1. UNIT AND DIMENSIONS

OBJECTIVE QUESTIONS

1. The number of significant figures in 30.00 m^2 are
(a) 1 (b) 2 (c) 3 (d) 4 **(H.P.B 2020)**

2. Out of 4.0 and 4.00, which is more accurate?
(a) 4.0 (b) 4.00 (c) Both are equally accurate (d) Nothing can be said.
(H.P.B. 2018)

3. Match the following List-I with List-II:

List-I	**List-II**
(A) Moment of Inertia	1. $[ML^2T^{-2}]$
(B) Torque	2. $[ML^2T^{-1}]$
(C) Angular momentum	3. $[M^0LT^0]$
(D) Radius of Gyration	4. $[ML^2T^0]$

(a) (A)-1 (B)-2 (C)-3 (D)-4
(b) (A)-2 (B)-3 (C)-4 (D)-1
(c) (A) -4 (B)-1 (C)-2 (D)-3
(d) (A) – 3 (B)-4 (C) – 1 (D) – 2 **(H.P.B. 2023)**

4. Match the following List-I with List-II

List-I	List-II
(A) Gravitational Intensity	1. Nm^2kg^{-2}
(B) Gravitational Potential	2. Ms^{-2}
(C) Gravitational Potential energy	3. Jkg^{-1}
(D) Gravitational constant	4. Joule(J)

(a) (A) – 1 (B)-2 (C)-3 (D)-4
(b) (A) – 2 (B)-3 (C)-4 (D)-1
(c) (A) – 3 (B)-4 (C)-1 (D)-2
(d) (A) – 4 (B)-3 (C)-2 (D)-1 **(H.P.B. 2023)**

5. SI unit of tensile stress
(a) Nm^{-2} (b) Nm (c) Nm^{-1} (d) Nm^{-3} **(H.P.B. 2024)**

6. Which of the following are dimensionally identical ?
(a) stress and strain (b) momentum and impulse
(c) density and relative density (d) work and power

7. The MKS unit of surface tension is:
(a) dyne/cm (b) N / m^2 (c) N/m (d) dyne/cm

8. Which of the following statements is wrong?
(a) unit of kinetic energy is Newton-metre
(b) unit of coefficient of viscosity is poise
(c) work and energy have the same dimensions
(d) unit of surface tension is Newton-metre.

9. The dimensions of the Planck's constant are the same as
(a) angular momentum (b) energy (c) power (d) angular frequency.

10. Dimensions of normal reaction are
(a) MLT^2 (b) MLT^{-2} (c) ML^2T (d) M^2LT^{-2}

11. Which of the following quantities has dimensions different from the other quantities ?
(a) force per unit area
(b) energy per unit volume
(c) angular momentum
(d) product of voltage and charge per unit volume.

12. The dimensional formula of gravitational constant G is:
(a) $[M^{-1}\ L^{\ 2}T^{-3}]$ (b) $[M^{-1}\ L^{\ 3}T^{-2}]$
(c) $[\ ML^{\ 3}T^{-2}]$ (d) $[\ ML^{\ 2}T^{-3}]$

13. The dimensional formula of velocity gradient is
(a) $M^0\ LT^{-1}$ (b) MLT^{-1} (c) $M^0\ L^0T^0$ (d) $ML^2\ \ T^{-2}$

14. Modulus of elasticity has the same dimensions as that of
(a) Energy (b) Torque (c) power (d) Pressure

15. The dimensional formula of stress is
(a) $M^{-1}\ L^2\ T^{\ -2}$ (b) $ML^{-1}\ T^{\ -2}$ (c) $MLT^{\ -2}$ (d) $ML^2\ T^{\ -2}$

16. The dimensional formula of pressure gradient is
(a) $\ ML^{-2}\ T^{\ -2}$ (b)) $MLT^{\ -1}$ (c) LT^{-2} (d) LT^{-1}

17. Candela is the unit of
(a) Acoustic intensity (b) Electric intensity
(c) Luminous intensity (d) Magnetic intensity

18. Which of the following has dimension of pressure ?
(a) $[MLT^{-2}]$ (b) $[ML^{-2}]$ (c) $[ML^{-1}T^{-2}]$ (d) $[ML^{-1}\ T^{-1}]$

19. The physical quantity strain has
(a) No units (b) basic units (c) derived units (d) Fundamental units

20. Dimensional formula of impulse is
(a) $[ML^{-1}T^{-1}]$ (b) $[MLT^{-1}]$ (c) $[M^2\ L^{\ -1}T]$ (d) $[M^{-1}\ LT^{-1}]$

21. The different terms like sound energy, wind energy and light energy are the forms of energy. Then the dimensional formula of sound energy is
(a) $[M^1L^1\ T^{-1}]$ (b) $[M^1L^2\ T^{-2}]$ (c) $[M^1L^0\ T^{-1}]$ (d) $[M^1L^2\ T^0]$

22. The dimensional formula of torque is
(a) $[ML^2T^{-2}]$ (b) $[M^1L^2T^{-2}]$ (c) $[M^0L^0T^{-1}]$ (d) $[MLT^{-2}]$

23. Dimensional formula for angular momentum is
(a) $[ML^2T]$ (b) $[MLT^{-2}]$ (c) $[ML^2T^{-1}]$ (d) $[M^{-1}L^2T^{-1}]$

24. Which of the following measurement is the most precise ?
(a) 7.00 m (b) 7.00 km (c) 7.00 cm (d) 7.00 mm

25. Dimensional Formula of coefficient of restitution is
(a) $M^0L^0\ T^0$ (b) MLT^{-2} (c) $ML^0\ T^{-2}$ (d) MLT^{-1}

ASSERTION (A) AND REASON (R) QUESTIONS

Select the most appropriate answer from the options given below:
(i) Both A and R are true and R is the correct explanation of A.
(ii) Both A and R are true but R is not the correct explanation of A.
(iii) A is true but R is false.
(iv) A is false and R is also false.

1. **Assertion (A):** Bigger is the unit to measure a physical quantity, smaller will be its numerical value.
Reason (R) : One kilogram is equal to 1000 grams because kilogram is bigger unit of mass than gram.

2. **Assertion (A):** Dimensions of velocity and velocity gradient are the same.
Reason (R) : Both velocity and velocity gradient represent the same physical quantity

3. **Assertion (A):** The formula: $S = u + \frac{1}{2} at^2$ dimensionally correct.
Reason (R) : The dimensions of each and every term in the formula are same.

4. **Assertion (A):** Method of dimensions can not be used to convert a newton into a dyne.
Reason (R) : A newton is a unit of force while a dyne is unit of power.

5. **Assertion (A):** In the number 11-56, there are four significant figures.
Reason (R) : All the non-zero digits in a number are significant

ANSWER KEY

1.(d) 2.(b) 3.(c) 4.(b) 5.(a) 6.(b) 7.(c) 8.(d) 9.(a) 10.(b)
11.(c) 12.(c) 13.(c) 14.(d) 15.(b) 16.(a) 17.(c) 18.(c) 19.(a) 20.(b)
21.(b) 22.(b) 23.(c) 24.(d) 25.(a)

ASSERTION (A) AND REASON (R) QUESTIONS

1.(ii) 2.(iv) 3.(iv) 4.(iv) 5.(i)

SUBJECTIVE QUESTIONS

1. What do you mean by least count. **(H.P.B. 2004)**

2. State the number of significant figures in the following:
(a) $0.007 m^2$ (b) $2.64 \times 10^{24} kg$ (c) $6.320 J$ (d) $0.2370 g cm^{-3}$ **(H.P.B.2007)**

3. Convert 100 J into erg using dimensional analysis. **(H.P.B. 2023)**

4. Derive by method of dimensions, an expression for the time period (T) of oscillations of the simple pendulum, assuming that this time period depends upon
(a) Length of Pendulum (l).(b) Acceleration due to gravity (g) . **(H.P.B. 2024)**

5. A body of mass m moves in a circular path of radius r with a velocity v. Find the expression for the centripetal force F acting on the body using the method of dimensions. **(H.P.B. 2002,2011)**

6. What are the four types of system of units? **(H.P.B. 2002)**

7. Convert 10 jule into erg by dimensional method. **(H.P.B. 2023, 2009, 2021, 2023)**

8. Check the accuracy of the relation $T = 2\pi\sqrt{\frac{L}{g}}$, Where T is the time period, L the length and g is the acceleration due to gravity. **(H.P.B. 2003)**

9. Convert 1 newton into dyne using dimensional analysis. **(H.P.B. 2003, 2013, 2018)**

10. Check the correctness of the relation $S = ut + \frac{1}{2}at^2$ using dimensional analysis.

11. A body of mass m is moving in a circle of radius r with angular velocity ω. Find an expression for the centripetal force f acting on it using method of dimensional analysis. **(H.P.B. 2004)**

12. The wavelength $'\lambda'$ associated with a moving particle depends upon its mass 'm', its velocity $'v'$ and Planck's constant $'h'$. S$\lambda \propto \frac{h}{mv}$. **(H.P.B. 2004)**

13. Define dimensional formula. Give uses of Dimensional analysis. **(H.P.B. 2005)**

14. Write down the limitations of Dimensional analysis. **(H.P.B. 2005, 2015)**

15. Derive by method of dimensions, an expression for the time period T of oscillation of the dimple pendulum, assuming that this time period depends on (i) length of the pendulum (l) and (ii) acceleration due to gravity (g). **(H.P.B. 2006, 2024)**

16. In van der Waals' equation

$\left[P + \frac{a}{V^2}\right][V - b] = RT$

What are dimension of constant a and b? **(H.P.B. 2006, 2017, 2019)**

17. Check the correctness of the relation

$F = \frac{mv^2}{r}$ by dimensional method. **(H.P.B. 2008, 2010)**

18. Check the correctness of the relation.

$\boldsymbol{v} = \sqrt{\frac{E}{\rho}}$

Where the symbols have their usual meanings.

19. Convert 1 dyne into newton by using dimensional analysis. **(H.P.B. 2009)**

20. What do you mean by the unit of measurement? Show that bigger is the unit, smaller is the numerical value of physical quantity and vice versa. **(H.P.B. 2011)**

21. What are the main characteristics of SI units? **(H.P.B. 2016)**

22. Assuming that the frequency (f) of a vibrating string depends upon the load (F) applied, length of the string (l) and mass per unit length (m), prove that $f = \frac{1}{2l}\sqrt{\frac{F}{m}}$.

2. MOTION IN ONE DIMENSIONS

OBJECTIVE QUESTIONS

1. A person starts his journey from his home at 9.00 a.m. to his office and came back to his home at 5.00 p.m. His office is 20 km from his home, then the displacement in his motion is

(a) 20 km (b) zero (c) Not defined (d) None of these **(HP B. 2015)**

2. A moving body is covering distance in proportional to square of time along a straight line. The acceleration of the body is

(a) Increasing (b) Decreasing (c) zero (d) Constant **(HP B. 2016)**

3. The acceleration of a moving body can be found from

(a) Area under velocity –time graph (b) Area under distance-time graph
(c) Slope of velocity –time graph (d) Slope of distance –time graph **(HP B. 2015)**

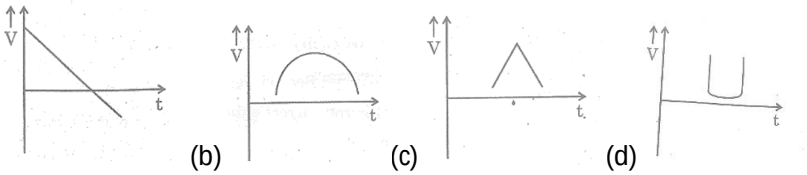
4. The displacement of a freely falling body is proportional to the

(a) time to fall (b) square of time of fall
(c) mass of the body (d) Square of mass of the body **(HP B. 2017)**

5. What does the speedometer of a vehicle read
(a) Average speed (b) Average velocity (c) Instantaneous speed (d) Instantaneous velocity
(HP B. 2019)

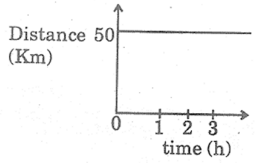
6. If the velocity of a body becomes double, its kinetic energy will become
(a) twice (b) half (c) four times (d) one fourth **(HP B. 2020)**

7. A particle is thrown up, then correct V-t graph will be:



(a) (b) (c) (d)
(HP B. 2023)

8. Distance time graph for a stationary body is shown in figure. Speed of the body after 2 hours will be



(a) 50 km h^{-1} (b) 100 km h^{-1} (c) 70 km h^{-1} (d) 0 km h^{-1} **(HP B. 2024)**

9. The equation of motion for the freely dropped body under gravity is

(a) $v^2 = -2as$ (b) $v^2 = 2gs$ (c) $v^2 = -2gs$ (d) $v^2 = 2as$

10. Out of the following which is not a scalar quantity?

(a) Time (b) Momentum (c) Volume (d) Density **(HP B. 2008)**

ANSWER KEY
1.(b) 2.(d) 3.(c) 4.(b) 5.(c) 6.(c) 7.(a) 8.(d) 9.(b) 10.(b)

SUBJECTIVE QUESTIONS

1. State average and instantaneous velocity. **(H.P.B.2001)**

2. Draw a velocity-time graph for a body which
(i) accelerates uniformally from rest (ii) then moves with uniform velocity
(iii) finally retarded uniformly. **(H.P.B.2005)**

3. Draw the velocity-time graph of uniform motion and prove that the displacement of an object in a time interval is equal to the area under velocity-time graph in that time interval. **(H.P.B.2002, 2011)**

4. Derive the relation $S = ut + \frac{1}{2}at^2$ for uniformaly accelerated motion along a straight line
(H.P.B.2009, 2017)

5. Derive the relation $v^2 - u^2 = 2as$ for uniformly accelerated motion along a straight line.
(H.P.B.2009)

6. Give the position-time$(x - t)$ graph of
(a) positive acceleration (b) negative acceleration (c) zero acceleration **(H.P.B.2008)**

7. Distinguish between terms distance and distance placement. **(HP B 2019, 2021 (Term-1)**)

8. Distinguish between speed and velocity. **(HP B. 2018)**

9. What are positive and negative acceleration? Give example. **(HP B. 2020)**

10. A body is moving with uniform acceleration of 10 m s^{-2}. If it starts from rest, calculate its displacement after 5 seconds. **(H P B 2021 term -1)**

11. What is a Velocity-time Graph? Mention its use. **(HP B. 2023)**

12. A car moving along a straight highway with a speed of 126 Kmh^{-1} is brought to a stop within a distance of 200 m. What is the retardation of the car and how long does it take for the car to stop? **(HP B. 2023)**

13. What is difference between Distance and Displacement ? **(HP B. 2024)**

14. "It is the velocity not the acceleration which decides the direction of motion of a body". Justify this statement with the help of a suitable example. **(HP B. 2024)**

3. VECTOR

OBJECTIVE QUESTIONS

1. Non-zero vectors $\vec{A}$ and $\vec{B}$ and perpendicular to each other , if
(a) $\vec{A} \cdot \vec{B} = 0$ (b) $\vec{A} \cdot \vec{B} = 1$ (c) $|\vec{A} \times \vec{B}| = 0$ (d) $\vec{A} \times \vec{B} = 1$

2. If $\vec{A}$ and $\vec{B}$ are perpendicular vectors and vectors $\vec{A} = 5\hat{\imath} + 7\hat{\jmath} - 3\hat{k}$ and $\vec{B} = 2\hat{\imath} + 2\hat{\jmath} - a\hat{k}$
The value of a is
(a) -2 (b) 8 (c) -7 (d) -8

3. The angle between negative vector is
(a) 30° (b) 45° (c) 60° (d) 180°

4. Identify the Vector quantity among the following:
(a) Work (b) Angular Momentum (c) Distance (d) Energy

5. Out of the following which is not a scalar quantity?
(a) Time (b) Momentum (c) Volume (d) Density

6. Magnitude of resultant vector which comes on the addition of two vectors $6\hat{\imath} + 7\hat{\jmath}$ and $3\hat{\imath} + 4\hat{\jmath}$ is
(a) $\sqrt{136}$ (b) $\sqrt{202}$ (c) $\sqrt{13.6}$ (d) $\sqrt{160.}$

7. Vectors $\vec{A}$ and $\vec{B}$ are parallel, if
(a) $|\vec{A} \times \vec{B}| = 1$ **(**b) $|\vec{A} \times \vec{B}| = 0$ (c) $\vec{A} \cdot \vec{B} = 1$ (d) $\vec{A} \cdot \vec{B} = 0$

8. Which of the following is a vector quantity?
(a) Density (b) Power (c) Work (d) Momentum

9. Unit vector of $\vec{A}$ is
(a) $\hat{A} = \vec{A}|\vec{A}|$ (b) $\hat{A} = \frac{|\vec{A}|}{\vec{A}}$ (c) $\hat{A} = \frac{\vec{A}}{|\vec{A}|}$ (d) $\hat{A} = |\vec{A}|$

10. Angle between two equal vectors is
(a) 0° (b) 30° (c) 90° (d) 180°

11. Identify the vector quantity among the following
(a) Work (b) Angular momentum (c) Distance (d) Energy

ASSERTION & REASON TYPE QUESTIONS
(i) Both A and R are true and R is the correct explanation of A
(ii) Both A and R are true but R is not the correct explanation of A
(iii) A is true but R is false
(iv) A is false and R is also false.

