

# Combined Public Exam Questions (2019–2025)

## Unit I: Nature of Physical World and Measurement

### One-mark Questions

[2019] • pub\_2019 Q3: Which of the following pairs of physical quantities have the same dimensions?

- (a) Torque and Power (b) Force and Torque (c) Force and Power (d) Torque and Energy

[2020] pub\_2020 Q1: Identify the unit vector in the following:

- (a)  $\frac{i+j}{\sqrt{2}}$  (b)  $i + j$  (c)  $\frac{i}{\sqrt{2}}$  (d)  $k - \frac{i}{\sqrt{2}}$

[2020] pub\_2020 Q6: The length of a body is measured as 3.51 m. If the least count is 0.01 m, the percentage error in the measurement is:

- (a) 0.035% (b) 351% (c) 0.28% (d) 1%

[2020] pub\_2020 Q11: The dimensional formula for Moment of Inertia is:

- (a)  $ML^{-1}T^{-1}$  (b)  $ML^2T^{-2}$  (c)  $MLT^2$  (d)  $ML^2$

[2021] pub\_2021 Q10: The dimensional formula of Planck's constant  $h$  is \_\_\_\_\_.

- (a)  $MLT^{-1}$  (b)  $ML^2T^{-1}$  (c)  $ML^3T^{-3}$  (d)  $ML^2T^{-3}$

[2022] pub\_2022 Q5: The dimensional formula for strain is:

- (a)  $ML^{-2}T^{-1}$  (b)  $M^0L^0T^0$  (c)  $ML^{-1}T^{-2}$  (d)  $M^0LT^0$

[2022] pub\_2022 Q14: If  $\pi = 3.14$ , then the value of  $\pi^2$  is:

- (a) 9.86 (b) 9.8596 (c) 9.9 (d) 9.860

[2023] pub\_2023 Q1: If a wire is stretched to double of its original length, then the strain in the wire is

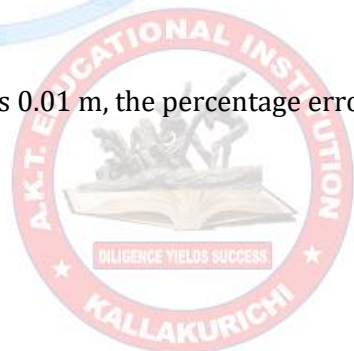
- (a) 3 (b) 1 (c) 4 (d) 2

[2023] pub\_2023 Q2: Round off the following number 19.95 into three significant figures.

- (a) 20.1 (b) 19.9 (c) 19.5 (d) 20.0

[2023] pub\_2023 Q13: Which one of the following physical quantities cannot be represented by a scalar?

- (a) momentum (b) mass (c) magnitude of acceleration (d) length



[2024] pub\_2024 Q1: Two resistances  $R_1 = (100 \pm 3) \Omega$ ,  $R_2 = (150 \pm 2) \Omega$  are connected in series. What is their equivalent resistance?

- (a)  $(250 \pm 1) \Omega$       (b)  $(250 \pm 5) \Omega$       (c)  $(250 \pm 3) \Omega$       (d)  $(205 \pm 5) \Omega$

[2024] pub\_2024 Q11: If the error in measurement of the radius of a sphere is 2%, then the error in its volume is:

- (a) 4%      (b) 8%      (c) 6%      (d) 2%

[2025] pub\_2025 Q9: Which of the following has the dimension of  $(\mu_0 \epsilon_0)^{-\frac{1}{2}}$ ?

- (a) velocity      (b) length      (c) force      (d) time

## Two-mark Questions

[2019] • pub\_2019 Q16: Write any two examples of systematic errors. Explain them.

[2020] pub\_2020 Q16: Check the correctness of the equation using dimensional analysis.

[2021] pub\_2021 Q18: Check the correctness of the equation  $v = u + at$  using dimensional analysis method.

[2023] pub\_2023 Q16: Write the rules for determining significant figures.

[2024] pub\_2024 Q17: Define “vector.” Give examples.

[2024] pub\_2024 Q23: What are the limitations of dimensional analysis?

[2025] pub\_2025 Q20: Check the correctness of the equation  $v = u + at$  using dimensional analysis method.

## Three-mark Questions

[2021] pub\_2021 Q31: What are the applications of dimensional analysis?

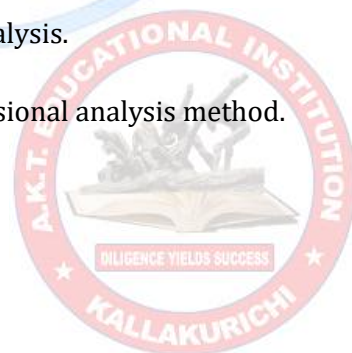
[2023] pub\_2023 Q25: What is Gross Error? State the reasons for it and how to minimize the errors.

[2024] pub\_2024 Q31: What are fundamental and derived quantities? Give examples.

