Physics

Time Allowed : 2.30 Hours **Maximum Marks : 70**

Instruction:

(1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

Part – I

Answer all the questions $15 \times 1 = 15$

Match the following questions (1 to 4)

1. The bullet fired from Gun – Bernoull's theorem
2. Cricket player catches the ball – Resonance
3. Breaking of glass due to sound – Illustration of impulse
4. Venturimeter - Projectile

Fill in the blanks

5. The triple point temperature of water is _____
6. If the linear momentum of the object is increase by 0.1% then the kinetic energy will increase by _____
7. Energy of a diatomic molecule at high temperature is _____
8. Suppose if humans had evolved in a planet near the star Sirius, then they would have had the ability to see the _____ rays.

Choose the add one out

9. a) closing a tap b) Opening a pen cap
   c) Opening a Door d) Car steering
10. a) Sound boards or stringed instruments
    b) Vibration of stretched string
    c) Oscillation of simple pendulum

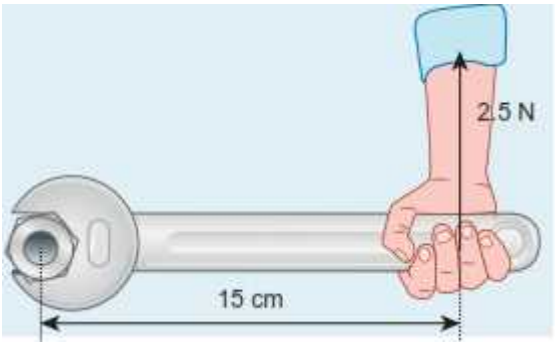
d) Vibration of tuning fork

11. Choose the correct pair
    a) Heliocentric model – Claudius Ptolemy
    b) Geocentric model – Nicholas Copernicus
    c) Law of area – Newton
    d) Radius of earth – Eratosthenes
12. Choose the INCORRECT pair
    a) $(V_{rms}, \sqrt{\frac{3KT}{m}})$
    b) $(\bar{V}, \sqrt{\frac{8KT}{m}})$
    c) $(V_{mp}, \sqrt{\frac{4KT}{m}})$
    d) $(P, \frac{1}{3} Nm\, \bar{v}^2)$
13. Assertion : Transverse waves are not possible in liquids and gases
    Reason: Because they don't possess elastic nature
    a) Both assertion and reason are correct
    b) Both assertion and reason are not correct
    c) Assertion is correct but reason is not correct
    d) Assertion is not correct but reason is correct
14. Choose INCORRECT statement
    a) Particles in the medium vibrate about their mean positions with the same amplitude
    b) No particles remains at rest permanently during wave propagation
    c) The different particle pass through the mean position move with different maximum velocity
    d) The phase at every particle ranges from a 0 to 2π
15. Choose the CORRECT statement
    a) For a fixed mass if we increase the speed the average speed will increase, as a result pressure will increase.
    b) Even at high temperature such as 5000k the degrees of freedom of diatomic molecules won't vary.
    c) The average speed of all molecules is called most probable speed.
    d) The molecules of a gas are in a state of uniform motion.

Part II

Answer any questions in which question number 24 is compulsory $6 \times 2 = 12$

16. Give the advantages of SI System
17. Consider two buses A and B moving along linear way with the same velocity in opposite direction let the velocity of each bus be 25kmh^{-1} calculate the relative velocities of the bus.
18. Give any two salient features of static Friction and Kinetic Friction
19. Define coefficient of restitution
20. If the force applied is perpendicular to the handle of the spanner as shown in the diagram find the (i) torque exerted by the force about the center of the nut and (ii) direction of torque



21. State Newton's Universal law of gravitation
22. Define Poisson's ratio
23. What is Wien's law?
24. The speed of a wave in a certain medium is 900 m/s. If 3000 waves passes over a certain point of the medium in 2 minutes, the compute its wavelength.