12. **Assertion(A) :** A 20 N force acts on the body along east. After 5 seconds, the same force acts on the body but in the north direction. Then there is a change in the force.
Reason(R) : Force is a vector quantity. A change in either the magnitude or the direction will cause a change in the force.

13. **Assertion(A):** Two vectors have magnitude of 4 and 5 units respectively. The resultant of the vectors is 11 units
Reason(R): Resultant of two vectors can be found by adding the magnitudes of two vectors under all conditions.

14. **Assertion(A):** Two vectors, each of magnitude x act at a point in the direction perpendicular of each other. The resultant has a direction making an angle of 45° with the direction of either
Reason(R): For two vectors $\vec{A}\ and\ \vec{B}$ inclined to each other at an angle θ, the resultant $|\vec{R}|$ is given by

15. **Assertion (A):** Dot product of two vectors is a vector quantity.
Reason (R) : Dot product is a simple multiplication of two vectors.

16. **Assertion (A):** The vectors $\vec{A} = \hat{\imath} + 2\hat{\jmath} + 3\hat{k}$ and $\vec{B} = 2\hat{\imath} - \hat{\jmath}$ are mutually perpendicular.
Reason (R) : Two vectors will be perpendicular if $|\vec{A} \times \vec{B}| = 0$

ANSWER KEY
1.(a) 2.(d) 3.(d) 4.(b) 5.(b) 6.(b) 7.(b) 8.(d) 9.(b) 10.(a)
11.(b)
ASSERTION AND REASON QUESTIONS
12.(i) 13.(iv) 14.(iii) 15.(iv) 16.(iii)

SUBJECTIVE QUESTIONS

1. Show that $\vec{A} = -6\hat{\imath} + 9\hat{\jmath} - 12\hat{k}$ and $\vec{B} = 2\hat{\imath} - 3\hat{\jmath} + 4\hat{k}$ are parallel to each other.

2. Define (i) Unit vector and (ii) Null vector. Prove that $(\vec{A} \times \vec{B})^2 + (\vec{A} \cdot \vec{B})^2 = A^2 B^2$

3. Show that $\vec{A} = 3\hat{\imath} + \hat{\jmath} - k$ and $\vec{B} = \hat{\imath} + 2\hat{\jmath} - 5\hat{k}$ are perpendicular to each other. **(H P B 2017)**

4. State parallelogram law of vector addition. Give analytical treatment to find its resultant when both vectors are inclined at an angle θ.

5. Two force whose magnitudes are in the ratio of 3 : 5 give a resultant of 35 N. If the angle of inclination is 60°, find magnitude of each force.

6. At What angle do the forces $(P + Q)$ and $(P - Q)$ act so that the resultant is $\sqrt{3P^2 + Q^2}$?

(H P B 2021, Term -1)

7. At what angle the two forces $(P + Q)$ and $(P - Q)$ act, so that their resultant is:
$\sqrt{3p^2 + Q^2}$? . **(H P B 2023)**

8. State Triangle law of Vector addition. Give its analytical treatment to find the magnitude and direction of a Resultant vector. **(H P B 2024)**

9. Differentiate between scalars and vectors.

10. What is resolution of a vector? Find rectangular components of a vector after resolution.

4. PROJECTILE

OBJECTIVE QUESTIONS

1. Which of the following does not affect the maximum height attained by the projectile?
(a) Magnitude of initial velocity (b) Acceleration of the projectile
(c) Angle of projection (d) Mass of the projectile

2. The projectile has the maximum value of the time of flight when the angle of projectile is
(a) 90° (b) 60° (c) 45° (d) 30°

3. The maximum height of a projectile is found to be half its range, then range will be
(a) $\frac{u^2}{5g}$ (b) $\frac{2u^2}{5g}$ (c) $\frac{3u^2}{5g}$ (d) $\frac{4u^2}{5g}$

4. A ball thrown by one player reaches the other in 2 sec. The maximum height attained by the ball above the point of projection will be (take $g = 10ms^{-2}$)
(a) 10m (b) 7.5 m (c) 5m **(**d) 5.5 m **(HP Board 2021 term -1)**

5. **Assertion (A):** A projectile fired horizontally along the surface of earth continues to move along the same direction.
Reason (R) : Earth's gravity has no effect on the motion of the projectile.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false.

ANSWER KEY
1.(d) 2.(a) 3.(d) 4.(d) 5.(d)

SUBJECTIVE QUESTIONS

1. What do you mean by projectile? A projectile is fired with velocity μ making an anlge θ with horizontal ground. Show that its path is parabolic. Also find an expression for maximum height, horizontal range and time of flight. **(H.P. Board 2018, 2021 (Term 1)**

2. Show that the path followed by a projectile thrown horizontally with a uniform velocity form the top of tower is parabolic.

3. Find the range of the ball, which when projected with velocity 29.4 ms^{-1} just passes over a pole 4.9 m high. **(H P B 2010)**

4. Prove that a gun will shoot three times as high when its angle of elevation is 60° as when it is 30°, but covers same horizontal range. **(H P B 2013)**

5. A projectile is thrown form a point 39.2 n away from a point 39.2 m away from the foot of a building 19.6 m high and just reaches the top horizontally. Find the velocity of projection and angle of throw.

(H P B 2013)

6. What do you mean by projectile? A projectile is fired with velocity (u) making an angle (θ) with horizontal ground. Show that its path is parabolic. Also find an expression for maximum-height and range attained.

(H P B 2023, 2024)

5. CIRCULAR MOTION

OBJECTIVE QUESTIONS

1. In a uniform circular motion
(a) speed and acceleration are constant (b) speed and acceleration are constant
(c) velocity and acceleration are variable (d) velocity and acceleration are constant

2. A particle moves with a constant speed but in constantly varying direction. The path of the particle will be
(a) Elliptical (b) Linear (c) Circular (d) Parabolic

3. Acceleration of a body moving with constant speed in a circle is **(H. P. B. 2009)**
(a) Zero (b) $r\omega$ (c) ω^2/r (d) $r\omega^2$

4. A particle moves in a circular path of radius 'r'. In half the period of revolution, its displacement and distance covered are **(H. P. B. 2010)**
(a) 2r, $2\pi\ r$ (b) $\frac{r}{2}, \pi r$ (c) $2r, \pi r$ (d) $r, \pi r$

5. A body is whirled in a horizontal circle of radius 20cm. It has angular velocity of 10 rad s^{-1} . What is the linear velocity of any point on the circular path? **(H. P. B. 2010)**
(a) 10 m s^{-1} (b) 2 m s^{-1} (c) 20 m s^{-1} (d) $\sqrt{2}\ ms^{-1}$

6. Uniform circular motion is the direct consequence of
(a) Newton's third law
(b) a force that is always tangent to the path
(c) an acceleration tangent to the path
(d) A force of constant magnitude that is always directed toward the same fixed point.

7. An object moving in a circle at constant speed
(a) must have only one force acting on it
(b) is not accelerating
(c) is held to its path by centrifugal force
(d) has an acceleration of constant magnitude

8. A batsman hits back a ball straight in the direction of bowler without changing its initial speed of 12 m s^{-1}. If the mass of ball is 0.15 kg, determine the impulse imparted to the ball.
(a) 1 N s (b) 3.6 N s (c) zero (d) 1.8 N s

9. A scooter goes round a circular track of radius 10 m with a speed of 30 m s^{-1}. The angular speed of the scooter is **(H.P.B. 2021)**
(a) 3 rad s^{-1} (b) 6 rad s^{-1} (c) 500 rad s^{-1} (d) None of these

10. The relation for linear velocity with angular velocity is
(a) $v = \frac{\omega}{r}$ (b) $\vec{v} = \vec{\omega} \times \vec{r}$ (c) $v = \omega^2 r$ (d) None of these

ANSWER KEY

1.	**(b)**	**2.**	**(c)**	**3.**	**(d)**	**4.**	**(c)**	**5.**	**(b)**	**6.**	**(d)**
7.	**(d)**	**8.**	**(b)**	**9.**	**(a)**	**10.**	**(B)**				

SUBJECTIVE QUESTIONS

1. What is the uniform circular motion? **(H.P.B. 2013)**

2. What do you mean by the time period?

3. Can a body have uniform speed, but still have acceleration? Give example

4. Can a object be accelerated without speeding up or slowing down? Explain. **(H.P.B. 2006)**

5. Can a body have a constant velocity and still a variable speed? **(H.P.B. 2004, 2008)**

6. Is circular motion possible at constant speed? Explain

7. If both speed of a body and radius of circular path are doubled, what happens to centripetal acceleration? **(H.P.B. 2006)**

8. Is the angular velocity of rotation of hour hand of a watch greater or smaller than the angular velocity or earth's rotation about its axis? Explain. **(H.P.B. 2008)**

9. Define angular displacement, angular speed and angular acceleration in case of a circular motion. How are linear velocity and linear acceleration related to angular speed and angular acceleration respectively? **(H.P.B. 2008)**

10. What is uniform circular motion? Derive a formula for centripetal acceleration? **(H.P.B. 2008)**

11. What is non uniform circular motion?

12. Find an expression to find out centripetal force

13. Find out relation between centripetal acceleration and angular frequency.

14. Calculate the angular speed of (i) minutes hand and (ii) Second hand of the clock. **(H.P.B. 2008)**

15. What is the angular velocity in radian s^{-1} of a flywheel making 300 rpm? **(H.P.B. 2007, 2008)**

16. How many revolutions, a particle completes when it is displaced through 10 radian?

17. Derive an expression for the acceleration of a particle having non-uniform circular motion.

18. What is the relation between linear acceleration and angular acceleration?

6. NEWTON'S LAWS OF MOTION

OBJECTIVE QUESTIONS

1. A jet engine works on the principle of
(a) Conservation of mass (b) Conservation of energy
(c) Conservation of linear momentum (d) Conservation of angular momentum.

2. A body of mass 4 kg weight 4.8 kg when suspended in a moving lift. The acceleration of the lift is
(a) 9.80 $m\ s^{-2}$ downwards (b) 9.80 $m\ s^{-2}$ upwards
(c) 1.96 $m\ s^{-2}$ downwards (d) 1.96 $m\ s^{-2}$ upwards.

3. Newton's third law of motion leads to the law of conservation of
(a) Angular momentum (b) Energy (c) Mass (d) Momentum

4. The apparent weight of a freely falling body is
(a) Decreased (b) Unchanged (c) Increased (d) Zero.

5. A bullet of mass A and velocity B is fired into a block of wood of mass (c). If loss of any mass and friction be neglected, the velocity of the system must be
(a) $\frac{AB}{A+C}$ (b) $\frac{A+C}{AB}$ (C) $\frac{AC}{A+B}$ (d) $\frac{A+B}{AC}$.

6. A shell of mass *m* moving with velocity *v* suddenly breaks into 2 pieces. The part having mass $\frac{m}{4}$ remains stationary. The velocity of the other shell will be
(a) $\frac{3}{4}v$ (b) 2 v (c) v (d) $\frac{4}{3}v$.

7. To shake off water from a wet cloth, it is common to give it a sudden jerk. In so doing, we are taking advantage of
(a) Newton's first law of motion (b) Newton's second law of motion
(c) Newton's third law of motion (d) Impulse. **(H.P.B. 2013)**

8. Change in momentum is given by **(H.P.B. 2008)**
(a) Force × Mass (b) Force × Time (c) Force × Velocity (d) Force × Distance.

9. 1 N is equal to
(a) 10^2 dyne (b) 10^3 dyne (c) 10^4 dyne (d) 10^5 dyn **(H.P.B. 2008)**

10. When a bus suddenly takes a turn, the passengers are thrown outward, because of
(a) Speed of bus (b) Inertia of motion (c) Acceleration of motion (d) None
(H.P.B. 2011)

11. Which of the followings is known as law of inertia ?
(a) Newton's first law of motion (b) Newton's second law of motion
(c) Newton's third law of motion (d) Law of conservation of mass

12. Ram jumps from his school bus while it is in running state, then Ram falls in
(a) forward direction (b) backward direction
(c) remain in straight direction (d) None of these

13. Rahul was sitting on the back of a horse. The horse suddenly started running, Rahul
(a) fell in forward direction (b) fell in backward direction
(c) remained in the sitting position (d) None of these.

14. Action and reaction are equal and opposite. If F be the magnitude of both the action and reaction, then
(a) Resultant of action and reaction is zero
(b) Resultant of action and reaction = 2F
(c) Resultant of action and reaction is less than F
(d) Action and reaction do not cancel each other.

15. A body of mass 50 g is moving with a constant velocity of 5 s^{-1} on a horizontal smooth surface. The force acting on the body is
(a) 1 N (b) 2 N (c) 5 N (d) Zero

16. If external force on a body is zero, its
(a) displacement is zero (b) velocity is zero
(c) acceleration is zero (d) None of these

17. The dimensional formula of impulse is
(a) $[MLT^{-1}]$ (b) $[MLT^{-2}]$ (c) $[ML^{-1}T]$ (d) $[ML^{-2}T]$

18. Change in momentum is given by
(a) Force x Mass (b) Force x Time (c) Force x Velocity (d) Force x Distance

19. The CGS unit of Force is
(a) N (b) Dyne (c) M (d)None

20. The unit of impulse are same as that of
(a) Energy (b) Linear momentum (c) velocity (d) Power

ANSWER-KEY

1. (c) 2. (d) 3. (d) 4.(d) 5. (a) 6. (d) 7. (a) 8. (b) 9. (d) 10. (d)
11. (a) 12. (a) 13. (b) 14. (d) 15. (d) 16. (c) 17. (b) 18. (b) 19. (b) 20.(b)

SUBJECTIVE QUESTIONS

1. What is inertia? Define and explain the three different types of inertia. **(H.P.B. 2003 C)**
2. Why we beat a carpet to remove dust? **(H.P.B. 2004, 2009)**
3. Why an athlete runs some steps before taking a jump? **(H.P.B. 2003, 2009)**

4. Explain why passengers are thrown forward from their seats when a speeding bus stops suddenly. **(H.P.B. 2024)**

5. A body is acted upon by a number of external forces. Can it remain at rest. **(H.P.B. 2005)**

6. Why an athelete runs some steps before taking a jump **(H.P.B. 2003, 09)**

7. What is force? Give and state the SI unit of force. **(H.P.B. 2004)**

8. Define the term momentum. Give its S.I. units. **(H.P.B. 2010)**

9. State Newton's 2nd law of motion. Prove that Newton's second law is the real law of motion. **(H.P.B. 2023)**

11. Two bodies of unequal masses move with same velocity. Which body has large momentum? Explain **(H.P.B. 2008)**

12. Bones of a person are fractured in an accident. Explain, why. **(H.P.B. 2008)**

13. Why a Cricket Player lowers his hands while catching a Cricket ball? **(H.P.B. 2023)**

14. Why are porcelain objects wrapped in paper or straw before packing for transportation?

15. If is more difficult to catch a cricket ball than to catch a tennis ball moving with the same velocity. Explain why. **(H.P.B. 2009)**

16. What is force? What are the absolute and gravitational units of force in CGS system and SI? How are these different units related to each other? **(H.P.B. 2009)**

17. If the net force acting on a body is zero, will the body remain necessarily in rest position? **(H.P.B. 2006)**

18. Assertion (A): Impulsive force is large and acts for a short time.
Reason (R): Finite change in momentum should be produced by the force.
(a) Both Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true **(H.P.B. 2023)**

19. If the net force acting on the body be zero, will the body remain necessarily in rest position? Explain your answer. **(H.P.B. 2006)**

20. What is the principle of rocket propulsion? **(H.P.B. 2003)**

21. A bus weighing 90 km is at rest on the bus stand. What is the linear momentum of the bus? **(H.P.B. 2002)**

22. A boy weighing 30 kg is sitting on a chair. How much reaction acts on the boy? **(H.P.B. 2008)**

23. A force of 1N acts on a body of mass 1g. Calculate the acceleration produced in the body. **(H.P.B. 2008)**

24. An objects of mass 50g is in motion at the rate of $(5\hat{\imath} - \hat{\jmath} + \hat{k})$ m s^{-1} . Calculate the linear momentum involved. **(H.P.B. 2002)**

25. Prove the impulse-momentum theorem. **(H.P.B. 2003 C, 2004 C, Model Paper 2013)**

26. State the law of conservation of linear momentum.

27. State Newton's third law of motion.

28. Sate laws of motion and hence explain that first law of motion gives the definition of inertia and second law gives the definition and magnitude of force.