## Five-mark Questions

[2019] • pub\_2019 Q34: Explain the principle of homogeneity of dimensions and derive an expression for the force  $F$  acting on a body moving in a circular path depending on mass ( $m$ ), velocity ( $v$ ), and radius ( $r$ ) of the circular path. Obtain the expression for the force by the dimensional analysis method (take the value  $k=1$ )

[2020] pub\_2020 Q35(a): What do you mean by propagation of errors? Explain propagation of errors in division of two quantities.



[2020] pub\_2020 Q25: Explain the RADAR pulse method for determining large distances.

[2020] pub\_2020 Q38(a):

(i) Determine the height of an accessible object using the triangulation method.

(ii) A tree is seen at  $60^\circ$  angle of elevation from a point 50 m away. Find its height.

[2021] pub\_2021 Q36(a): Convert 76 cm of Hg into  $\text{N/m}^2$  using the method of dimensions.

[2022] pub\_2022 Q34(a) (i): write the applications of the dimensional Analysis.

(ii): Check the correctness of the equation  $\frac{1}{2}mv^2 = mgh$  using dimensional analysis

[2023] pub\_2023 Q34(b): Explain in detail the Triangle Law of Vector Addition.

[2025] pub\_2025 Q34(a): Explain in detail the various types of errors.

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## Unit II: Kinematics

### One-mark Questions

[2019] • pub\_2019 Q1: What is the angular displacement made by a particle after 5 s, when it starts from rest with an angular acceleration of  $0.2 \text{ rad/s}^2$ ?

- (a) 4 rad    (b) 1 rad    (c) 2.5 rad    (d) 5 rad

[2020] pub\_2020 Q5: Which one of the following is a scalar quantity?

- (a) Speed    (b) Velocity    (c) Displacement    (d) Linear momentum

[2021] pub\_2021 Q2: If a particle executes uniform circular motion in the xy plane in the clockwise direction, then its angular-velocity vector points in the \_\_\_\_\_ direction.

- (a) -z direction    (b) +y direction    (c) -x direction    (d) +z direction

[2021] pub\_2021 Q4: Which of the following is not a Scalar ?

- (a) Pressure    (b) Viscosity    (c) Stress    (d) Surface tension

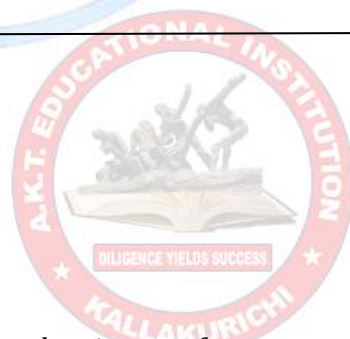
[2021] pub\_2021 Q5: If an object is thrown vertically upward with initial speed  $u$  from ground, the total time to return to ground is \_\_\_\_\_.

- (a)  $\frac{u}{2g}$     (b)  $\frac{u^2}{2g}$     (c)  $\frac{2u}{g}$     (d)  $\frac{u^2}{g}$

[2021] pub\_2021 Q15: Consider a circular leveled road of radius 10 m having coefficient of static friction 0.81.

With what speed a car has to move on the turn so that will have safe turn ? ( $g = 10 \text{ m/s}^2$ )

- (a)  $12 \text{ ms}^{-1}$     (b)  $8 \text{ ms}^{-1}$     (c)  $14 \text{ ms}^{-1}$     (d)  $10 \text{ ms}^{-1}$



**[2022] pub\_2022 Q4:** Two objects are projected at  $30^\circ$  and  $60^\circ$  angles with the same speed. Choose the correct relation for their ranges:

(a)  $R_{30} = \frac{R_{60}}{2}$  (b)  $R_{30} = R_{60}$  (c)  $R_{30} = 2R_{60}$  (d)  $R_{30} = 4R_{60}$

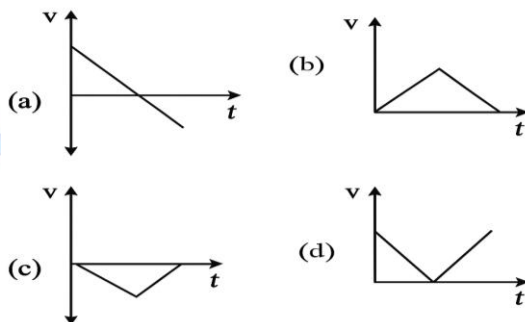
**[2023] pub\_2023 Q7:** If an object is falling from a height of 20 m, then the time taken by the object to reach the ground: (ignore air resistance and take  $g = 10 \text{ m/s}^2$ )

(a) 2 s (b) 1.732 s (c) 1.532 s (d) 1.414 s

**[2024] pub\_2024 Q6:** If  $\mathbf{v} = 2\mathbf{i} + t^2\mathbf{j} - 9\mathbf{k}$ , then at  $t = 1 \text{ s}$  the acceleration is:

(a) zero (b)  $1 \text{ m/s}^2$  (c)  $-1 \text{ m/s}^2$  (d)  $2 \text{ m/s}^2$

**[2024] pub\_2024 Q10:** A ball is projected vertically upwards with initial velocity  $v$  and returns in time  $t$ . Which  $v$ - $t$  graph correctly represents its motion?



