8 Km/s respectively. Calculate average and root mean square speed. 2

20. What is the speed of a transverse wave in a rope of length 30m and mass 0.090Kg under a tension of 270N ? 2

Question Nos. 21 to 26 are "Short Answer Type I" questions carrying 3 marks each.

21. A stone is thrown vertically upwards and then it returns to the thrower. Is it a projectile ? Justify your answer. 3

OR

A person travels along a straight road for the first half length with a velocity v_1 and the second half length with velocity v_2. Prove that the average velocity of the person is $\frac{2v_1v_2}{v_2+v_1}$. 3

22. Two ball bearings of mass m each moving in opposite direction with equal speeds v collide head on with each other. Predict the outcome of the collision, assuming it to be perfectly elastic. 3

OR

A light body and a heavy body have same linear momentum. Which one has greater kinetic energy ? Give reason for your answer. 3

23. If angular momentum is conserved in a system whose moment of inertia is decreased, will its rotational kinetic energy be also conserved ? Explain. 3

OR

Explain the centre of mass of an isolated system has a constant velocity. 3

24. A person sitting in an artificial satellite of earth feels weightlessness but a person standing on moon has weight though, moon is also a satellite of earth. 3

OR

If the earth, supposed to be a uniform sphere contracts slightly so that its radius becomes less by (1/n) than before. Show that the length of the body shortens by (48/n) hours. (Give M.I. of a sphere $=\frac{2}{5}MR^2$) 3

25. On a hot summer day a car is left in sun light with all its windows closed. After sometimes the car is found to be considerably hot than outside. Why ? 3

OR

Why small drops of mercury are spherical and large drops become flat. Give reason. 3

26. Draw the labelled diagram of standing wave formed in an open organ pipe for first and second mode of vibration. $1\frac{1}{2}+1\frac{1}{2}=3$

OR

Draw the labelled diagram of formation of beats. 3

Question Nos. 27 to 29 are " Long AnswerType " questions carrying 5 marks each.

27. Find the total energy of a particle executing simple harmonic motion. 5

OR

Find the time period of a simple pendulum. 5

28. Find the excess pressure inside a liquid drop. A spherical body of water has a diameter 2mm.If surface tension of water is 72×10^{-3}N/m, find the pressure difference between outside and inside the soap. 3+2=5

OR

Derive an expression for the critical velocity of a liquid drop using dimensional method. What should be the minimum velocity of water in a tube of radius 10mm, so that the flow is turbulent. (Velocity of water is 10^{-3}Pa s) 3+2=5

29. Prove that the principle of conservation of linear momentum. A shell of mass 0.02Kg is fired by a gun of mass 100 Kg. If the muzzle speed of the shell is $80ms^{-1}$, what is the recoil speed of the gun? 3+2=5

OR

Explain Newton's second law of motion.

A 20gm bullet moving at 300m/s stops after penetrating 3cm of bone. Calculate the average force exerted by the bullet. 3+2=5

Question Nos. 30 to 36 are 'Multiple Choice Type' questions carrying 1 mark each. Choose the correct answer out of the four alternatives and rewrite the correct answer.

30. For a point close to the earth's surface, the escape velocity and orbital velocity are related as 1

(A) $V_e = 2V_o$

(B) $V_e = \sqrt{V_o}$

(C) $V_e = \sqrt{2}V_o$

(D) $V_e = V_o$

31. Which of the following have same dimensions ? 1

(A) Specific heat and latent heat

(B) Momentum and impulse

(C) Moment of momentum and moment of inertia

(D) Tension and surface tension

32. For a body moving with constant speed in a horizontal circle, which of the following remains constant ? 1

(A) Velocity

(B) Acceleration

(C) Centripetal force

(D) Kinetic energy

33. Two masses of 1 gm and of 4 gm are moving with equal linear momenta. The ratio of their kinetic energies is – 1

(A) 4:1

(B) $\sqrt{2}$:1

(C) 1:2

(D) 1:16

34. The moment of inertia of a uniform circular ring about any diameter of the ring is – 1

(A) MR^2

(B) $\frac{1}{2}MR^2$

(C) $\frac{3}{2}MR^2$

(D) $2MR^2$

35. The sudden force acting on an object for a short interval of time is given by – 1

(A) change in linear momentum

(B) change in mass

(C) change in force

(D) change in acceleration

36. The angle between two collinear vectors is always – 1

(A) 0° and 90°

(B) 0° and 180°

(C) 90° and 180°

(D) 45° and 90°