29. A bomb explodes in mid air into two equal fragments. What is the direction of motion of the two fragments.

30. What is recoiling of a gun? Find recoil velocity of gun.

31. Calculate the impulse of an average force of 2N acting on a body for the time interval of 10 millisecond. Also find the change in momentum of the body.

32. Find the magnitude and direction of the reaction force acting on a coin of 10g lying on the surface of the floor. Take g = 10 ms^{-2}.

33. Action and reaction are equal and opposite. Why cannot they cancel each other? **(H.P.B. 2008)**

34. Why a gun recoils back when it is being fired? **(H.P.B. 2004, 05, 07, 08, 09, 15)**

35. Why does a heavy gun not recoil so strongly as a light gun firing the same bullet? **(H.P.B. 2006)**

36. How Newton's third law of motion helps us in walking?

37. When a man jumps out of a boat, the boat is pushed away. Why?

38. State the law of conservation of linear momentum. Derive law of conservation of linear momentum form Newton's third law of motion. **(H.P.B. 2005, 07, 07, 08, 16)**

39. What are concurrent forces? Prove that under the action of three concurrent force $\vec{F}_1$, $\vec{F}_2$ and $\overrightarrow{F_3}$ a body will be in equilibrium, When $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 0$

40. Sate Newton's third law of motion. Derive the principle of conservation of linear momentum from it. **(H.P.B. 2003)**

7. FRICTION

OBJECTIVE QUESTIONS

1. A body starts sliding down at angle θ to horizontal. Then coefficient of friction is equal to
(a) tan θ (b) sin θ (c) cos θ (d) cot θ

2. If the coefficient of friction of a plane inclined at 45° is 0.5, the acceleration of a body sliding freely on it is
(a) $\frac{9.8}{\sqrt{2}}$ m/s^{-2} (b) 9.8 m/s^{-2} (c) 4.9/$\sqrt{2}$ m/s^{-2} (d) $\frac{9.8}{2\sqrt{2}}$ m/s^{-2}

3. The coefficient of kinetic friction
(a) it in the direction of the frictional force (b) is in the direction of the normal force
(c) is the ratio of force to area (d) is none of the above

4. Acceleration of a body moving with constant speed in a circle is
(a) Zero (b) $r\omega$ (c) ω^2 (d) $\omega^2 r$

5. The static force of friction
(a) Remains the same with increase in applied force (b) decreases with increase in applied force
(c) increases with increase in applied force (d) increases with decrease in applied force

6. Direction of force of friction is
(a) Perpendicular to the motion of body (b) Along the direction of motion
(c) Opposite to the direction of motion (d) None of these

7. Air is thrown on the soil of a stationary boat by an electric fan kept on it. The boat will
(a) Remain stationary (b) Start moving in the direction in which air is blown
(c) Start moving in the direction opposite to that in which air is blown
(d) Start with uniform acceleration

8. A brick slides on a horizontal surface. Which of the following will increase the magnitude of frictional force on it?
(a)Putting second brick on top (b) Decreasing surface area of contract
(c) Decreasing the mass of brick (d) Increasing surface area of contact

9. A box is placed on the bed of a truck. When the truck accelerates in the forward direction then direction of force of friction between the lower surface of box and bed of truck is
(a) in backward direction (b) in forward direction
(c) in upward direction (d) in downward direction

10. A body of weight W rests on a frictional surface. Angle between force of friction and normal reaction is
(a) 0° (b) 90° (c) 60° (d) 30°

11. If μ_s, μ_k and μ_r to be the coefficient of static, kinetic and rolling friction respectively then
(a) $\mu_s > \mu_k < u_r$ (b) $\mu_s < \mu_k < \mu_r$ (3) $\mu_s < u_k > \mu_r$ (d) $\mu_s > \mu_k > \mu_r$

12. It is difficult to walk on a slippery road. Sand is thrown on slippery roads so that people can walk easily on slippery roads. When sand is thrown on road
(a) Force of friction decreases (b) Force of friction increases
(c) Force of friction is not affected (d) Road looks good.

13. Proper inflation of tyres saves fuel. This is because
(a) Contact area is increased (b) Contact area is decreased
(c) Normal reaction is reduced (d) Normal reaction is increased

14. Aeroplanes, jets etc. are streamlined to reduce
(a) Dynamic friction (b) Sliding friction
(c) Rolling friction (d) Fluid friction

15. Brakes of very small contact area are not used although friction is independent of area because friction
(a) Resists motion (b) Cause wear and tear
(c) Depends upon nature of material (d) Operating in this case is sliding friction

16. Which of the following is a self-adjusting force?
(a) Kinetic friction (b) Limiting friction
(c) Static friction (d) All the three

17. Angle of repose for a rough inclined plane is 60°. The coefficient of friction is
(a) $\sqrt{3}$ (b)$1/\sqrt{3}$ (c) 1 (d) Zero

18. If a normal force is doubled, then coefficient of friction is
(a) Halved (b) doubled (c) Trippled (d) Remains unchanged

ANSWER KEY
1.(a) 2.(c) 3.(c) 4.(d) 5.(c) 6.(c) 7.(c) 8.(a) 9.(b) 10.(b)11.(d) 12.(b) 13.(b) 14.(d) 15.(d) 16.(c) 17.(a) 18.(c)

SUBJECTIVE QUESTIONS

1. What is friction? **(H. P. B 2004)**

2. Static friction is self-adjusting. Explain.

3. On what factors does the coefficient of friction depend? **(H. P. B 2005)**

4. A cubical block rests on a plane of coefficient of friction = $\frac{1}{\sqrt{3}}$. Determine the angle through which the plane be inclined to the horizontal so that block just slides down. **(H. P. B 2010)**

5. Define coefficient of friction and angle of friction. Show that the coefficient of friction is equal to tangent of the angle of friction. **(H. P. B 2006)**

6. What is the difference between static friction and kinetic friction? Which of the two is smaller?
(a) Sliding friction or rolling friction. (b) Rolling friction or fluid friction. **(H. P. B 2006)**

7. Explain the terms friction and limiting friction. Sate the laws of limiting friction. Give some methods for reducing friction.

8. Show that friction is a necessary evil. How friction can be reduced. **(H. P. B 2003, 2004)**

9. Explain, why is it easier to pull a body than to push the body.

10. Calculate the acceleration in sliding the body down an inclined plane.

11. What is need of banking of roads? Discuss the motion of vehicle in banked circular road.

12. Derive an expression for the work done in sliding the body on a rough horizontal surface.

13. Obtain an expression for the speed with which a vehicle can safely negotiate a flat curved road.

14. What is need of banking of roads? Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at angle θ.

15. Why sand is thrown on the road/tracks covered with snow?

16. Why do we slip easily on rainy day?

17. Why are wheels made circular? Explain

18. Does the angle of friction between two bodies in contact if coefficient of friction is $\frac{1}{\sqrt{3}}$

19. Why friction force is increased when a surface is polished beyond certain limit?

20. Why the tyres are usually provided with irregular projections over their surfaces.

21. Write down the methods of increasing friction.

22. Write down the methods of reducing friction.

8. WORK POWER ENERGY

OBJECTIVE QUESTIONS

1. A kilowatt – hour is a unit of:
(a) Power (b) Energy (c) Work (d) Power/time.

2. A light and a heavy body have equal momentum. which one has grater K.E.?
(a) The light body (b) The heavy bod y
(c) Both have equal K.E (d) The data given is incomplete (H.P.B. 2014)

3. A man pulls a bucket out of a well by means of a rope. The work done by gravity is:
(a) Positive (b) Negative (c) Zero (d) None of these. (H.P.B. 2016)

4. Work done by centripetal force is
(a) Positive (b) Negative (c) Zero (d) None of these (H.P.B. 2017)

5. A force does maximum work on an object. The angle between the force and displacement vector is:
(a) 0^0 (b) 30^0 (c) 60^0 (d) 90^0 (H.P.B. 2021)

6. If the velocity of a body becomes double, its kinetic energy will become
(a) twice (b) half (c) four times (d) one-fourth. (H.P.B. 2018,2019)

7. When a body is thrown up, work done by gravity on the body is
(a) positive (b) zero (c) negative (d) can't say.

8. A body is undergoing non uniform circular motion. Work done by radial force on body is
(a) zero (b) positive (c) negative (d) none of these

9. Which of the following is non conservative force?
(a) Gravitational force (c) Magnetic force (b) Electrostatic force (d) Force of friction.

10. Area under force displacement graph is equal to
(a) impulse (b) momentum (c) work done (d) none of these.

11. A body has uniform circular motion. Which of the quantity of the body will remain the same ?
(a) Velocity (b) Momentum (c) K.E.
(d) Both velocity and momentum

12. A bus and car have the same momentum. If K.E. of the bus K_1 and K.E. of car is K_2 then
(a) $K_1 = K_2$ (b) $K_1 = K_2$ (c) $K_1 > K_2$ (d) $K_1 \geq K_2$

13. If the momentum of body is increased by 0.01% than its K.E. will be increased by
(a) 001% (b) 0.02% (c) 0.03% (d) 0.04%

14. A light and heavy body have equal K.E. Which has greater momentum?
(a) A heavy body (b) A light body
(c) Both have equal momentum (d) Data given is incomplete

15. In any kind of collision
(a) Linear momentum is always conserved (b) K.E. is always conserved
(c) both (a) and (b) (d) Neither (a) nor (b).

16. For perfectly elastic collision and perfectly inelastic collision values of coefficient of restitution are
(a) 0, 0 (b) 0, 1 (c) 1, 0 (d) 1, 1

17. Which of the following is not the unit of energy?
(a) joule (b) kWh (c) V (d) watt

18. A man pulls a bucket out of a well by means of a rope. The work done by the man is
(a) positive (b) negative (c) zero (d) none of these

19. Work is said to be done if the force and displacement are
(a) Parallel (b) Perpendicular
(c) Acting in opposite directions (d) None of these.

20. A man pushes a wall with his hands and fails to displace it.
(a) Negative work (b) No work at all
(c) Maximum positive work (d) Positive work but not maximum

21. Dimensional formula for force constant is
(a) $[M^0 L\, T^{-2}]$ (b) $[\, M\, L^0\, T^{-1}]$ (c) $[ML^0\, T^{-2}]$ (d) $[M^0\, L^2\, T^{-2}]$

22. In inelastic collision
(a) Only momentum is conserved (b) Only K.E. is conserved
(c) Both momentum and K.E. are conserved (d) neither momentum nor K.E. is conserved

23. Dimensional formula for coefficient of restitution is
(a) $[M^0LT]$ (b) $[M^0L^0T]$ (c) $[M^0L^0T^0]$ (d)$[M^0L^{-1}T^0]$

24. The C.G.S unit of work is
(a) Newton (b) Dyne (c) Erg (d) Joule

25. Mechanical energy is the sum of K.E. and .....
(a) Potential energy (b) Spring energy (c) Electric energy (d) None of these

26. The S.I. unit of gravitational potential energy is
(a) Erg (b) Joule/Sec (c) Kg m^2 s^{-2} (d) None of these

ANSWER-KEY

1. (b) 2. (a) 3. (b) 4. (c) 5. (a) 6. (c) 7. (c) 8. (a) 9. (d) 10. (c) 11. (c) 12. (b) 13. (b)
14. (a) 15. (a) 16. (c) 17. (d) 18. (a) 19. (a) 20. (b) 21. (c) 22. (a) 23. (c) 24. (c) 25. (a) 26. (c)

SUBJECTIVE QUESTIONS

1. What are conservation forces? Give example. **(H.P.B. 2003 C, 2004 C)**

2. What is a non-conservation force? Give example. **(H.P.B. 2003 C)**

3. (a) Explain the meaning of the term work. Calculate the work done by a constant force. Is work a scalar or vector quantity. **(H.P.B. 2006, 2006 C)**
(b) When is the work + ve, - ve or zero? Give its S.I. units.

4. Prove that 1 J = 10^7 erg. **(H.P.B. 2008)**

5. Does the work done in raising a box on to a platform depend upon how fast it is raised? Justify your answer. **(H.P.B. 2008)**

6. A force $\vec{F} = 2.0\,\hat{\imath} - 6.0\,\hat{\jmath}$ is applied on a body, which is sliding over a floor. If the body is displaced through $(-3.0\,\hat{\jmath})$ m, how much work is done by the force? **(H.P.B. 2009)**

7. If $\vec{A} = \hat{2} + 3\hat{\jmath} - 4\hat{k}$ and $\vec{B} = 3\hat{\imath} - 4\hat{\jmath} + 5\hat{k}$, find $\vec{A} \cdot \vec{B}$. **(H.P.B. 2011)**

8. Explain the scalar product of two vectors. What does it physically signify? **(H.P.B. 2011)**

9. A body constrained to move along the y-axis of a coordinate system is subjected to a constant force $\vec{F} = (2\hat{\imath} - 3\hat{\jmath} + \hat{k})$ N. What is the work done by the force in moving the body a distance of 2 m along y-axis? **(H.P.B. 2007)**

10. A particle moves from a point $\vec{r_1} = 3\hat{\imath} + 2\hat{\jmath} - 6\hat{k}$ to $\vec{r_2} = 14\hat{\imath} + 13\hat{\jmath} - 9\hat{k}$ under the action of a force $\vec{F} = 4\hat{\imath} - \hat{\jmath} + 3\hat{k}$ N. Calculate the work done. **(H.P.B. 2003)**

11. A man weighing 70 kg carries a weight of 10 kg to the top of a tower 100 m high. Calculate the work done **(H.P.B. 2003 C)**

12. Calculate the amount of work done in moving a 50 kg block through a distance of 10 m by applying a force of 100 N. **(H.P.B. 2003 C)**

13. What is the amount of work done by a force when a body moves in a circular path? **(H.P.B. 2004, 2005 C)**

14. Why a coolie does not work, when he moves on a level road while carrying a box on is head. **(H.P.B.2003 C)**

15. Give one example of each of the following (i) zero work and (ii) negative work. **(H.P.B. 2003)**

16. A man weighing 50 kg climbs 10 m. calculate the work done by gravity. **(H.P.B. 2002)**

17. A particle is displaced through $(3\hat{\imath} - 2\hat{\jmath} + 2\hat{k})$ m, under the influence of a force $(-\hat{\imath} + \hat{\jmath} - 5\hat{k})$N. Calculate the work done. **(H.P.B. 2002)**