**[2025] pub\_2025 Q14:** An object is dropped in an unknown planet from height 50 m; it reaches the ground in 2 s. The acceleration due to gravity in this unknown planet is:

(a)  $15 \text{ m/s}^2$  (b)  $20 \text{ m/s}^2$  (c)  $30 \text{ m/s}^2$  (d)  $25 \text{ m/s}^2$

## Two-mark Questions

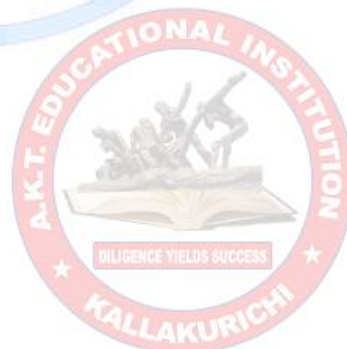
**[2019] • pub\_2019 Q17:** What is a projectile? Give two examples.

**[2020] pub\_2020 Q17:** Define distance and displacement.

**[2021] pub\_2021 Q16:** Define angular velocity.

**[2022] pub\_2022 Q24:** A particle moves along the x-axis in such way that its coordinates  $x$  varies with time ' $t$ ' according to equation  $x = 2 - 5t + 6t^2$ . What is its initial velocity of the particle?

**[2023] pub\_2023 Q17:** Define scalar. Give examples.



## Three-mark Questions

[2020] pub\_2020 Q26: An object is projected at  $30^\circ$  with a speed of 5 m/s. Calculate the maximum height reached and horizontal range.

[2021] pub\_2021 Q27: Show that in horizontal projection, the path of a projectile is a parabola .

[2023] pub\_2023 Q26: Write the properties of scalar product of two vectors.

[2024] pub\_2024 Q33: An object is thrown with initial speed 5 m/s with an angle of projection  $30^\circ$ . Calculate the height and range reached by the particle.

[2025] pub\_2025 Q33: A wire 10 m long has a cross-sectional area  $1.25 \times 10^{-4} \text{ m}^2$ . It is subjected to a load of 5 kg. If Young's modulus of the material is  $4 \times 10^{10} \text{ N/m}^2$ , calculate the elongation produced in the wire. Take  $g = 10 \text{ m/s}^2$ .

## Five-mark Questions

[2019] • pub\_2019 Q38(a): (i) Write down the equation of motion for a freely falling body under gravity.

(ii) A ball is thrown vertically upwards with 19.6 m/s from a building and reaches the earth in 6 s. Find the height of the building.

[2020] pub\_2020 Q34(a): Derive the expression for centripetal acceleration.

[2021] pub\_2021 Q38(a): Explain the need for banking of tracks.

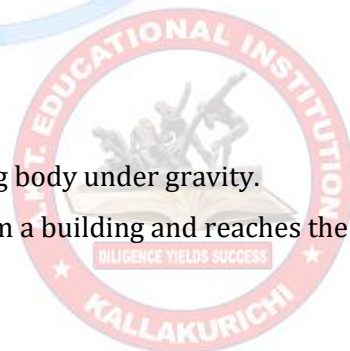
[2022] pub\_2022 Q35(b): Derive the kinematic equations of motion for constant acceleration.

[2024] pub\_2024 Q37: (a) Derive the kinematic equations of motion for constant acceleration. OR (b) Derive the expression for the mean free path of a gas.

[2025] pub\_2025 Q35(a): What is the need of banking of tracks? Explain in detail.

[2025] pub\_2025 Q36(a): Derive the expression for centripetal acceleration.

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## Unit III: Laws of Motion

### One-mark Questions

[2019] • pub\_2019 Q2: The process in which heat transfer is by actual movement of molecules in fluids such as liquids and gases is called:

- (a) Thermal conductivity (b) Convection (c) Conduction (d) Radiation

[2020] pub\_2020 Q8: When a car takes a sudden left turn, passengers are pushed to the right due to:

- (a) absence of inertia (b) inertia of direction (c) inertia of motion (d) inertia of rest

[2021] pub\_2021 Q1: Two equal masses  $m_1$  and  $m_2$  are moving along the same straight line with velocities 5 m/s and -9 m/s respectively. If the collision is elastic, calculate the velocities of  $m_1$  and  $m_2$  after collision.