Part III

Answer any six questions in which question number 32 is compulsory $6 \times 3 = 18$

25. Convert 76cm of mercury pressure into Nm^{-2} using the method of dimensions.
26. Deduce the relation for work - Energy Theorem.
27. A book of mass m is at rest on the table (i) What are the forces acting on the book (ii) what are forces exerted by the book (iii) draw the free body diagram for the book.
28. Derive the equation for Velocity – displacement relation
29. Write down the postulates of kinetic theory of Gases (any six)

30. Find the moment of inertia of a uniform rod about an axis which is perpendicular to the rod and touches any one end of the rod.
31. Obtain the expression for excess pressure inside a soap bubble.
32. An unknown planet orbits the sun with distance twice the semi major axis distance of the Earth's orbit. If the Earth's time period is T_1, what is the time period of this unknown planet?
33. Derive the equation for work done an adiabatic process.

Part – IV

Answer all the questions **5× 5= 25**

34. a. (i) Deduce the fractional error.

(ii) The voltage across a wire is (100±5) V and the current passing through it is (10±0.2) A. Find the resistance of the wire.

or

b. (i) Obtain the Coefficient of performance COP. (β).

(ii) An ideal refrigerator keeps its content at 0^0C while the room temperature is 27^0C calculate its coefficient of performance.

35. a. Derive the time period of simple pendulum executing simple harmonic motion.

or

b. Explain the variation of 'g' with altitude and depth.

36. a. Show that the path followed by an oblique projectile is an inverted parabola.

or

b. Deduce the expression for center of Mass for distributed point masses.

37. a. Obtain expression for the lowest point of motion in a vertical circle.

or

b. State and prove Bernoulli's theorem for a flow of incompressible, non-viscous and streamlined flow of fluid.

38. a. Show that the velocity of a travelling wave produced in a string is $V = \sqrt{\frac{T}{\mu}}$

or

b. To move an object, Push or pull, which is easier? Explain.

Answer key

1. The bullet fired from Gun – Projectile
2. Cricket player catches the ball – Illustration of impulse
3. Breaking of glass due to sound – Resonance
4. Venturimeter – Bernoulli's theorem
5. 273.16K
6. 0.2%
7. 7/2 RT
8. ultra violet ray
9. c) opening a door
10. a) sound boards or stringed instruments
11. d) Radius of the Earth – Eratosthenes
12. c) $V_{mp} = \sqrt{\frac{4KT}{m}}$
13. a) Both assertion and reason are correct
14. c) The different particles pass through the mean position more with different maximum velocity.
15. a) For a fixed mass if we increase the speed the average speed will increase as a result pressure will increase.
16. any 2 pt (each pt 1 mark)
17. $V_A = +25 Km5^1 \quad V_B = -25\ kmh^{-1} - \frac{1}{2} mark$

    $V = V_A - V_B = 25 — (-25) = 50\ kmh^{-1} - 1\frac{1}{2} mark$
18. any 2 pt (each pt 1 mark)
19. Correction definition (2 mark)
20. $\tau = 37.5 \text{ X } 10^{-2}$ -------- (1 Mark)

    Out of page ----------(1Mark)
21. Correct statements (2mark)

(or) only formulae (1 mark)

22. Correct definition (2 mark)

23. Correct statement (2 mark)

24. Formulae ½ mark

Substitution - ½ mark

Answer -1 mark

2 5. Formulae $\frac{1}{2} Mark$

Up to a=1, b=1, c=-2 -------1½ mark

Substitution and Ans ----------1 mark

26) W=Fs -------$\frac{1}{2} mark$

F=ma -------$\frac{1}{2}$ *mark*

$a = \frac{v^2 - u^2}{25} - \frac{1}{2} mark$

Upto $W = \Delta KE$ ----------$1\frac{1}{2} mark$

27) Explaining

About 2 forces acting -1 mark

Free Body diagram -1mark

Explaining about force exerted -1mark

28) upto $a = \frac{1}{2}\frac{dv^2}{ds}$ *one mark*

Upto $v^2 = u^2 + 2as$ 0*ne mark*

Upto $s = \left(\frac{u+v}{2}\right)t$ $(1\ mark)$

29) Each point $\frac{1}{2}\ mark$

$6 \times \frac{1}{2} = 3 mark$

30) Fixing of origin $\frac{1}{2}\ mark$

Diagram 1 mark

Solving and Answer $1\frac{1}{2}\ mark$

31) Construction = $\frac{1}{2}\ mark$

Diagram = $\frac{1}{2} Mark$

Explaining various forces 1 mark

upto $\Delta P = \frac{4T}{R}$ ----- *One mark*

32) Formulae -1 mark

Substitution 1 mark

Upto $T_2 = 2\sqrt{2T_1}$ 1*Mark*

33) $W = \int_{V_i}^{V_f} PdV$ ---------- ½ mark

$W_{adia} = \int_{V_i}^{V_f} \frac{Constant}{V^{\gamma}} dV$ ------ ½ mark

$P_i V_i = \mu R T_i \quad \frac{1}{2} mark$

$W_{adia} = \frac{\mu R}{\gamma - 1}(T_i - T_f) \quad \frac{1}{2} Mark$

Part IV (5 Marks)