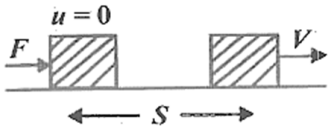
18. What is a Joule? **(H.P.B. 2005)**

19. What is work done in holding a 15 kg suitcase while waiting for a bus for 15 minutes? **(H.P.B. 2005 C)**

20. Define energy and power. What are their units in S.I. **(H.P.B. 2001, 2013)**

21. What is K.E. and P.E.? Find expression for K.E. of a moving body. **(H.P.B. 2001 C)**

22. Derive expression for kinetic energy of a body. **(H.P.B. 2020)**



23. Explain work-energy theorem.

24. Express the relation of kinetic energy with momentum. **(H.P.B. 2003 C)**

25. How does the K.E. of the object change if its momentum is doubled? **(H.P.B. 2001, 2003,2003 C, 2005)**

26. A light and heavy body have equal K.E. Which has larger momentum? **(H.P.B. 2004 C, 2010)**

27. How will the momentum of a body change, if its kinetic energy is doubled? **(H.P.B. 2005 C, 2008)**

28. A body mass 5 kg is lying on a frictionless table. A table of 20 N is applied on it for 10 second. Calculate its kinetic energy. **(H.P.B. 2004 C)**

29. A body of mass 5 kg initially at rest is subjected to a force of 20 N. What is the kinetic energy acquired by the body at the end of 10 seconds? **(H.P.B. 2007)**

30. A particle moves from position $\overrightarrow{r_1} = (2\hat{\imath} + 3\hat{\jmath})$ m to $\overrightarrow{r_2} = (10\hat{\imath} + 13\hat{\jmath})$ N. Calculate the work done **(H.P.B. 2009)**

31. Calculate the work done by a constant force of $(3\hat{\imath} + 2\hat{\jmath} - \hat{k})$ N producing displacement $(\hat{\imath} + \hat{\jmath} - 2\hat{k})$ m **(H.P.B. 2009, 2014)**

32. A man pushes a roller with a force of 60 N through a distance of 30 m. Calculate the work done if the handle of the roller is inclined at angle of 60° with the ground **(H.P.B. 2009)**

33. How will be momentum of a body change if its K.E. is doubled? **(H.P.B. 2021)**

34. What is gravitational potential energy? Derive an expression for it. **(H.P.B. 2021)**

35. Explain potential energy with example. Derive an expression for the potential energy stored in a system of a block attached to a massless spring, when the block is pulled from its equilibrium position. **(H.P.B. 2004 C)**

36. State the principle of conservation of energy. Define kinetic and potential energy. Prove it for freely falling body. **(H.P.B. 2003, 2002 C)**

37. Define restoring force and force constant. Give SI units of force constant. **(H.P.B. 2009)**

38. Define potential energy. Show that the potential energy of an elastic spring of spring of spring constant k compressed by an amount x is $\frac{1}{2}kx^2$. **(H.P.B. 2009)**

39. 230 joules were spent in lifting a 10 kg weight to a height 2 m. Calculate the acceleration with which it was raised. Take $g = 10\ m\ s^{-2}$. **(H.P.B. 2010)**

40. A body of mass 1.0 kg initially at rest is moved by a horizontal force of 0.5 N on a smooth frictionless table. Calculate the work done by the force in 10 second and show that this work done is equal to the change in kinetic energy of the body. **(H.P.B. 2004 C)**

41. Define force constant of a spring. Give its S.I. units. **(H.P.B. 2005 C)**

42. Define Power. Prove that instantaneous power is given by scalar product of force and velocity. **(H.P.B. 2006 C)**

43. Define and explain the terms: Work, Power and energy and state their SI unit. **(H.P.B. 2003)**

44. A girl of mass 40 kg climbs a rope 6 m long at constant speed in 15 seconds. What power she expands during the climb? **(H.P.B. 2004 C)**

45. A man of mass 60 kg runs up a flight of 30 steps in 40 second. If each step is 20 cm high, calculate the power of the man. **(H.P.B. 2003)**

46. Discuss elastic collision between the balls in one dimensions and obtain the expression for their velocities after collision. **(H.P.B. 2003 C, 2004 C, 2001, 2014)**

47. Show that in head on collision between two balls of equal masses moving along a straight line, the balls simply exchange their velocities. **(H.P.B. 2003, 2003 C, Similar H.P.B. 2007)**

48. A cyclist comes to a skidding stop in 10 m. During the process, the force on the cycle due to road is 200 N and is directly opposed to the motion. How much work does the road do on the cycle?

9. CENTER OF MASS (ROTATIONAL MOTION)

OBJECTIVE QUESTIONS

1. A bomb travelling in parabolic path under the effect of gravity, explodes in mid- air. The center of mass of the fragments will

(a) move in irregular path

(b) move vertically downwards

(c) move vertically upwards and then vertically downwards

(d) move in the parabolic path the unexploded bomb would have travelled **(H. P. B. 2013)**

2. The torque acting on a body is the rotational analogue of
(a) Mass (b) Force (c) Velocity (d) Kinetic energy **(H. P. B. 2008)**

3. The torque of a force $\vec{F} = -3\hat{\imath} + \hat{\jmath} + 5\hat{k}$ acting at the point $\vec{r} = 7\hat{\imath} + 3\hat{\jmath} + \hat{k}$ is
(a) $14\hat{\imath} - 38\hat{\jmath} + 16\hat{k}$ (b) $4\hat{\imath} + 4\hat{\jmath} + 6\hat{k}$
(c) $-21\hat{\imath} + 4\hat{\jmath} + 4\hat{k}$ (d) $-14\hat{\imath} + 38\hat{\jmath} - 16\hat{k}$ **(H. P. B. 2008)**

4. The unit of moment of inertia in SI system is **(H. P. B. 2009)**
(a) g cm^2 (b) g cm (c) kg m (d) kg m^2

5. The unit of radius of gyration is **(H. P. B. 2009)**
(a) kg m^2 kg^2 m (c) kg (d) m

6. If I, α and τ are moment of intertia, angular acceleration and torque respectively of a body rotating an axis with angular velocity ω, then
(a) $\tau = I\alpha$ (b)) $\tau = I\omega$ (c)) $I = \tau\omega$ (d) $a = \tau\omega$
(H. P. B. 2010)

7. The moment of momentum is called
(a) Moment of inertia (b) Torque (c) Impulse (d) Angular momentum
(H. P. B. 2015)

8. If a person sitting on a rotating stool with his arms stretched, suddenly lowers his hands
(a) The angular velocity decrease (b) His M.I decrease
(c) The angular velocity remains constant (d) Angular momentum increase **(H. P. B. 2010)**

9. Generally, the mass of a flywheel is concentrated on its rim, why
(a) to increase moment of inertia (b) to decrease moment of inertia
(c) to obtain stable equilibrium (d) to obtain a strong wheel **(H. P. B. 2011)**

10. The kinetic energy in rotational motion is given by $\left(\frac{1}{2} I\omega^2\right)$ and in translational motion is $\left(\frac{1}{2} m\,\omega^2\right)$. Here 'I' is moment of inertial, $'\omega'$ in angular velocity. 'm' is the mass of the body and 'v' is the linear velocity. The role of mass in translational motion is played by which quantity in rotational motion
(H.P.B 2013)
(a) Linear velocity (b) Angular velocity (c) Moment of inertia (d) None of these

11. For which of the following does the centre of mass lie outside the body. **(H. P. B. 2014)**
(a) A pencil (b) a dice (c) a bangle (d) a shotput

12. The unit of angular momentum is
(a) Nm (b) kg m^{-1} s^{-1} (c) kg m^2 s^{-1} (d) kg^2 m^2 s^{-1} **(H. P. B. 2016)**

13. The moment of inertia of a rigid body, depends upon
(a) Mass of the body (b) Angular acceleration of body
(c)Time period of its rotation (d) None of these **(H. P. B. 2017)**

14. For which of the following does the centre of mass lie outside the body?
(a) Solid sphere (b) Solid cylinder
(c) a disc (d) a ring **(H. P. B. 2018)**

15. The centre of mass of a uniform disk of radius R is located:
(a) on the rim
(b) at the centre
(c) at a distance R/3 from the centre
(d) at a distance 2R/3 from the centre.

16. When a body is rotated on a circular path with uniform speed, then the work done by centripetal force is
(a) zero (b) finite (c) infinite (d) indeterminate

17. Two particles of same mass are moving with same speed on circular paths of radius r_1 and r_2. The ratio of centripetal forces will be
(a) $\frac{r_2}{r_1}$ (b) $\sqrt{\frac{r_2}{r_1}}$ (c) $\frac{r_1}{r_2}$ (d) $\left(\frac{r_2}{r_1}\right)^2$

18. A bomb travelling in parabolic path under the effect of , explodes in mid-air. The centre of mass of the fragments will
(a) move in irregular path
(b) move vertically downwards
(c) move vertically upwards and then vertically downwards
(d) move in the parabolic path the unexploded bomb would have travelled

19. A tap can be operated easily using two fingers because
(a) the force available for the operation will be more
(b) this helps application of angular forces
(c) the rotational effect is caused by the couple formed
(d) the force by one finger overcomes friction and the other finger provides the force for the operation.

20. Three identical metal balls, each of the radius are placed touching each other on a horizontal surface such that an equilateral triangle is formed when centres of three balls are joined. The centre of mass of the system is located at
(a) line joining centres of any two balls (b) centre of one of the balls
(c) horizontal surface (d) point of intersection of the medians.

21. The moment of inertia of a disc of mass M and radius R about an axis, which is tangential to the circumference of the disc and parallel to its diameter is
(a) $\frac{3}{2}MR^2$ (b) $\frac{2}{3}MR^2$ (c) $\frac{5}{4}MR^2$ (d) $\frac{4}{5}MR^2$

22. Which of the following has highest moment of inertia ?
(a) a circular plate of radius R (b) a circular ring of radius R
(c) a thin rod of length 2R (d) rectangular plate.

23. A solid sphere rolls on a plane the total K.E. is surface. The ratio of its K.E. of rotation and
(a) 2:7 (b) 2:5 (c) 1:3 (d) 1: 6.

24. The rotational inertia of a wheel about its axle does not depend upon its:
(a) diameter (b) mass
(c) distribution of mass (d) speed of rotation.

25. Two masses m_1 and m_2 are respectively at a distance a_1 and from their centre of mass. Then

(a) $\frac{m_1}{m_2} = \frac{a_1}{a_2}$ (b) $\frac{m_1}{m_2} = \frac{a_2}{a_1}$ (c) $\frac{m_1}{m_2} = \frac{a_1^2}{a_2^2}$ (d) $\frac{m_1}{m_2} = \sqrt{\frac{a_2}{a_1}}$

26. When a man on a frictionless rotating stool extends his arms horizontally, his rotational kinetic energy:

(a) must increase (b) must decrease

(c) must remain the same

(d) may increase or decrease depending on his initial angular velocity.

27. An earth satellite is moving around the earth in circular orbit. Which of the following is conserved ?

(a) Velocity (b) Linear momentum (c) Angular momentum (d) None of these

28. If there is no external torque acting on system of particles, which of the following will be constant ?

(a) Linear momentum (b) Angular Momentum (c) Force (d) Impulse.

29. The point where total mas of a body is supposed to be concentrated is known as

(a) Dead centre (b) Centre of mass (c) Centre of gravity (d) Centre of motion

30. When milk is churned, cream separates out because of the

(a) Cohesive force (b) Gravitational force (c) Frictional force (d) Centrifugal force

31. The centre of mass of a system shall be

(a) At the centre of the system (b) Outside the system

(c) Inside or outside the system (d) Inside the system

32. The angular momentum of a moving body remains. constant, if

(a) Net external force is applied (b) Net pressure is applied

(c) Net external torque is applied (d) Net external torque is not applie

ANSWER KEY

1. (d) 2. (b) 3. (d) 4. (d) 5.(d) 6. (a) 7. (d) 8. (b) 9. (a) 10. (c)
11. (c) 12. (c) 13. (a) 14. (d) 15. (b) 16. (a) 17. (a) 18. (d) 19. (c) 20. (d)
21. (c) 22. (b) 23. (a) 24. (d) 25. (b) 26. (b) 27. (c) 28. (b) 29. (b) 30. (d)
31. (c) 32. (d)

SUBJECTIVE QUESTIONS

1. Define moment of inertia **[HP BOARD 2018, 2021]**

2. What is physical significance of momentum of inertia.

3. Does moment of inertia of rigid body change with speed of rotation? Explain

4. What is the SI unit of moment of inertia?

5. On what factors does the moment of inertia depend.

6. Derive relation between torque and moment of inertia.

7. Derive the relation between angular momentum and moment of inertia.

8. A cat is able to land on its feet after a fall, why?

9. Define centre of mass. What will be the position of centre of mass of two particles of equal masses, moving opposite to each other the same velocity? **(H. P. B. 2008)**

10. Where does the centre of mass of rectangle lie? **(H. P. B. 2003)**

11. Define the term radius of gyration of a body about an axis of rotation. **(H. P. B. 2003 C)**

12. Define angular momentum **(H. P. B. 2004 C)**

13. What is torque? Give its SI unit . **(H. P. B. 2004, 2004 C, 2005 C)**

14. Why is handle provided at near the edge of plank of door? **(H. P. B. 2005 C)**

15. What is turning effect of force called? On what factors does the turning effect of force depend. **(H. P. B. 2013)**

16. Does centre of mass lie inside a body? Justify. **(H. P. B. 2001)**

17. State and explain the Law of Conservation of angular momentum. Give S.I. unit of angular momentum. **(H. P. B. 2005, 2010)**

18. If no external torque acts on a body, will its angular velocity remain constant. **(H. P. B. 2006)**

19. If angular momentum is conserved in a system, whose moment of inertia is decreased, will its rotational kinetic energy be also conserved? Explain your answer. **(H. P. B. 2006)**

20. Discuss the motion of center of mass in earth-moon system revolving around the sun.(H P B. 2006 C)

21. Does the momentum of inertia of a rigid body change with the speed of rotation? Explain **(H. P. B. 2009)**

22. A person with heavy weights in his hands close to the chest is standing on a rotating turn table. When he stretches his hands, the speed of rotation of the turn table. **(H. P. B. 2008)**

23. If the torque acting on the particle about origin is zero, what can we say about the angular momentum of the particle about the origin. **(H. P. B. 2008)**

24. Can a torque be balanced by a single force? Explain. **(H. P. B. 2009)**

25. What is the position of centre of mass in case of the following bodies?

(i) Uniform rod (ii) Cylinderical body (iii) conical body (iv) Circular ring **(H. P. B. 2011)**

26. Explain, why it is difficult to open door by pushing or pulling it near the hinge **. (H. P. B. 2011)**

27. While turning the page of a book, we usually apply force perpendicular to the plane of the page at the farthest end. Explain. **(H. P. B. 2011)**

28. Find a relation between moment of inertia and torque. **(H. P. B. 2002, 2004, 2002, 2003, 2004)**

29. Find a relation between momentum of inertia and angular momentum . **(H. P. B. 2002, 2003)**

30. Define angular momentum. Show that the angular momentum is equal to twice the product of mass and areal velocity? **(H. P. B. 2004, 2006, 2007)**

31. Which physical quantities are represented by the following?

(i) Product of moment of inertia and the angular velocity.

(ii) Product of moment of inertia and the angular acceleration.

32. Obtain an expression for kinetic energy of a rotating body and hence, define moment of inertia.

33. A girl is swinging in a swing in the sitting position. How will the time period of the swing be affected, if she stands up?