- (a)  $-9 \text{ ms}^{-1}$  and  $5 \text{ ms}^{-1}$  (b)  $-4 \text{ ms}^{-1}$  and  $5 \text{ ms}^{-1}$  (c)  $5 \text{ ms}^{-1}$  and  $1 \text{ ms}^{-1}$  (d)  $-4 \text{ ms}^{-1}$  and  $5 \text{ ms}^{-1}$

[2022] pub\_2022 Q2: When a car takes a sudden left turn in the curved road, passengers are pushed to the right due to:

- (a) Inertia of rest (b) Inertia of direction (c) Absence of inertia (d) Inertia of motion

[2022] pub\_2022 Q3: Two equal masses  $m_1$  and  $m_2$  are moving along the same straight line with velocities 5 m/s and -9 m/s respectively. If collision is elastic, then calculate the velocities after collision after the collision of :

- (a) -9 m/s and 5 m/s (b) -4 m/s and 10 m/s (c) 5 m/s and 1 m/s (d) 10 m/s, 0 m/s

[2022] pub\_2022 Q12: A couple produces:

- (a) Rotation and translation (b) Pure rotation (c) No motion (d) Pure translation

[2023] pub\_2023 Q6: The centrifugal force appears to exist

- (a) in any accelerated frame (b) only in inertial frames (c) both in inertial and non-inertial frames  
(d) only in rotating frames

[2023] pub\_2023 Q12: A rigid body rotates with an angular momentum  $L$ . If its kinetic energy is

- (a)  $2L$  (b)  $L$  (c)  $\frac{L}{\sqrt{2}}$  (d)  $\frac{L}{2}$

[2025] pub\_2025 Q4: A particle undergoes uniform circular motion. The angular momentum of the particle remains conserved about:

- (a) any point inside the circle (b) the center point of the circle (c) any point outside the circle  
(d) the point on the circumference of the circle



**[2025] pub\_2025 Q5:** When the object is moving at constant velocity on a rough surface,

- (a) only external force acts on the object    (b) net force on the object is zero  
(c) only kinetic friction acts on the object    (d) no force acts on the object

**[2025] pub\_2025 Q10:** An athlete covers 5 rounds on a circular track of radius 25 m. The total distance and displacement travelled by him is:

- (a) 785 m, zero    (b) 942 m, zero    (c) 125 m, zero    (d) zero, zero

## Two-mark Questions

**[2019] • pub\_2019 Q18:** State Newton's Second Law of Motion.

**[2019] • pub\_2019 Q19:** A car takes a turn with a velocity of 50 m/s on a circular road of radius 10 m. Calculate the centrifugal force experienced by a person of mass 60 kg inside the car.

**[2019] • pub\_2019 Q20:** Why is it more difficult to revolve a stone tied to a longer string than a stone tied to a shorter string?

**[2020] pub\_2020 Q20:** What is coefficient of restitution?

**[2021] pub\_2021 Q19:** Give two everyday examples of torque.

**[2022] pub\_2022 Q22:** State Newton's second law.

**[2022] pub\_2022 Q23:** State conservation of angular momentum.

**[2023] pub\_2023 Q18:** Under what condition will a car skid on a levelled circular road?

**[2024] pub\_2024 Q16:** Which is more elastic—steel or rubber? Why?

**[2024] pub\_2024 Q22:** Define the coefficient of restitution.

**[2025] pub\_2025 Q16:** State Newton's second law of motion.

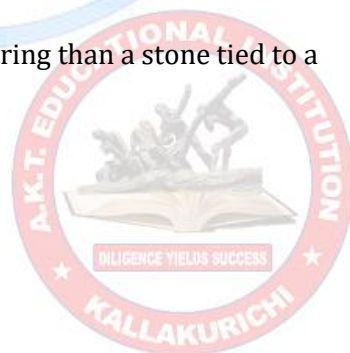
**[2025] pub\_2025 Q18:** Calculate the area of the triangle for which two of its sides are given by the vectors  $A = 5\mathbf{i} - 3\mathbf{j}$  and  $B = 3\mathbf{i} + 4\mathbf{j}$ .

## Three-mark Questions

**[2020] pub\_2020 Q27:** Why does a cricket player pull his hands backward while catching a ball?

**[2021] pub\_2021 Q25:** Derive the relation between momentum and kinetic energy.

**[2022] pub\_2022 Q25:** Compare elastic and inelastic collision.



[2023] pub\_2023 Q27: State the differences between centripetal force and centrifugal force.

[2024] pub\_2024 Q25: Derive an expression for the work done by a torque.

[2025] pub\_2025 Q25: Write the properties of vector product (Any six).

[2025] pub\_2025 Q27: A box is pulled with a force 25N to produce a displacement of 15m. If the angle between the force and displacement is find the work done by the force.

### Five-mark Questions

[2019] • pub\_2019 Q35: (a) Prove the law of conservation of momentum. Use it to find the recoil velocity of a gun when a bullet is fired from it.

[2020] pub\_2020 Q36(b): Explain bending of cyclist in curves and arrive at an expression for angle of bending.