34) a(i) Derivation ----------3 marks

(ii) Formulae ----------1 mark

Substitution and Answer – ----------1 Mark

b) Definition ---------- 1 mark

(i) upto $\beta = \frac{1}{\frac{Q_H}{Q_L} - 1} \qquad 1 mark$

$\beta = \frac{T_L}{T_H - T_L} \qquad (1 mark)$

(ii) Formulae --------- 1 Mark

Substitution ---------- ½ mark

Result ---------- ½ mark

35) a) Description ---------- ½ mark (V-II Page 207)

Diagram ---------- ½ mark

Normal Component ---------- ½ mark

Tangential Component ---------- ½ mark

Upto $- mg \sin\theta = \frac{md^2 s}{dt^2} \quad (1 mark)$

Upto $\frac{d^2\theta}{dt^2} = \frac{-g}{l}\theta$ $(1\,mark)$

Upto $T = 2\pi\sqrt{\frac{l}{g}}$ $(1Mark)$

b) Altitude

$g' = \left[\frac{Gm}{(R_e+h)^2}\right]$ ----- ½ **mark** (V-II Page 19)

upto $g' = \frac{Gm}{R_e^2}\left[1+\frac{h}{R_e}\right]^{-2}$ ---------- 1 mark

upto $g' = g\left[1-\frac{2h}{R_e}\right]$ ---------- ½ mark

$g' < g$ ---------- ½ mark

Depth

$g' = \left[\frac{Gm'}{(R_e-d)^2}\right]$ ---------- ½ mark (V-II Page 20)

$M' = \frac{M}{R_e^3}(R_e - d)^3$ ---------- ½ mark

Upto $g' = g\left[1-\frac{d}{R_e}\right]$ ---------- 1 mark

$g' < g$ ------- ½ mark

36) a) Diagram ----------1 mark (V-I Page 84)

Upto $V_y = u\sin\theta - gt$ $(1mark)$

Upto $y = u\sin\theta t - = \frac{1}{2}gt^2$ $(1mark)$

Thus the path followed by the projectile is an inverted parabola --1 mark

b) Diagram and explanation = 1 mark (V-I Page 209)

$X_{CM} = \frac{\sum m_i x_i}{\sum m_i}$ ---------1 mark

$X_{CM} = \frac{\sum m_i x_i}{M}$ ---------1 mark

$Y_{CM} = \frac{\sum m_i y_i}{M}$ ---------- ½ mark

$Z_{CM} = \frac{\sum m_i z_i}{M}$ ---------- ½ mark

$\vec{r}_{CM} = \frac{\sum m_i \vec{r}_i}{M}$ ---------- 1 mark

37) Diagram and description ---------- 1 mark (V-I Page 187)

Resolving components ---------- 1 mark

Upto values $T_1 \& T_2$ $(1mark)$

Minimum height upto $V_2 = \sqrt{gr}$ $(1mark)$

Upto $V_1 = \sqrt{5gr}$ $(1mark)$

b) statement ---------- 1 mark (V-II Page 83)

Diagram and description ----------1 mark

Upto total energy at A ------ 1 Mark

Upto total energy at B ---------- 1mark

Upto $\frac{P}{\rho g} + \frac{V^2}{2g} + h = a \quad cons\tan t$ $(1mark)$

38) a) Diagram and description =1 mark (V-II Page 232)

Upto $\frac{(dm)v^2}{R} = \frac{\mu v^2 dl}{R}$ $(2mark)$

Upto $V\sqrt{\frac{T}{\mu}}$ $(2mark)$

b) Easy to pull =1 mark (V-I Page 140)

description ---------- ½ mark

$N_{push} = mg + F\cos\theta$ ---------- ½ mark

Free body Diagrams ---------1mark

Upto $N_{pull} = mg - F\cos\theta$ ---------- 2 mark