34. Explain why the speed of innermost layer of a whirl wind in a tornado is alarmingly high?

35. Derive relation between kinetic energy of rotation and moment of inertia.

10. GRAVITATION

OBJECTIVE QUESTIONS

1. Let M denote the mass of Earth and Let R denote its radius. The ratio g/G at earth's surface is
(a) R^2/M (b) M/R^2 (c) MR^2 (d) M/R **(H. P. B 2013)**

2. The force of gravitation is
(a) repulsive (b) electrostatic (c) Conservative (d) non-conservative
(H. P. B 2011, 14)

3. If V_e and V_0 represent the escape velocity and orbital velocity of a satellite corresponding to a circular orbit of radius R (= radius of earth), then (H. P. B 2011)
(a) $V_e = V_0$ (b) $V_e = \sqrt{2}\, V_0$ (c) $V_e = \frac{V_0}{\sqrt{2}}$ (d) V_e amd V_0 are not related

4. If the mass of the body is 'M' on the earth surface, then mass of the same body on the moon is
(a) $\frac{M}{6}$ (b) zero (c) M (d) none of these **(H. P. B 2013)**

5. An astronaut weighing 60kg goes to the space in a spacecraft. Then, what will happen to the weight of the astronaut?
(a) Decreases (b) Increases (c) Remain same (d) zero **(H. P. B 2013)**

6. The acceleration due to gravity at the centre of earth is
(a) 9.8 m s^{-2} (b) 4.9 m s^{-2} (c) zero (d) None of these **(H. P. B 2015)**

7. If we move form equator to pole, the value of acceleration due to gratuity
(a) First increase then decreases (b) Remains (c) Increase (d) Decreases
(H. P. B 2017)

8. When a body is taken to the moon from the earth then
(a) its mass and weight both decreases
(b) its mass increases but weight decreases
(c) its mass decreases but weight increases
(d) its mass remains the same but its weight decreases **(H. P. B 2018)**

9. The mass of an object:
(a) is slightly different at different locations on Earth
(b) is a vector
(c) is independent of the acceleration due to gravity
(d) is the same for all objects of the same size and shape.

10. What is the rank of the earth in the solar system in terms of size ?
(a) third (b) fourth (c) fifth (d) sixth.

11. In the formula = $\frac{Gm_1 m_2}{r^2}$, the quantity G:
(a) depends on the local value of g
(b) is used only when Earth is one of the two masses
(c) is greatest at the surface of Earth
(d) is a universal constant of nature

12. Let M denote the mass of Earth and let R denote its radius. The ratio g/G at Earth's surface is:
(a) R^2/M (b) M/R^2 (c) MR^2 (d) M/R

13. The time period of a parking orbit is
(a) 6 hours (b) 12 hours (c) 18 hours (d) 24 hours

14. Inside a satellite, a body can be weighed by
(a) spring balance (b) beam balance (c) any of the above (d) none of the above
(H.P.B. 2013)

15. In order to find time, the astronaut orbiting in an earth satellite should use
(a) pendulum clock
(b) a watch having hair spring
(c) either pendulum clock or a watch
(d) neither a pendulum clock nor a watch

16. The term Geostationary is connected with
(a) stationary satellite (b) artificial satellite (c) moving satellite (d) ordinary artificial

17. An astronaut feels his weight in space
(a) smaller than on earth (b) greater than on earth
(c) indefinite (d) nil

18. A satellite appears to be at rest when seen from the equator. Its height from earth's surface is nearly
(a) 3200 km (b) 6400 km (c) 12800 km (d) 36000 km

19. Ratio of inertial mass of gravitational mass is
(a) 0.5 (b) 1 (c) 2 (d) non fixed number

20. Which of the following statements is true?
(a) g is less at the earth's surface than at a height above it or a depth below it
(b) g is the same at all places on the surface of the earth
(c) g has its maximum value at the equator
(d) g is greater at the poles than at the equator.

21. An astronaut in an earth satellite will observe sky as
(a) deep red (b) sky blue (c) deep blue (d) black

22. If we remove the atmosphere of earth then the duration of day will
(a) increase (b) decrease (c) will remain same (d) depends upon season

23. According to Kepler's laws, which of the following is correct? (where T is the time period of rotation around sun and R is the average distance between planet and sun).
(a) $T^2 \propto R^{3/2}$ (b) $T^2 \propto R^3$ (c) $T^2 \propto R^{2/3}$ (d) $T^2 \propto R^2$

24. A planet which is twin sister of earth is
(a) Mercury (b) Venus (c) Mars (d) Jupiter

25. G is a constant and it called due to universal gravitational constant and g is a variable called the acceleration due to gravity. For a planet g varies with shape, as we go up above the surface of earth and as we go down deep into the same and equal $6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$
Now answer the following questions

(i) G is called universal constant because its value is
(a) the same everywhere
(b) varies from place to place
(c) it is ultimate constant of nature
(d) its value is equal to the value of g

(ii) The value of acceleration due to gravity is maximum
(a) on the surface of earth (b) below the surface of earth
(c) above the surface of earth (d) at the centre of earth

26. The maximum velocity required by a body to overcome the gravitational pull of earth is called the mass of the body. It depends upon the mass and radius of the planet and is given by $v = \sqrt{\frac{2GM}{R}}$. For earth the value of escape velocity is 11.2 $km\ s^{-1}$
Read the above paragraph and answer the following

(i) A body will overcome the gravitational pull of earth if it is projected with a velocity
(a) 10 $km\ s^{-1}$ (b) 11 $km\ s^{-1}$ (c) 12 $km\ s^{-1}$ (d) 0.

(ii) Assuming that the mass of a planet is 4 times the mass of earth and its radius is 16 times as that of earth, the escape velocity on the planet is
(a) 2.8 $km\ s^{-1}$ (b) 5.6 $km\ s^{-1}$ (c) 7.8 $km\ s^{-1}$ (d) 11.2 $km\ s^{-1}$

27. The gravitational force between two bodies as an action-reaction force. It does not depend upon the nature of the intervening medium. As a result we cannot depend upon the presence or absence of other bodies. It is an inverse square force and holds good for both small and large distances. It is always attractive in nature
Read the above passage and answer the following questions.

(i) Gravitational force should directly obey
(a) Newton's first law of motion
(b) Newton's second law of motion
(c) Hooke's law
(d) Newton's third law of motion

(ii) The force of attraction F acts between 1 kg cotton and 4 kg rubber. A 5 kg iron piece is now placed in between the two. The new force between cotton and rubber is now
(a) F (b) 2F (c) 3F (d) 4F

ANSWER-KEY

1. (b) 2. (c) 3. (b) 4. (c) 5. (d) 6. (c) 7. (c) 8.(d) 9.(c) 10.(c)
11.(d) 12.(b) 13.(d) 14.(d) 15.(b) 16.(a) 17.(a) 18.(d) 19.(b) 20.(d)
21.(d) 22.(c) 23.(b) 24.(b) 25.i.(a) ii.(a) 26. i.(c) ii.(b) 27.i.(d) ii.(a)

SUBJECTIVE QUESTIONS

1. What is the difference between 'g' and G? **(H. P. B 2002)**

2. State Newton's law of gravitation and define the universal gravitational constant. **(H. P. B 2003, c)**

3. Which is greater-attraction of Earth for 1 kg of lead or attraction of 1 kg of lead for earth **(H. P. B 2002)**

4. What is acceleration due to gravity? **(H. P. B 2008)**

5. What is the value of 'G' and 'g'?

6. What is the weight of a body at the centre of earth? **(H. P. B 2005)**

7. Where does the body weigh more – at the surface of the earth or in a moon? **(H. P. B 2005)**

8. Why weight of body become zero at the centre of earth? **(H. P. B 2005 C)**

9. What provides the centripetal force to a satellite revolving round the earth? **(H. P. B 2011)**

10. A body weighs 90kg on the surface of the earth. How much will it weigh on the surface of mars, whose radius is 1/2 & mass 1/9 of that of earth? **(H. P. B 2001)**

11. Moon has no atmosphere. Why? **(H. P. B 2003, 14)**

12. Explain why a 5 kg body weigh more at poles and less at the equator? **(H. P. B 2003, 2018)**

13. Define the universal gravitational constant.

14. Express Newton's law of gravitational in vector form. Derive Newton's third law of motion.

15. What is acceleration due to gravity? Find expression for it.

16. Give the value of g in CGS and FPS system.

17. Show that the value of acceleration due to gravity decrease with altitude.

18. Show that value of acceleration due to gravity decrease with depth.

19. Explain why a tennis ball bounces higher on hills than in the plains?

20. The value of acceleration due to gravity on the surface of earth in 9.8 m s^{-2} . Calculate the value of 'g' at a height of 100 km above the surface of earth. Given the radius of earth = 6400 km.

21. Find the value of 'g' at a height 400 km, above the surface of earth. Given radius of earth, R = 6400 km and the value of 'g' at the surface of earth is 9.8 m s^{-2}.

22. The acceleration due to gravity at depth 'd' reduces by 25 % from the value at the surface. Calculate the value of 'd' if radius of earth is 6,400 km.

23. What is the relation between height h and depth d for the same change in the value of g?

24. Explain, why one can jump higher on the surface of moon than on the earth?

25. Explain, why 1 kg mass of salt weighs move at pole and less at equator?

26. Distinguish between mass and weight.

27. Define gravitational field and intensity of gravitational field. What is the SI unit of gravitational field?

28. Derive an expression for gravitational potential energy of body of mass M at distance r form centre of earth.

29. Define escape velocity. Obtain an expression for the escape velocity of a body form the surface of earth.

30. The escape velocity of a plant given 22.4 km s^{-1}. Find the escape velocity of another planet having mass 1500 times and radius 15 times that of first planet.

31. Calculate the escape velocity for a particle 1600 km above earth's surface. Given g = 9.8 m/s^2 and R = 6400 km.

32. What is a satellite?

33. What is an artificial satellite?

34. Define orbital velocity and the time period of a satellite. Derive expressions for these.

35. A satellite revolve around the earth at a height of 1000 km. The radius of earth is 6.38 x 10^3 km. Mass of earth is 6 x 10^{24} kg and G = 6.67 x 10^{-11} $Nm^2 Kg^{-2}$. Find the orbital velocity and period of revolution.

36. Find the expression for energy of an orbiting satellite.

37. A satellite orbits the earth at a height of 400 km above the surface. How much energy must be expended to rocket the satellite out of the earth's gravitational influence? Mass of the satellite = 200 kg, mass of the earth 6 x 10^{24} kg, radius of earth = 6.4 x 10^6 m, G = 6.67 x 10^{-11} N $m^2 kg^{-2}$

38. Distinguish between inertial mass and gravitational mass.

39. Why 'G' is called universal constant?

40. Write down Kepler's Laws of planetary motion.

41. State & prove Kepler's 3rd law of planetary motion.

11. MECHANICAL PROPERTIES OF SOLID

OBJECTIVE QUESTIONS

1. The volumetric strain is inversely proportional to
(a) compressibility (b) normal stress (c) bulk modulus (d) tangential stress

2. The substance which is nearly perfectly elastic is:
(a) phosphor bronze (b) copper (c) silver (d) rubber

3. Which one of the following has the highest elasticity?
(a) plastic (b) steel (c) copper (d) rubber

4. Units of Bulk modulus can be
(a) N (b) Nm^{-1} (c) Nm (d) Nm^{-2}

5. Hooke's law is valid
(a) for all types of bodies (b) for perfectly elastic bodies with in elastic limit
(c) for perfectly inelastic bodies beyond elastic limit (d) None of the above

6. The Young's modulus of a perfectly rigid body is
(a) unity (b) zero (c) infinity (d) None of these

7. According to Hooke's law, the force required to change the length of a wire by $'l'$ is proportional to
(a) l^{-2} (b) l^{-1} (c) l (d) l^2

8. A spring is stretched by applying a load to its free end. The strain produced in the spring is :
(a) Volumetric (b) Shear (c) Longitudinal and Shear (d) Longitudinal

9. SI unit of tensile stress
(a) N m $^{-2}$ (b) N m (c) N m $^{-1}$ (d) N m $^{-3}$

10. Match the quantity in Column I with its definition in Column II

Column I	**Column II**
(a) Longitudinal strain	(1) Restoring force per unit area
(b) Shear strain	(2) Ratio of change in length to the original length
(c) Volumetric strain	(3) Ratio of change in volume to the original volume
(d) Stress	(4) Ratio of lateral displacement to the distance between Two parallel faces.

(A) (a)-1 (b)-2 (c)-3 (d)-4 (B) (a)-2 (b)-4 (c)-3 (d)-1
(C) (a)-4 (b)-1 (c)-2 (d)-3 (D) (a)-3 (b)-2 (c)-4 (d)-1

11. Match the quantity with its definition in the following table

Column I	Column II
(a) Young's Modulus	(1) $\frac{Stress}{Strain}$
(b) Bulk Modulus	(2) $\frac{\text{Tangential stress}}{\text{shear strain}}$
(c) Shear Modulus	(3) $\frac{\text{Normal stress}}{\text{Volumeteric strain}}$
(d) Hooke's law	(4) $\frac{\text{Normal stress}}{\text{Longitudinal strain}}$

(A) (a)-1 (b)-2 (c)-3 (d)-4 (B) (a)-2 (b)-4 (c)-3 (d)-1
(C) (a)-4 (b)-3 (c)-2 (d)-1 (D) (a)-3 (b)-2 (c)-4 (d)-1

ANSWER KEY

1.(b) 2.(a) 3.(b) 4.(d) 5.(d) 6.(c) 7.(c) 8.(c) 9.(a) 10.(b) 11.(c)

SUBJECTIVE QUESTIONS

1. What is a plastic body? **(H.P.B. 2002)**

2. What is meant by elasticity? **(H.P.B. 2002)**

3. State Hooke's law. **(H.P.B. 2003)**

4. What is elastic after effect? **(H.P.B. 2003)**

5. Why do spring balances show wrong reading after long use? **(H.P.B. 2006, 2008)**

6. Define deforming force and restoring force. **(H.P.B. 2007)**

7. Why bridge are declared unsafe after long use? **(H.P.B. 2003, 2010, 2015)**

8. Define Young's modulus, modulus of rigidity and explain why do spring balance show wrong reading after long use. **(H.P.B. 2005)**

9. Define elastic limit and elastic fatigue. What are ductile and brittle substances. **(H.P.B. 2006)**

10. Why steel is more elastic than rubber? **(H.P.B. 2006, 2007, Model Question Paper 2013, 2016)**

11. Define Young's modulus and Bulk modulus and give their SI units. **(H.P.B. 2004 C)**

12. Define elastic limit and elastic fatigue. What are ductile and brittle substances ? **(H.P.B. 2006)**

13. A piece of copper having a rectangular cross-section of 15.2 mm× 19.1 mm is pulled in tension with 44,500 N force producting only elastic deformation. Calculate the resulting strain. Given shear modulus of elasticity of copper 42×10^9 N m $^{-2}$. **(H.P.B. 2024)**

14. Define the terms stress and strain and also state their SI units. Draw the stress versus strain graph for a metallic wire, when stretched up to the breaking point. **(H.P.B. 2024)**

15. What is the Young's modulus and Bulk modulus for a perfect rigid body? **(H.P.B. 2023)**

16. It is possible to double the length of a metallic wire by applying a force over it ?

17. What are the two factors on which the modulus of elasticity depends?

18. What do you understand by yield point?

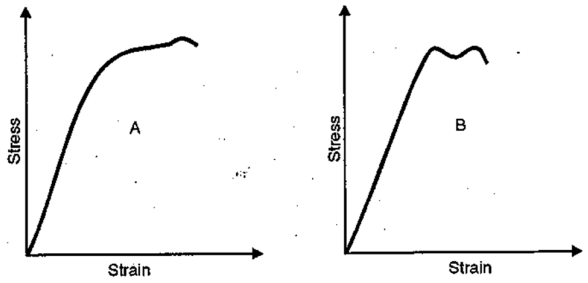
19. Which of the three states : solid, liquid gas has the three types of the elasticity.

20. What is the reciprocal of Bulk modulus?

21. How does Young's modulus change with the rise in temperature?

22. The stress-strain graphs for materials A and B are shown in Figure

The graphs are drawn to the same scale:



(a) Which of the material has greater Young's modulus?

(b) Which materials is more ductile?

(c) Which is more brittle?

(d) Which of the two is stronger material?