[2024] pub\_2024 Q36: (a) Describe the vertical motion of blocks connected by a string.

## Unit IV: Work, Energy and Power

### One-mark Questions

[2019] pub\_2019 Q9: A body of mass 5 kg is thrown up vertically with a kinetic energy 1000 J. If acceleration due to is  $10 \text{ m/s}^2$ , find the height at which Kinetic Energy becomes half of the original value.

- (a) 10 m    (b) 20 m    (c) 50 m    (d) 100 m

[2019] pub\_2019 Q15: If the linear momentum of an object increases by 0.1%, its kinetic energy increases by:

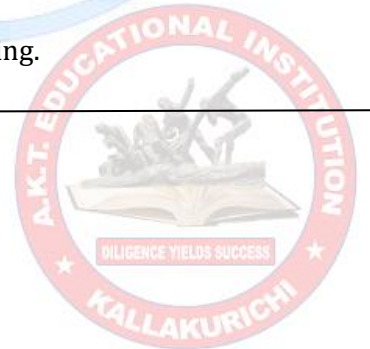
- (a) 0.4%    (b) 0.01%    (c) 0.1%    (d) 0.2%

[2020] pub\_2020 Q7: A body of mass 20 kg moving at 10 m/s on a smooth horizontal surface collides with a massless spring of force constant 5 N/m .If the mass stops after collision, distance of compression of the spring will be :

- (a) 10 m    (b) 50 m    (c) 5 m    (d) 20 m

[2023] pub\_2023 Q11: A uniform force of  $(2\mathbf{i} + \mathbf{j}) + N$  acts on a particle of mass 1 kg. The particle displaces from position  $(3\mathbf{j} + \mathbf{k}) \text{ m}$  to  $(5\mathbf{i} + 3\mathbf{j}) \text{ m}$ . The work done by the force on the particle is:

- (a) 10 J    (b) 9 J    (c) 12 J    (d) 6 J





[2024] pub\_2024 Q3: The work done by a conservative force for a closed path is:

(a) always positive (b) always negative (c) not defined (d) zero

## Two-mark Questions

[2021] pub\_2021 Q24: A 75 W fan runs 8 h/day for 30 days. Calculate the energy consumed in kWh.

[2023] pub\_2023 Q19: Write any two differences between conservative and non-conservative force.

[2023] pub\_2023 Q24: Two objects of masses 3 kg and 6 kg are moving with the same momentum of  $30 \text{ kg}\cdot\text{m/s}$ . Will they have same kinetic energy?

[2024] pub\_2024 Q32: State the law of conservation of energy.

## Three-mark Questions

[2019] • pub\_2019 Q27: A heavy body and a light body have the same momentum. Which has more kinetic energy and why?

[2022] pub\_2022 Q33: A person does 30 kJ work on 2kg of water by stirring using a paddle wheel. While stirring, around 5 Kcal of heat is released from water through its container to the surface and surroundings by thermal conduction and radiation. What is the change in internal energy of the system

[2023] pub\_2023 Q28: State the various types of potential. Explain its formulae.

## Five-mark Questions

[2019] • pub\_2019 Q36: (a) What is an elastic collision? Derive expressions for final velocities of two bodies which undergo elastic collision in one dimension.

[2020] pub\_2020 Q35(b): Derive the work done in an adiabatic process.

[2022] pub\_2022 Q37(b): State and explain work-energy theorem. Discuss the inferences of work-kinetic energy theorem.

[2023] pub\_2023 Q35(b): Derive an expression for power and velocity.

[2024] pub\_2024 Q35: (a) State and explain the work-energy principle with three examples.

[2025] pub\_2025 Q38(a): (i) Define power. Give any two units of power.

(ii) Calculate the energy consumed in electrical units when a 75 W fan is used for 8 hours daily for one month (30 days).

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# Unit V: Motion of System of Particles and Rigid Bodies

## One-mark Questions

[2019] • pub\_2019 Q13: A closed cylindrical container is partial filled with water. As the container rotates in a horizontal plane about a perpendicular bisector, Its moment of inertia:

- (a) Remains constant (b) Depends on direction (c) Increases (d) Decreases

[2020] pub\_2020 Q15: Moment of inertia of a solid cylinder of mass  $M$ , length  $l$  and radius  $r$  about its own axis is:

- (a)  $M \left( \frac{r^2}{2} + \frac{l^2}{12} \right)$  (b)  $Mr^2$  (c)  $\frac{1}{4} Mr^2$  (d)  $\frac{1}{4} Mr^2$

[2021] pub\_2021 Q8: A “couple” acting on a rigid body produces \_\_\_\_\_.

- (a) Rotation and translation (b) pure rotation (c) no motion (d) pure translation

[2024] pub\_2024 Q2: If a person moves from Pole to Equator, the centrifugal force acting on him:

- (a) remains the same (b) increases (c) first increases then decreases (d) decreases

[2024] pub\_2024 Q7: A couple produces:

- (a) rotation and translation (b) pure rotation (c) no motion (d) pure translation

[2025] pub\_2025 Q1: The moment of inertia of a uniform rod about an axis which is perpendicular to the rod and touches any one end of the rod is:

- (a)  $I = MR^2$  (b)  $I = \frac{1}{12} Ml^2$  (c)  $I = \frac{1}{2} MR^2$  (d)  $I = \frac{1}{3} Ml^2$

## Two-mark Questions

[2023] pub\_2023 Q20: What are the conditions in which force cannot produce torque?

[2021] pub\_2021 Q21: A book of mass  $m$  rests on a table. Draw the free-body diagram.

[2021] pub\_2021 Q28: Define the centre of gravity of a body.

[2024] pub\_2024 Q18: A 60 kg person sits in a car taking a 10 m turn at 50 m/s. Calculate the centrifugal force on him.

[2024] pub\_2024 Q20: A rolling wheel has velocity of its centre of mass as 5 m/s . if its radius 1.5 m and angular velocity is 3 rad/s , then check whether it is in pure rolling or not.

[2025] pub\_2025 Q21: Give any two examples of torque in day-to-day life.

### Three-mark Questions

[2019] • pub\_2019 Q25: What is the torque of the force  $F = 3i - 2j + 4k$  acting at point  $r = 2i + 3j + 5k$  about the origin?

[2019] • pub\_2019 Q28: Find the rotational kinetic energy of a ring of mass 9 kg and radius 3 m rotating with 240 rpm about an axis through its center and perpendicular to its plane.

[2020] pub\_2020 Q33: A force  $(4i - 3j + 5k)$  N is applied at a point whose position vector is  $(7i + 4j - 2k)$  m. Find the torque of this force about the origin.

[2022] pub\_2022 Q28: What are the resultants of the vector product of two vectors given by  $A = 4i - 2j + k$  and  $B = 5i + 3j - 4k$  ?

[2025] pub\_2025 Q32: What is the relation between torque and angular momentum?

### Five-mark Questions

[2019] pub\_2019 Q35 (b): State and prove the parallel axis theorem.

[2020] pub\_2020 Q37(a): Derive the expression for moment of inertia of a thin uniform rod about an axis passing through the centre and perpendicular to its length.

[2021] pub\_2021 Q37(b): Derive an expression for kinetic energy in rotation.

[2022] pub\_2022 Q36(a): Explain the motion of blocks connected by a string in vertical motion.

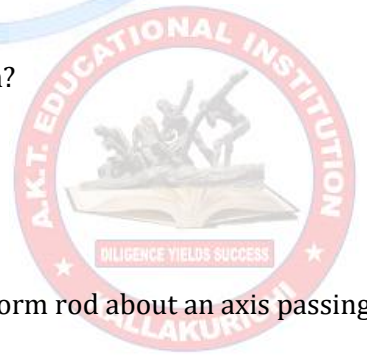
[2023] pub\_2023 Q36(a): Derive the expression for moment of inertia of a rod about its centre and perpendicular to the rod.

[2024] pub\_2024 Q35 (b): Define coefficient of performance and explain the working of a refrigerator.

[2024] pub\_2024 Q38: (a) Derive the moment of inertia of a uniform ring about an axis passing through the center and perpendicular to the plane.

[2025] pub\_2025 Q37(b): Discuss rolling on an inclined plane and arrive at the expression for the acceleration.

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# Unit VI: Gravitation

## One-mark Questions

[2020] pub\_2020 Q14: If the distance between the Earth and Sun is twice its present value, the number of days in a year will be :

- (a) 730 (b) 1032 (c) 64.5 (d) 182.5

[2021] pub\_2021 Q12: The gravitational potential energy of the Moon with respect to the Earth is always \_\_\_\_.

- (a) can be positive or negative (b) always positive (c) always zero (d) always negative

[2022] pub\_2022 Q13: If the mass and radius of the Earth are both doubled, then the acceleration due to gravity becomes:

- (a) 2g (b) remains same (c) 4g (d) g/2

[2022] pub\_2022 Q15: If gravity becomes 4 times its original value, the escape speed:

- (a) becomes halved (b) remains same (c) 4 times of original value (d) 2 times of original value

[2023] pub\_2023 Q5: The kinetic energy of the satellite orbiting around the Earth is

- (a) greater than potential energy (b) equal to potential energy (c) zero (d) less than potential energy

[2024] pub\_2024 Q15: If the masses of the Earth and Sun both doubled, the gravitational force between them would:

- (a) increase four times (b) remain the same (c) decrease two times (d) increase two times

[2025] pub\_2025 Q2: According to Kepler's second law, the radial vector to a planet from the Sun sweeps out equal areas in equal intervals of time. This law is a consequence of conservation of:

- (a) energy (b) linear momentum (c) kinetic energy (d) angular momentum

## Two-mark Questions

[2020] pub\_2020 Q18: Why there is no lunar eclipse and solar eclipses not occur every month?