12. MECHANICAL PROPERTIES OF FLUID

OBJECTIVE EXERCISE

1. Bernoulli's equation is the equation at which follows laws of
(a) conservation of mass (b) conservation of linear momentum
(c) conservation of energy (d) conservation of angular momentum

2. The most characteristic property of a liquid id
(a) elasticity (b) fluidity (c) formlessness (d) volume conservation

3. Powder clings to the skin '
(a) because of compression (b) because of cohesion
(c) because of adhesion (d) because of capillary action

4. The shape of the liquid meniscus in a capillary tube placed in a liquid that does not wet the surface of the tube is
(a) flat (b) convex upward (c) concave upward (d) none of the above

5. In a capillary tube is replaced by a tube of insufficient length, water will
(a) not rise (b) change the meniscus (c) overflow (d) fall down

6. For a liquid which does not wet the glass, the angle of contact is
(a) less than 90° (b) more than 90° (c) 0° (d) none of these

7. With the increase in temperature, the viscosity of a liquid
(a) increases (b) decreases (c) remain constant (d) may increase or decrease

8. With the increase in temperature, the viscosity of a gas
(a) increases (b) decreases (c) remain constant (d) may increase or decrease

9. A small and a large rain drop are falling through air. Which of the drops will move faster?
(a) small rain drops (b) large rain drops
(c) both the drops move with the same speed (d) data insufficient

10. Viscosity is closed related to
(a) inertia (b) shearing strain (c) friction (d) none of these

11. One decapoise is equals to :
(a) 10 poise (b) 1/10 centipoise (c) 1000 poise (d) 100 centipoise

12. The lift in an aeroplane is based on
(a) Archimede's principle (b) Pascal's law
(c) Torricelli's theorem (d) Bernoulli's principle . (H.P.B. 2019)

13. Ball pen works on the principle of
(a) Viscosity (b) Boyle's law (c) Gravitational force (d) Capillarity
(H.P.B. 2008)

14. If the area of cross-section of the pipe increases, the velocity of flow of the liquid
(a) Increases (b) decreases (c) Remains the same (d) Becomes zero

15. Which of the following substance has the greatest viscosity?
(a) Air (b) Hydrogen (c) Water (d) Mercury

16. Height of a liquid in a capillary tube is
(a) directly proportional to radius of capillary tube
(b) inversely proportional to radius of capillary tube
(c) independent of radius of tube
(d) None of these

17. Viscosity is the internal property of the liquids and gases, which is more closely related to
(a) Elasticity (b) Inertia (c) Surface tension (d) Friction

18. When area of cross-section of a pipe decreases, the velocity of flow of liquid
(a) increases (b) decreases (c) becomes zero (d) remains same (H.P.B. 2011)

19. S.I. unit of coefficient of viscosity is :
(a) $N\,s^{-1}\,m^{-1}$ (b) Nsm^{-2} (c) Nsm^{-1} (d) Nm (H.P.B. 2022 Term-II)

20. Dimensional formula of surface tension is
(a) $[MLT^{-2}]$ (b) $[ML^0\,T^{-2}]$ (c) $[ML^0\,T^{-1}]$ (d) $[M^{-1}\,LT^{-2}]$
(H.P.B. 2022 Term-II)

21. Assertion: Hot soup takes better than the cold soup.
Reason : Hot soup has high surface tension and it does not spread propertly. (H.P.B. 2024)
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.
(c) If the assertion is true but the reason is false.
(d) If both the assertion and reason are false.

22. Match the following terms in Column I and Column II

Column I	**Column II**
(a) Hydraulic lift	(1) Solid
(b) Ship in floating on ocean water	(2) Pascal law
(c) Deep water runs slow	(3) Archimedes's principle
(d) Modulus of rigidity	(4) Equation of continuity

(A) (a)-3 (b)-2 (c)-1 (d)-4 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-4 (b)-2 (c)-2 (d)-1 (D) (a)-2 (b)-3 (c)-4 (d)-1

23. Match the following terms in Column I and Column II

Column I	**Column II**
(a)Rain drops are spherical	(1) Perfectly elastic
(b)Heart attack	(2) Capillarity
(c)Quartz	(3) Bernoulli's Theorem
(d)The sand is drier than clay	(4) Surface tension

(A) (a)-4 (b)-3 (c)-1 (d)-2 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-1 (b)-2 (c)-3 (d)-4 (D) (a)-2 (b)-3 (c)-1 (d)-4

24. Match the following terms in Column I and Column II

Column I	**Column II**
(a)Bunsen burner	(1) Bernoulli's Theorem
(b)Hydraulic Brake	(2) Capillary action
(c) Sandy soil is more dry than clay	(3) Pascal law
(d)Spherical sphape of rain drops	(4) Surface tension

(A) (a)-1 (b)-2 (c)-3 (d)-4 (B) (a)-2 (b)-2 (c)-4 (d)-3
(C) (a)-1 (b)-3 (c)-4 (d)-2 (D) (a)-1 (b)-2 (c)-2 (d)-4

25. Match the terms in the two Column given below

Column I	**Column II**
(a) fixed shape and volume	(1) plasma
(b)only fixed volume but not fixed shape	(2) solid
(c)neither fixed volume nor fixed shape	(3) liquid
(d)ionized form	(4) gas

(A) (a)-4 (b)-3 (c)-1 (d)-2 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-1 (b)-2 (c)-3 (d)-4 (D) (a)-2 (b)-3 (c)-4 (d)-1

26. Match the explanation with the reason in the two sides of the following table:

Column I	**Column II**
(a)A bubble bursts after some time	(1) surface tension
(b)A small insect floats on the water surface	(2) Pressure
(c) Tractors have broader tyres	(3) Excess of pressure
(d)Oil rises in the wick of a lamp	(4)Capillary action

(A) (a)-3 (b)-2 (c)-1 (d)-4 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-4 (b)-3 (c)-2 (d)-1 (D) (a)-2 (b)-3 (c)-4 (d)-1

27. Match the Column I and II given below:

Column I	**Column II**
(a) Rate of flow or liquid	(1) Stoke's law
(b) Force acting on a body having a critical velocity	(2) Compressibility
(c) Reciprocal of Bulk modulus	(3) Bernoulli's Theorem
(d)During storms, the roots fly off	(4) Poisenuille's relation

(A) (a)-2 (b)-4 (c)-3 (d)-1 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-4 (b)-1 (c)-2 (d)-3 (D) (a)-1 (b)-3 (c)-2 (d)-1

ANSWER KEY

1.(c) 2.(d) 3.(c) 4.(b) 5.(b) 6.(b) 7.(b) 8.(a) 9.(c) 10.(c)
11.(a) 12.(d) 13.(a) 14.(b) 15.(d) 16.(d) 17.(d) 18.(a) 19.(a) 20.(b)
21.(c) 22.(d) 23.(a) 24.(d) 25.(d) 26.(b) 27.(c)

SUBJECTIVE EXERCISE

1. Why mercury does not wet glass? **(H.P.B. 2004)**

2. Explain why two streamlines cannot cross each other? **(H.P.B. 2004)**

3. Why hot soup taste better than cold soup? **(H.P.B. 2004)**

4. Why air bubble in a liquid move in an upward direction? **(H.P.B. 2007, 2017)**

5. We can cut an apple easily with a sharp knife than a blunt knife. Explain. **(H.P.B. 2009)**

6. Why the roofs of houses are blown off during thunderstorm? **(H.P.B. 2016**

7. Find an expression for excess pressure inside soap bubble. **(H.P.B. 2001, 2006, 2009)**

8. Explain the phenomenon of surface tension on the basis of the molecular theory. **(H.P.B. 2003)**

9. Define coefficient of viscosity, Distinguish between viscosity and solid friction. **(H.P.B. 2004)**

10. Give the principle and explain the working of hydraulic brakes. **(H.P.B. 2004)**

11. Derive an equation of continuity for the steady flow of incompressible liquid. **(H.P.B. 2008)**

12. Define surface tension. Give its units. Explain **(H.P.B. 2005)**

13. Give the principle and working of an atomizer. **(H.P.B. 2010)**

14. Water rises in a capillary tube, whereas mercury falls in the same tube. Explain **(H.P.B. 2011)**

15. What do you mean by the fluid pressure? Derive an expression for the pressure due to a fluid column of height "h". **(H.P.B. 2011)**

16. A 50 Kg girl wearing high heel shoes balances on a single heel. The heel is circular with a diameter of 1.0 cm. What is the pressure exerted by the heel on the horizontal floor? **(H.P.B. 2023)**

17. State Pascal's law and give experimental proof of Pascal's law. **(H.P.B. 2023)**

18. What is Stoke's law? Find an expression for it. **(H.P.B. 2023)**

19. What is terminal velocity? **[H.P.B. 2022)**

20. Find an expression for terminal velocity attained by the spherical body falling through a viscous medium. **[H.P.B. 2022 (Term – II)]**

21. What is a capillary tube? Also define capillarity. **[H.P.B. 2022 (Term – II)]**

22. Derive an expression for rise of liquid in a capillary tube. **[H.P.B. 2022 (Term – II)]**

23. Find an expression for excess pressure inside soup bubbles. **(H.P.B. 2001 C, 2006 C, 2009)**

24. Define coefficient of viscosity. Distinguish between viscosity and solid friction. **(H.P.B. 2004 C)**

25. Define surface tension. Give its units. Explain **(H.P.B. 2008 C, Model Question Paper 2013)**

26. What do you mean by the fluid pressure? Derive an expression for the pressure due to a find column of height "h". **(H.P.B. 2011)**

27. A 50 kg girl wearing high heel shoes balances on a single heel. The heel is circular with a diameter 1.0 cm. What is the pressure exerted by the heel on horizontal floor? **(H.P.B. 2023)**

28. Derive the relation between surface tension and surface energy. **(H.P.B. 2015)**

13. THERMAL PROPERTIES OF MATTER

OBJECTIVE QUESTIONS

1. At $4°C$, given mass of water has maximum
(a) Heat (b) Volume (c) Energy (d) Density **(H.P.B. 2008)**

2. The amount of thermal radiations emitted from unit area of a perfectly black body in one second is proportional to
(a) T (b) T^2 (c) T^3 (d) T^4 **(H.P.B. 2009)**

3. Woolen clothes keep the body warm, because wool
(a) is bad conductor of heat (b) increase the temperature of body
(c) decreases the temperature of body (d) None of these

4 . Match the terms in Column I and II given below:

Column I	Column II
(a) Conduction	(1) Cooling of room by an air conditioner
(b) Convection	(2) Heating of earth's surface by sun
(c) Radiation	(3) A small gap is left between the two iron rails
(d) Thermal expansion	(4) Wooden handles are provided to cooking utensils

(A) (a)-2 (b)-4 (c)-3 (d)-1 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-4 (b)-1 (c)-2 (d)-3 (D) (a)-1 (b)-3 (c)-2 (d)-1

ANSWER KEY
1.(d) 2.(d) 3.(a) 4.(c)

SUBJECTIVE QUESTIONS

1. Distinguish between temperature and heat. **(H.P.B. 2001)**
2. Derive Newton's law of cooling from Stefan's law. **(H.P.B. 2001)**
3. Why a thick glass tumbler often cracks, when boiling water is poured in it? **(H.P.B. 2010)**

4. Derive Newton's law of cooling from Stefan's law. **(H.P.B. 2001 C)**
5. Define (a) Coefficient of linear expansion. **(H.P.B. 2005)**

6. Derive an expression for the coefficient of thermal conductivity and hence define it. **(H.P.B. 2003)**
7. Define the two specific heats of a gas. Why is $C_P > C_V$? **(H.P.B. 2004, Similar 20036 C)**

8. State and explain three modes of transference of heat. How the loss of heat due to these modes is minimized in a Thermos flask? **(H.P.B. 2005)**

9. What do you mean by thermal expansion? Explain coefficient of linear, superficial and cubical expansion.

10. What mercury is used in thermometer? **(H.P.B. 2002 C)**

11. In laying a railway line a small gap is always left between the iron rails. Why? **(H.P.B. 2002)**

12. Ten gets cooled when sugar is added to it, why? **(H.P.B. 2002)**

13. Why springs are made of steel and not of copper? **(H.P.B. 2003, 2010)**
14. Why is a new quilt warmer than an old one? **(H.P.B. 2004 C)**
15. Why stainless steel vessels are preferred with extra copper plating at the bottom? **(H.P.B. 2007)**
16. Animals curl into a ball when there is very cold. Why? **(H.P.B. 2007)**
17. At what temperatures, the reading of the Celsius and Fahrenheit scales coincide? **(H.P.B. 2003, 2007)**

14. HEAT AND THERMODYNAMICS

OBJECTIVE QUESTIONS

1. The evidence that a gas consists mostly of empty space is :
(a) the density of a gas becomes much greater when it is liquefied
(b) gases exert pressure on the walls of their containers
(c) heating a gas increase the molecular motion
(d) gases are transparent

2. An isothermal process for an ideal gas is represented on a $P-V$ diagram by:
(a) a horizontal line (b) a portion of a hyperbola
(c) a portion of an ellipse (d) a portion of a parabola.

3. A real gas is changed slowly from state 1 to state 2 during which no work is done on or by the gas. This process must be :
(a) isothermal (b) adiabatic (c) isovolumic (d) isobaric

4. The specific heat at constant pressure is greater than that of the same gas at constant volume because
(a) at constant pressure work is done in expanding the gas
(b) at constant volume work is done in expanding the gas
(c) the molecular attraction increases more at constant pressure
(d) the molecular vibration increases more at constant pressure

5. During a reversible adiabatic expansion of an ideal gas, which of the following is NOT true?
(a) ${}_{\mathrm{p}}V^{\Upsilon}$ =constant (b) $p^{V} = n\mathrm{RT}$ (c) p^{V} = constant (d) W = $\int pd\ V$.

6. Compressed air in the tube of a wheel of a cycle at normal temperature suddenly starts coming out from a puncture. The air inside
(a) starts becoming hotter (b) remains at the same temperature
(c) starts becoming cooler (d) may become hotter or cooler depending upon the amount of water vapour present

7. According to first law of thermodynamics
(a) heat neither enters nor leaves the system (b) heat is constant in isothermal system
(c)energy is conserved (d) none of these **(H.P.B. 2024)**

8. The internal energy of an ideal gas depends on
(a) Volume (b) Pressure (c) Temperature (d) Size of the molecule

9. Consider the processes A and B shown in the figure. Then
(a) A is adiabatic and B is isothermal (b) A is isothermal and B is adiabatic
(c) both the processes are isothermal (d) both the processes are adiabatic

10. According to the second law of thermodynamics
(a) all heat engines have the same efficiency
(b) all reversible heat engines have the same efficiency
(c) the efficiency of any heat engine is independent of its working substance

(d) the efficiency of a carnot engine depends only on the temperature of the two reservoirs

11. A gas performs minimum work when it expands
(a) adiabatically (b) isothermally (c) isobarically (d) isochorically

12. The first law of thermodynamics is based on the law of conservation of
(a) Mass (b) Momentum (c) Energy (d) Angular momentum

13. Internal energy of an ideal gas depends upon
(a) Volume (b) Temperature (c) Pressure (d) Temperature and volume

14. The S.I. unit of Joule's mechanical equivalent of heat is
(a) Joule/ calorie (b) Erg/calorie (c) Joule× Calorie (d) Erg× Calorie

15. Which of the following formulae is wrong?
(a) $C_v = \frac{R}{\Upsilon-1}$ (b) $C_p = \frac{\Upsilon R}{\Upsilon-1}$ (c) $\frac{C_p}{C_v} = \Upsilon$ (d) $C_p - C_v = 2R$

16. The 1 st law of thermodynamics confirms the law.
(a) Conservation of momentum of molecules (b) Conservation of energy
(c) Flow of heat in a particular direction (d) Conservation of heat and mechanical energy

17. In adiabatic expansion of gas
(a) Heat is neither lost nor gained (b) Heat is gained or lost
(c) Temperature is kept constant (d) Volume is kept constant

18. The temperature of system decreases in the process of
(a) free expansion (b) adiabatic expansion
(c) isothermal expansion (d) isothermal compression

19. A gas in a vessel expands, its internal energy decreases. The process involves is :
(a) Isothermal (B) Isobaric (c) Adiabatic (d) Isochoric

20. Boyle's law is applicable for an
(a) Isothermal process (b) Adiabatic process (c) Isobaric process (d) Isochoric process

ASSERTION & REASON TYPE QUESTION

Select the most appropriate answer from the options given below.