[2021] pub\_2021 Q23: Why is the total energy of a satellite (or planet) negative?

[2022] pub\_2022 Q20: Define gravitational potential.

[2023] pub\_2023 Q21: State Newton's Universal Law of Gravitation.

[2024] pub\_2024 Q26: Explain how  $g$  varies with altitude.

[2025] pub\_2025 Q23: Define gravitational field. Give its SI unit.

### Three-mark Questions

[2019] • pub\_2019 Q29: What do you mean by the term weightlessness? Explain the state of weightlessness of a freely falling body.

[2020] pub\_2020 Q28: State Kepler's three laws of planetary motion.

[2022] pub\_2022 Q29: Write a short note on polar satellites.

[2023] pub\_2023 Q29: Explain geostationary satellites.

[2025] pub\_2025 Q28: Write a note on geostationary and polar satellites.

### Five-mark Questions

[2019] • pub\_2019 Q38(b): (i) Define orbital velocity and derive its expression.

(ii) Calculate the orbital velocity for an artificial satellite of Earth orbiting at a height of 1000 km (Mass of the Earth =  $6 \times 10^{24}$  kg, radius = 6370 km).

[2020] pub\_2020 Q36(a): (i) Derive the expression for the variation of acceleration due to gravity (g) with depth from the surface of the earth(d).

(ii) Find the ratio of the acceleration due to gravity at a height  $R/2$  from the surface of the earth to the value at a depth  $R/2$  from the surface of the earth ( $R$  – radius of the earth)

[2021] pub\_2021 Q38(b): Explain the variation of g with depth below Earth's surface.

[2022] pub\_2022 Q36(b): Explain the variation of acceleration due to gravity (g) with altitude.

[2023] pub\_2023 Q36(b): Explain the variation of Acceleration due to gravity with depth from the Earth's surface.

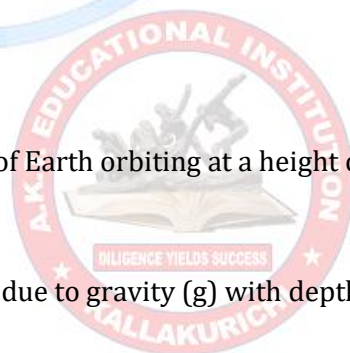
[2024] pub\_2024 Q36 (b): State and explain Kepler's three laws of planetary motion.

[2024] pub\_2024 Q38 (b): Explain how overtones are produced in a closed organ pipe.

[2025] pub\_2025 Q38(b): (i) Derive an expression for the energy of a satellite.

(ii) Calculate the energy of the Moon orbiting the Earth.

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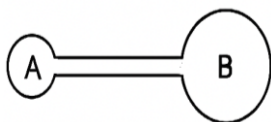




# Unit VII: Properties of Matter

## One-mark Questions

[2019] • pub\_2019 Q5: There is a small bubble at one end and a bigger bubble at the other end of a pipe. Which will happen?



- (a) Remains in equilibrium (b) Smaller will grow until collapse (c) Bigger will grow until collapse  
(d) None of the above

[2019] • pub\_2019 Q7: If the temperature of a wire is increased, the Young's Modulus will:

- (a) Increase rapidly (b) Increase slightly (c) Remain the same (d) Decrease

[2020] pub\_2020 Q10: A spring of constant  $k$  is cut into two pieces such that one piece is twice as long as the other. The force constant of the longer piece becomes:

- (a)  $6k$  (b)  $\frac{2}{3}k$  (c)  $\frac{3}{2}k$  (d)  $3k$

[2021] pub\_2021 Q7: When an object rests on a rough inclined plane, the static and kinetic friction acting on it are \_\_\_\_.

- (a) Static friction is not zero and kinetic friction is zero  
(b) static and kinetic frictions acting and kinetic friction is zero  
(c) static and kinetic frictions are not zero (d) static is zero but kinetic friction is not zero

[2021] pub\_2021 Q11: The SI unit of surface energy is \_\_\_\_.

- (a)  $Nm^3$  (b)  $Nm^{-2}$  (c)  $Nm$  (d)  $Nm^{-1}$

[2022] pub\_2022 Q7: Which of the following is not a scalar?

- (a) Pressure (b) Viscosity (c) Stress (d) Surface tension

[2023] pub\_2023 Q14: The dimensional formula for coefficient of viscosity is:

- (a)  $ML^{-2}T^{-2}$  (b)  $MLT^{-2}$  (c)  $ML^{-1}T^{-2}$  (d)  $ML^{-1}T^{-1}$

[2024] pub\_2024 Q9: With an increase in temperature, the viscosity of a liquid and a gas, respectively, will:

- (a) decrease & increase (b) increase & increase (c) decrease & decrease (d) increase & decrease



[2025] pub\_2025 Q11: If the temperature of the wire is increased, then the Young's modulus will:  
(a) increase rapidly (b) remain the same (c) increase by a very small amount (d) decrease

## Two-mark Questions

[2019] • pub\_2019 Q22: List the factors affecting Brownian motion.