(i) Both A and R are true and R is the correct explanation of A.
(ii) Both A and R are true but R is not the correct explanation of A.
(iii) A is true but R is false
(iv) Both A and R are false

21. **Assertion (A) :** In real world, we cannot find a reversible system.
Reason (R) : Most of processes in the real world occur with dissipation of energy

22. **Assertion (A) :** Zeroth law gives us the concept of energy.
Reason (R) : Energy does not depend upon temperature.

23. **Assertion (A) :** First law of thermodynamics is only a restatement of law of conservation of energy
Reason (R) : Energy is a fundamental quantity.

24. **Assertion (A) :** A body kept in air loses heat quickly even though air is a bad conductor of heat.
Reason (R) : The heat is lost only due to radiation.

25. **Assertion (A) :** The specific heat of a gas for an adiabatic change is zero.
Reason (R) : Specific heat is directly proportional to the change in heat.

26. **Assertion (A) :** When air is rapidly pumped into the tyre, heat is produced.
Reason (R) : Rapid pumping of air is an adiabatic process.

27. **Assertion (A) :** During an isothermal change, whole of heat energy is converted into work.
Reason (R) : For an isothermal change, temperature remains constant.

ANSWER KEY

1.(a)	**2.(b)**	**3.(c)**	**4.(a)**	**5.(c)**	**6.(c)**	**7.(c)**	**8.(c)**	**9.(b)**	**10.(b)**
11.(d)	**12.(c)**	**13.(b)**	**14.(a)**	**15.(d)**	**16.(b)**	**17.(a)**	**18.(b)**	**19.(c)**	**20.(a)**

ASSERTION & REASON TYPE QUESTION

21.(i)	**22.(iv)**	**23.(iii)**	**24.(iii)**	**25.(i)**	**26.(i)**	**27.(iii)**

SUBJECTIVE QUESTIONS

1. State and explain zeroth law of thermodynamics. **(H.P.B. 2016)**

2. State first law of thermodynamics and apply this law to obtain a relationship between two specific heats of a gas. **(H.P.B. 2023)**

3. Write the two necessary conditions for the system to be reversible. **[H.P.B. 2022 (Term – II)]**

4. Can temperature of a body be raised without heating it? **(H.P.B. 2004C)**

5. Is 'J' a conversion factor? **(H.P.B. 2005C)**

6. What is the effect on the pressure of a gas, if it is compressed at constant temperature? **(H.P.B. 2005C)**

7. What is change in internal energy of a gas which is compressed isothermally? **(H.P.B. 2006)**

8. Explain the need for second law of thermodynamics **(H.P.B. 2001 C, 2014)**

9. What are limitations of first law of thermodynamics? **(H.P.B. 2006 C, 2011)**

10. Give two statements of second law of thermodynamics. Show that they are equivalent. **(H.P.B. 2003C, 2018)**

11. What are reversible and irreversible processes? Give one example of each **(H.P.B. 2005C, 2006C, 2011, 2013)**

12. Define the two specific heat of a gas. Why is $C_P > C_V$? **(H.P.B. 2004)**

13. A gas has two specific heats, whereas a liquid and a solid have only one**?(H.P.B. 2004C)**

14. Explain the reason for cooling when gas expands adiabatically. **(H.P.B. 2004C)**

15. State and explain First law of thermodynamics. Discuss its use in isothermal and Adiabatic process. **(H.P.B. 2014)**

16. Define molar specific heat at constant pressure (C_P) and constant volume (C_V) and deduce a relation between C_P and C_V for a gas. **(H.P.B. 2003, 2004)**

17. Define an isothermal process. Derive an expression for work done during isothermal process. **(H.P.B. 2004C, 2009, 2013)**

18 Define adiabatic and isothermal processes. Calculate the work done in an adiabatic process.

(H.P.B. 2002, 2004C, 2005C)

19. What are the conditions for thermodynamic equilibrium? **(H.P.B. 2022 Term-II)**

20. Why water is preferred to any other liquid in hot water bottles? **(H.P.B. 2024)**

15 . KINETIC THEORY OF GASES

OBJECTIVE QUESTIONS

1. A clear evidence that molecules of a gas are in constant motion is :
(a) winds exert pressure (b) two gases interdiffuse quickly
(c) gases are easily compressed (d) energy as heat is needed to vapourize a liquid

2. The energy of a given sample of an ideal gas depends only on its
(a) pressure (b) volume (c) temperature (d) mass

3. The pressure of a gas, according to the kinetic theory of gases, is due to :
(a) change of kinetic energy of molecules as they strike the wall
(b) change of momentum of molecules as they strike the wall
(c) average kinetic energy of the molecules
(d) rms speed of the molecules

4. For a gas, $\frac{R}{C_v}$ = 0.67. The gas molecules are
(a)monoatomic (b) triatomic (c) diatomic (d) polyatomic

5. The pressure P of a gas and its mean K.E. per unit volume are related as
(a) $P = \frac{1}{2}E$ (b) $P = \frac{2}{3}E$ (c) $P = \frac{3}{2}E$ (d) $P = E$

6. The force applied on the walls of a container containing gas is due to:
(a) the repulsive force between gas molecules
(b) a slight loss in the speed of a gas molecule during a collision with the wall
(c) a change in momentum of a gas molecule during a collision with the wall
(d) elastic collisions between gas molecules

7. The temperature of a gas is most closely related to
(a) the kinetic energy of translation of its molecules
(b) its total molecular kinetic energy
(c) the size of its molecules
(d) the potential energy of its molecules.

8. The average velocity of the molecules in a gas in equilibrium is
(a) proportional to T (b) proportional to $\sqrt{T}$
(c) proportional to T^2 (d) none of these

9. If a gas has n degree of freedom, ratio of principal specific heats of the gas is
(a) $1 + \frac{2}{n}$ (b) $1 + \frac{n}{2}$ (c) $1 - \frac{n}{2}$ (d) $1 - \frac{2}{n}$

10. The number of degree of freedom of a rigid diatomic gas is
(a) 5 (b) 4 (c) 6 (d) 7 **(H.P.B. 2015)**

11. The internal energy of an ideal gas depends on
(a) the temperature and pressure only (b) the pressure only
(c) the volume only (d) the temperature only

12. The root-mean-square speed of molecules in a gas is
(a) the most probable speed
(b) that speed such that half the molecules are moving faster than rms and the other half are moving slower.
(c) the average speed of the molecules (d) none of the above

13. The mean free path of a gas molecule is
(a) the shortest dimension of the containing vessel
(b) the cube root of the volume of the containing vessel
(c) approximately the diameter of a molecule
(d) average distance a molecule travels between intermolecular collisions

14. Degrees of freedom of a monoatomic gas molecule is
(a) 3 (b) 5 (c) 6 (d) 7 **(H.P.B. 2011)**

15. Number of degrees of freedom of a diatomic gas is
(a) 4 (b) 5 (c) 6 (d) 7 **(H.P.B. Model Question Paper 2021)**

16. The degree of freedom of a diatomic gas is
(a) 3 (b) 4 (c) 5 (d) 6 **(H.P.B. 2021)**

17. On what factor does the average kinetic energy of gas molecules depend?
(a) Nature of the gas (b) Temperature
(c) Volume (d) Mass **(H.P.B. 2022 Term-II)**

18. A pressure cooker reduces cooking time for food because
(a) heat is more evidently distributed in the cooking space
(b) cooking involves chemical changes helped by a rise in temperature
(c) boiling point of water involved in cooking is increased
(d) the higher pressure inside the cooker crushes the food material

19. The ratio of specific heats (Υ) of diatomic gas is
(a) $\frac{3}{5}$ (b) $\frac{5}{7}$ (c) $\frac{7}{9}$ (d) $\frac{7}{5}$

ASSERTION & REASON TYPE QUESTION

Select the most appropriate answer from the options given below.
(i) Both A and R are true and R is the correct explanation of A.
(ii) Both A and R are true but R is not the correct explanation of A.
(iii) A is true but R is false.
(iv) Both A and R are false.

20. **Assertion (A) :** The ratio of kinetic energies of hydrogen and helium at constant temperature is 1.
Reason (R) : The kinetic energy of a gas is a function of temperature alone.

21. **Assertion (A) :** Gases are always in random motion and do not settle to the bottom of a container.
Reason (R) : Gases have a high kinetic energy

22. **Assertion (A) :** RMS speed and most probable speed of the molecules of a gas are equal
Reason (R) : The Maxwell distribution of speeds of molecules of a gas is symmetrical.

23. **Assertion (A) :** A contains containing a gas is in motion. If it suddenly stops, temperature of gas will increase.
Reason (R) : The kinetic energy of motion of the gas is converted into the kinetic energy of random motion of molecules.

24. **Assertion (A) :** According to kinetic energy theory, all molecular motion stops at $0°C$
Reason (R) : $0°C$ is the absolute zero temperature.

25. **Assertion (A) :** When a gas is filled in a balloon at constant temperature, its volume increases.
Reason (R) : At constant pressure, volume of a given mass of a gas is directly proportional to the absolute temperature of the gas.

26. **Assertion (A) :** The total kinetic energy of all molecules of a given mass of an ideal gas is $\frac{3}{2}$ times the product of its pressure and its volume.
Reason (R) : The molecules of a gas collide with each other and the velocities of molecules change due to collision.

ANSWER KEY

1.(b) 2.(c) 3.(b) 4.(a) 5.(b) 6.(c) 7.(a) 8.(b) 9.(a) 10.(a)
11.(a) 12.(d) 13.(d) 14.(a) 15.(c) 16.(c) 17.(b) 18.(c) 19.(d)
ASSERTION & REASON TYPE QUESTION
20.(i) 21.(i) 22.(iv) 23.(i) 24.(iv) 25.(ii) 26.(ii)

SUBJECTIVE QUESTIONS

1. State the postulates of kinetic theory of gases. **[H.P.B 2023]**

2. Derive an expression for pressure exerted by an idea of gas. **[H.P.B 2022 Term -II)**

3. What is the kinetic interpretation of temperature? **[H.P.B 2009, 2010, 2017, 2023]**

4. Give equation of a state for one mole of an ideal gas. **(H.P.B. 2010)**

5. Derive the relation between Pressure and mean K.E. of the gas. **(H.P.B. 2005)**

6. All molecular motion ceases at zero kelvin(0K). Explain. **(H.P.B. 2006C)**

7. Calculate the r.m.s. velocity of oxygen molecules at S.T.P. The molecular weight of oxygen is 32. **(H.P.B. 2005C, 2010)**

8. Calculate the r.m.s velocity of air molecules at S.T.P. Given that density of air at S.T.P. is $1.296 kg\ m^{-3}$ and mercury is $13.6 \times 10^3\ kg\ m^{-3}$ **(H.P.B. 2005C)**

9. Calculate the root-mean square velocity of the molecules of hydrogen at standard temperature and pressure. Given, density and pressure of hydrogen are $0.09 kg\ m^{-3}$ and $1.01 \times 10^5\ Pa$ respectively. **(H.P.B. 2005C)**

10. Calculate the molecular kinetic energy of a unit mass of helium at N.T. P. What will be its kinetic energy at $100°C$? Given $R = 8.31\ J\ mol^{-1}\ K^{-1}$. **(H.P.B. 2005, 2006, 2006C)**

11. Estimate the total no. of air molecules (inclusive of Oxygen, Nitrogen, Water vapour and other Consituent) in a room of capacity 25.0 m^3 at a temperature of $27°C$ and 1 atmospheric pressure. Given R = $8.314\ J\ mol^{-1}\ K^{-1}$. **(H.P.B. 2024)**

12. The kinetic energy of a molecule of hydrogen at $0°C$ is $5.64 \times 10^{-21} J$. Calculate Avogadro's number. Given universal gas constant $R = 8.31\, J\, mole^{-1}K^{-1}$ **(H.P.B. 2006)**

13. Find the kinetic energy of 1 g of nitrogen gas at $77°C$. Given = $8.31 J\, mole^{-1}K^{-1}$. **(H.P.B. 2006)**

14. A gas has neither a definite shape nor a definite volume. Explain. **(H.P.B. 2006C)**

15. The different gases have exactly same temperature. Does this mean that their molecules have the same rms speed. **(H.P.B. 2006C)**

16. If Avogadro's no. is 6.02×10^{23} molecules mol^{-1} and Boltzmann's constant 1.38×10^{-23} $molecule^{-1}K^{-1}$, what is the average velocity of oxygen at $27°C$? **(H.P.B. 2008)**

17. Calculate the temperature at which the rms velocity of nitrogen molecule will be equal to $8 kms^{-1}$. Molecule weigh of nitrogen is 28. **(H.P.B. 2008)**

18. At what temperature will the r.m.s speed of a gas be half of its value at $0°C$? Pressure being constant. **(H.P.B. 2009)**

19. Define mean free path.

20. What is meant by degrees of freedom? State law of equipartition of energy. Hence calculate the specific heat of mono-, di- and tri-atomic gases. **(H.P.B. 2006C)**

21. What do you understand by degrees of freedom? Find degrees of freedom of diatomic gas. **(H.P.B. 2008, 2013, 2016)**

22. State and explain law of equipartition of energy. **(H.P.B.2009, 2011)**

16. OSCILLATIONS (S.H.M)

OBJECTIVE QUESTIONS

1. Dynamical condition of an SHM is :
(a) F = $-kx$ (b) F = $-\frac{k}{x}$ (c) F = $-kx^2$ (d) F = kx

2. In case of SHM :
(a) potential energy is conserved (b) kinetic energy is conserved
(c) total energy is conserved (d) none of above

3. At mean position of vibration, the velocity of a particle executing S.H.M. is
(a) zero (b) maximum (c) infinite (d) none of the above

4. At extreme position of vibration, the acceleration of the particle is
(a) zero (b) infinity (c) maximum (d) none of the above

5. Total energy of a particle executing SHM is proportional to :
(a) the square of velocity (b) the square of amplitude
(c) the square of acceleration (d) the square of displacement

6. An idea simple pendulum vibrating in an evacuated chamber will:
(a) oscillate forever with the same amplitude and frequency
(b) come to rest immediately

(c) oscillate with the same frequency and amplitude will decrease with time
(d) nothing can be said

7. A swinging pendulum stops because
(a) its energy is destroyed (b) its energy is converted to kinetic energy
(c) its energy is converted to potential energy
(d) its energy is converted to heat energy

8. The length of the pendulum of the clock is decreased, it will :
(a) go fast (b) go slow (c) neither go slow nor fast (d) none of these

9. If the acceleration of simple harmonic motion increases, its time period:
(a) decreases (b) increases (c) remain changes (d) none of these

10. The unit of force constant is :
(a) newton per metre (b) newton per metre^2
(c) newton per kg^2 (d) newton per kg

11. In SHM, the displacement at which the energy is half kinetic and half potential, is equal to
(a) $\frac{1}{4}$ amplitude (b) $\frac{1}{2}$ amplitude (c) $\frac{1}{\sqrt{2}}$ amplitude (d) $\frac{1}{8}$ amplitude

12. The displacement of particle in S.H.M. in one time period (H.P.B.2010)
(a) r (b) Zero (c) $2\,r$ (d) $4\,r$

13. A particle executes S.H.M given by (H.P.B.2010)
$y = 0.02 \sin 100\,t$
The amplitude and frequency are
(a) $0.02, 100$ (b) $0.02, \frac{50}{\pi}$ (c) $0.01, 50$ (d) $\frac{1}{0.02}, \frac{50}{\pi}$

14. The time period of a simple pendulum will be double if we (H.P.B.2010)
(a) increase the length 4 times (b) increase the length 2 times
(c) decrease the length 4 times (d) decrease the length 2 times

15. A metallic hollow sphere filled with water having a hole at the bottom is used as the bob of a pendulum. The time period of such a pendulum (H.P.B.2011)
(a) decreases with time (b) remains constant
(c) increases with time (d) first increases and then decreases

16. A child, swinging on a swing in sitting position stands up. Then, the time period of the swing will
(a) increase (b) decrease (c) remain same
(d) increase, if the child is long and decrease if child is short.

17. Displacement is given by $y = 0.2 \sin 50\,\pi\,t$ then its angular frequency will be
(a) 0.2 (b) 50 (c) $50\,\pi\,t$ (d) $50\,\pi$ (H.P.B.2018)

18. Time period of a simple pendulum at the centre of earth is
(a) Infinite (b) Zero
(c) Half as on the surface of Earth (d) None of these

19. If the length of a simple pendulum is increased by 2% , then the time period
(a) increase by 2 % (b) decrease by 2 %
(c) increase by 1 % (d) decrease by 1 %

20. Motion of an oscillating liquid column is a U-tube is
(a) Periodic but not simple harmonic
(b) Simple harmonic and time period is independent of the density of the liquid
(c) Non-periodic
(d) Simple harmonic and time period is directly proportional to the density of the liquid
(H.P.B.2023)

21. In S.H.M., $y = 10^{-2}\sin\left(10\pi t + \frac{\pi}{6}\right)$ metre. The amplitude of the particle is
(a) $\frac{\pi}{6}$m (b) 10^{-2}m (c) $10\,\pi$ m (d) $\left(10\pi + \frac{\pi}{6}\right)$m **(H.P.B.2024)**

22. Match the following

Column I	**Column II**
(a) Amplitude	(1) Reciprocal of time period
(b) Frequency	(2) Amplitude of sound
(c) Loudness	(3) Shrillness of sound
(d) Pitch	(4) Maximum displacement on either side.

(A) (a)-1 (b)-3 (c)-2 (d)-4 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-4 (b)-1 (c)-2 (d)-3 (D) (a)-3 (b)-4 (c)-1 (d)-2

23. Match the following Columns related to S.H.M. :

Column I	**Column II**
(a) Magnitude of Maximum velocity	(1) $\frac{1}{2}$ Mω^2A^2
(b) Magnitude of Maximum acceleration	(2) ωA
(c) Maximum total energy	(3) ω^2A
(d) Magnitude of Maximum Force	(4) m ω^2A

(A) (a)-1 (b)-3 (c)-2 (d)-4 (B) (a)-3 (b)-4 (c)-2 (d)-1
(C) (a)-4 (b)-1 (c)-2 (d)-3 (D) (a)-2 (b)-3 (c)-1 (d)-4

ANSWER KEY

1.(a)	**2.(c)**	**3.(b)**	**4.(b)**	**5.(b)**	**6.(a)**	**7.(d)**	**8.(a)**	**9.(c)**	**10.(a)**
11.(c)	**12.(b)**	**13.(b)**	**14.(a)**	**15.(b)**	**16.(b)**	**17.(d)**	**18.(a)**	**19.(c)**	**20.(b)**
21.(b)	**22.(c)**	**23.(b)**							

SUBJECTIVE QUESTIONS

1. What do you mean by S.H.M.? **(H.P.B.2016)**
2. What is the time period of a pendulum in a space ship? **(H.P.B.2002C)**
3. Define force constant and give its dimensional formulae. **(H.P.B.2003)**
4. How does the time period of simple pendulum depend upon the mass of the bob? **(H.P.B.2004C)**
5. Why doesn't a simple pendulum vibrate at the centre of the earth? **(H.P.B.2004C)**
6. What is a periodic motion? **(H.P.B.2004, 2002C, 2003C, 2006C)**
7. When a simple pendulum is taken to the top of a mountain, does it lose or gain time? **(H.P.B.2004)**
8. What is the displacement of a particle executing S.H.M.? **(H.P.B.2005)**
9. A bus begins to make a loud rattling sound at a certain speed on road, why? **(H.P.B.2005)**
10. At what points is the energy entirely kinetic and potential in S.H.M? **(H.P.B.2005C)**
11. At what points, the energy of a simple harmonic oscillator will be entirely potential. **(H.P.B.2006)**
12. At what points, the energy of simple harmonic oscillator will be entirely kinetic. **(H.P.B.2006)**
13. Derive an expression for the velocity of a particle undergoing simple harmonic motion. **(H.P.B.2001, 2004, 2014)**
14. Derive an expression for the instantaneous velocity of a particle executing simple harmonic motion. **(H.P.B.2008)**

15. Find an expression for acceleration and time period of SHM. **(H.P.B.2001C, 2002C, 2003C, 2004C)**

16. A simple harmonic motion is represented by $y = 5\,sin(20t + 0.5)$ metre. What are its amplitude, angular frequency and time period? **(H.P.B.2003)**

17. The time period of a body executing simple harmonic motion of second. How much time will its displacement be half of its amplitude? **(H.P.B.2003)**

18. A particle executes SHM of amplitude 'a'. At what distance from mean position its K.E. is equal to its P.E. **(H.P.B.2003, 2006 C)**

19. A particle executes S.H.M. of amplitude 30 cm and time period 4 sec. What is the maximum time required for the particle to move from mean position to a point 15 cm ? **(H.P.B.2005)**

20. S.H.M. is represented by : $y = 10\sin(20t + 0.5)$. Write down its amplitude, frequency and time period, if displacement is measured in metres and time in seconds. **(H.P.B.2005)**

21. Show that Phase difference between: (i) displacement and velocity is $\frac{\pi}{2}$ rad. (ii) displacement and acceleration is π rad in S.H.M. **(H.P.B.2005)**

22. A particle is executing S.H.M. with time period 4 s . If the amplitude of oscillation is 5 cm, calculate (i) displacement, (ii) velocity and (iii) acceleration of particle after 1 second it starts oscillating. **(H.P.B.2005)**

23. A particle executes S.H.M. given by
$y = 0.24\cos(400t - 0.5)$ in S.I. units
Find amplitude, frequency and period of vibration. **(H.P.B.2005, 2006C, 2022 Term-II)**

24. A restoring force is a must for a body to execute S.H.M. Explain. **(H.P.B.2006)**

25. Motion of earth around the sun is not simple harmonic, explain. **(H.P.B.2007)**

26. Define simple pendulum. How will simple pendulum behave, if it is taken to moon? **(H.P.B.2008)**

27. Find an expression for the total energy of a body vibrating simple harmonically. **(H.P.B.2002, Similar H.P.B. 2006 C, 2007, 2010)**

28. Show that the motion of a mass $'m'$ suspended by a spring is SHM, when it is displaced from its mean position and then released. **(H.P.B.2004, 2006, 2016)**

29. What is a simple pendulum? Show that motion executed by bob of simple pendulum is S.H.M. and hence find its time period. **(H.P.B.2005 C, 2006, 2011, 2024)**

17 . WAVE

OBJECTIVE QUESTIONS

1. When a sound wave goes from air into water, the quantity that remains unchanged is its:
(a) velocity (b) amplitude (c) frequency (d) wavelength

2. Of the following properties of a wave, the one that is independent of the others
(a) velocity (b) amplitude (c) wavelength (d) frequency

3. Sound waves can not pass through
(a) solid (b) liquid (c) gas (d) vacuum

4. Sound waves in air are :
(a) stationary waves (b) longitudinal waves
(c) transverse waves (d) none of the above

5. According to the Newton's formula, the velocity of sound waves in a medium is maximum in:
(a) solids (b) gases (c) liquids (d) vacuum

6. The velocity of sound in air at N. T. P. is:
(a) 332 ms^{-1} (b) 288 ms^{-1} (c) 256 ms^{-1} (d) zero

7. Sound waves cannot be
(a) polarised (b) reflected (c) diffracted (d) refracted

8. Echo is
(a) reflection of sound (b) interference of sound
(c) refraction of sound (d) polarization of sound

9. Distance between two consecutive nodes is :
(a) $\frac{\lambda}{2}$ (b) $\frac{\lambda}{4}$ (c) λ (d) 2λ

10. The node is a point where
(a) amplitude is maximum and strain is maximum
(b) both amplitude and strain are maximum
(c) both amplitude and strain is maximum (d) amplitude is maximum and strain is maximum.

11. Frequency of fundamental mode is :
(a) greater than overtone frequency (b) less than overtone frequency
(c) equal to overtone frequency (d) none of these

12. In an open pipe:
(a) all harmonics are present (b) only even harmonics are present
(c) only odd harmonics are present (d) data insufficient

13. When tension in a string is increased to four times its original value, the velocity of transverse waves is :
(a) increased in 4 times (b) decreased 2 times
(c) increased 2 times (d) becomes 1/2

14. The speed of sound will be greatest in (H.P.B.2010)
(a) Air (b) Vacuum (c) Water (d) Metal

15. Elastic waves in solid are **(H.P.B.2010)**
(a) transverse (b) longitudinal
(c) either transverse or longitudinal (d) neither transverse nor longitudinal

16. Energy is not carried by which of following wave?
(a) Progressive wave (b) Stationary wave
(c) Transverse wave (d) Electromagnetic wave
(H.P.B.2011, H.P.B. Model Question Paper 2013)

17. The temperature at which speed of sound in air becomes double of its value
(a) 54°C (b) 327°C (c) 927°C (d) 1000°C **(H.P.B.2014)**

18. Which of the following equations represents a wave?
(a) $Y = A \sin \omega t$ (b) $Y = A \tan (\alpha t + bx + c)$
(c) $Y = A \cos kx$ (d) $Y = A\ (\omega t - kx)$ **(H.P.B.2022 Term-II)**

19. With propagation of longitudinal waves through a medium, the quantity transmitted is

(a) Energy (b) Matte
(c) Energy and Matter (d) Energy, Matter and Momentum **(H.P.B.2023)**

20. Match the two columns given below:

Column I	**Column II**
(a) Sound has maximum velocity	(1) Air
(b) Sound has velocity 332 m s^{-1} at NTP	(2) Vacuum
(c) Velocity of sound ix zero	(3) Pressure
(d) Velocity of sound does not depend upon	(4) Solid

(A) (a)-2 (b)-3 (c)-1 (d)-4 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-4 (b)-1 (c)-2 (d)-3 (D) (a)-1 (b)-3 (c)-2 (d)-4

21. Match the velocity in a medium given in the left column with its value in the right column.

Medium	**Velocity**
(a) Solid	(1) 340 m s^{-1}
(b) Liquid	(2) 10000 m s^{-1}
(c) Gas	(3) 60000m s^{-1}
(d) Vacuum	(4) zero

(A) (a)-3 (b)-2 (c)-1 (d)-4 (B) (a)-4 (b)-1 (c)-2 (d)-3
(C) (a)-4 (b)-3 (c)-2 (d)-1 (D) (a)-3 (b)-2 (c)-4 (d)-1

22. Match the characteristic with the type of wave in the following columns.

Column I	**Column II**
(a) There is continuous change in phase from one to next particle.	(1) Stationary wave
(b) All particles between two successive nodes are in same phase	(2) beats
(c) There is formation of maxima and minima of sound with time	(3) Interference
(d) An alternate pattern of maxima and minima of sound with distance	(4) Progressive wave

(A) (a)-1 (b)-2 (c)-3 (d)-4 (B) (a)-2 (b)-4 (c)-3 (d)-1
(C) (a)-3 (b)-1 (c)-4 (d)-2 (D) (a)-4 (b)-1 (c)-2 (d)-3

23. For an open end and closed end an organ pipe, match the terms in the first and second column

First Column	**Second Column**
(a) First code of vibration in closed End organ pipe.	(1) Three antinodes and two nodes
(b) Second mode of vibration in closed end organ pipe	(2) Two nodes and two antinodes
(c) First mode of vibration in open end organ pipe	(3) Two antinodes and one node
(d) Second mode of vibration in open end organ pipe.	(4) One node one antinode

(A) (a)-4 (b)-2 (c)-3 (d)-1 (B) (a)-3 (b)-1 (c)-2 (d)-4
(C) (a)-1 (b)-2 (c)-3 (d)-4 (D) (a)-2 (b)-1 (c)-4 (d)-3

ANSWER KEY

1.(c) 2.(b) 3.(d) 4.(b) 5.(a) 6.(a) 7.(a) 8.(a) 9.(a) 10.(d)
11.(d) 12.(a) 13.(c) 14.(d) 15.(c) 16.(b) 17.(c) 18.(a) 19.(a) 20.(c)
21.(a) 22.(d) 23.(a)

SUBJECTIVE QUESTIONS

1. (a) Derive the relation given by Newton to find the speed of a longitudinal wave in an ideal gas.
(b) Estimate the speed of Sound in air at STP. **[H.P.B 2022, Term -II]**

2. Derive Newton's formula for the velocity of sound in air. What corrections Laplace apply to it? **[H.P.B 2023]**

3. Define persistence of hearing. **(H.P.B.2003)**

4. Why CO_2 is filled in a sound lens? **(H.P.B.2003)**

5. Why does sound travel faster in iron than in air? **(H.P.B.2004C)**

6. Why female voice is sweeter than male? **(H.P.B.2004C)**

7. Why are stationary waves so called? **(H.P.B.2004, 2004, 2005C)**

8. What is the essential condition for the formation of beats? **(H.P.B.2004C)**

9. Can transverse waves be produced in Air? **(H.P.B.2005)**

10. What do you mean by Beat? **(H.P.B.2005)**

11. Sound travels faster in warm air than in cool air. Why? **(H.P.B.2005C)**

12. Two sound sources produce 12 beats in 4 seconds. By how much do their frequencies differ?**(H.P.B.2006)**

13. State basic difference between beats and standing waves. **(H.P.B.2006)**

14. What is the frequency of notes produced in open end and closed end organ pipe.**(H.P.B.2006)**

15. Which properties of the medium are responsible for the propagation of wave through it? **(H.P.B.2006C)**

16. Can two astronauts talk on the surface of moon as they do on earth. Why? **(H.P.B.2006)**

17. Sound can be heard over long distances on a rainy day. Why? **(H.P.B.2011, 2013)**

18. The velocity of sound is generally greater in solids than in gases at N.T.P. **(H.P.B.2017)**

19. What is the difference between musical sound and noise? **(H.P.B.2002 C)**

20. What is the effect of temperature on the velocity of sound? Derive the relation. **(H.P.B.2002 C)**

21. Explain any three important characteristics of a transverse wave. **(H.P.B.2003)**

22. At what temperature will the speed of sound in air be double than the speed of sound in air at 22°C. **(H.P.B.2004)**

23. The speed of sound in air is 332 m s^{-1} at 0°C. At what temperature will be speed become half of that at 0°C. **(H.P.B.2004)**

24. Show that the speed of sound in a gaseous medium varies directly as the square root of its absolute temperature. **(H.P.B.2004 C)**

25. At what temperature will the speed of sound be double? **(H.P.B.2004)**

26. Distinguish between Longitudinal waves and Transverse waves. **(H.P.B.2005, 2005 C, 2020)**

27. Distinguish between Progressive waves and Stationary waves. **(H.P.B.2005)**

28. Prove that the ratio of the frequencies of first harmonics in the closed end organ pipe is 1 : 3 : 5. **(H.P.B.2005)**

29. Discuss the effect of density, humidity and temperature of the medium on the speed of sound. **(H.P.B.2007)**

30. Define longitudinal wave motion and transverse wave motion and explain them by diagrams. **(H.P.B.2002, 2017)**

31. Discuss the formation of standing waves in a string fixed at both ends and different modes of vibration. **(H.P.B.2002, 2005 C, 2007)**

32. Explain the formation of beats analytically. **(H.P.B.2003, 2006, 2007, 2010)**

33. What is progressive wave? Derive an equation which represents progressive wave. **(H.P.B.2005 C, 2006)**

34. Explain the formation of stationary waves in a pipe open at both ends. Discuss various modes of vibration **(H.P.B.2007, 2008, 2011)**

35. What do you understand by fundamental frequency? Show that the fundamental frequency of open organ pipe is double the fundamental frequency of closed organ pipe. **(H.P.B.2008, 2011, 2018, 2024)**