[2019] • pub\_2019 Q24: The surface tension of a soap solution is 0.03 N/m. How much work is done in producing a soap bubble of radius 0.05 m?

[2020] pub\_2020 Q30: Why do we use a straw to suck soft drinks?

[2022] pub\_2022 Q16: What is Reynolds number?

[2023] pub\_2023 Q22: Define Poisson's ratio.

## Three-mark Questions

[2019] • pub\_2019 Q30: Derive an expression for the terminal velocity of a sphere in a viscous liquid.

[2021] pub\_2021 Q30: List the salient features of static and kinetic friction.

[2022] pub\_2022 Q30: Give any three applications of viscosity.

[2023] pub\_2023 Q30: Write the practical applications of capillarity.

[2024] pub\_2024 Q27: What are the factors affecting the surface tension of a liquid?

[2025] pub\_2025 Q30: Compare the salient features of static friction and kinetic friction.

## Five-mark Questions

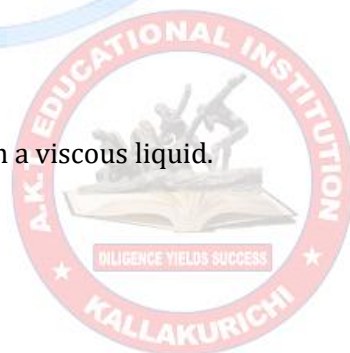
[2020] pub\_2020 Q38(b): Derive the expression for the terminal velocity of a sphere moving in a high viscous fluid, using Stokes' formula.

[2021] pub\_2021 Q33: A soap bubble has excess pressure balanced by an oil column of height 4 mm (SG = 0.8); its radius is 2.0 cm. Find the surface tension.

[2021] pub\_2021 Q37(a): State and prove Bernoulli's theorem.

[2023] pub\_2023 Q35(a): Show that in an inclined plane, angle of friction is equal to angle of repose.

[2025] pub\_2025 Q35(b): State Pascal's law. Explain the working of a hydraulic lift.



# Unit VIII: Heat and Thermodynamics

## One-mark Questions

[2019] • pub\_2019 Q4: For a satellite orbiting Earth, the ratio of kinetic to potential energy is:

- (a) 2    (b)  $\sqrt{2}$     (c)  $\frac{1}{2}$     (d)  $\frac{1}{\sqrt{2}}$

[2019] • pub\_2019 Q6: A refrigerator has a COP of 3. How much work must be supplied to a refrigerator in order to remove 200 J of heat from its interior?

- (a) 33.33 J    (b) 44.44 J    (c) 66.67 J    (d) 50 J

[2019] • pub\_2019 Q8: If the internal energy of an ideal gas ( $U$ ) and volume ( $V$ ) are doubled, then pressure of the gas

- (a) Halves    (b) Quadruples    (c) Doubles    (d) Remains same

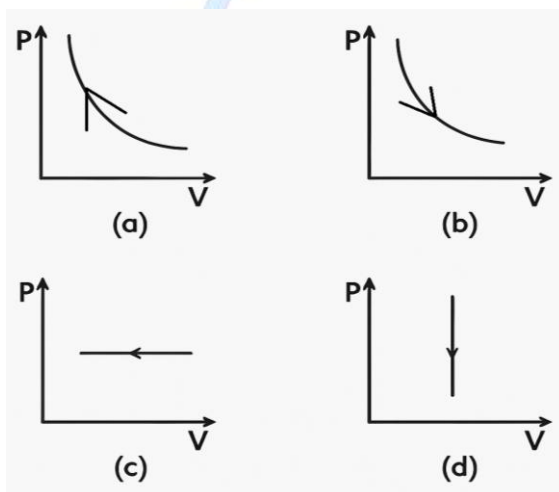
[2019] • pub\_2019 Q11: In an isochoric process, find which is relevant among the following:

- (a)  $\Delta U = 0$     (b)  $\Delta T = 0$     (c)  $W = 0$     (d)  $Q = 0$

[2020] pub\_2020 Q9: The efficiency of a heat engine operating between the freezing point and boiling point of water is:

- (a) 12.5%    (b) 6.25%    (c) 20%    (d) 26.8%

[2020] pub\_2020 Q12: Which one of the following P-V diagrams corresponds to isobaric compression?



[2021] pub\_2021 Q6: The efficiency of a Carnot engine operating between the freezing point ( $0^\circ\text{C}$ ) and boiling point ( $100^\circ\text{C}$ ) of water is \_\_\_\_.

- (a) 26.8%    (b) 6.25%    (c) 12.5%    (d) 20%

[2022] pub\_2022 Q6: The efficiency of a heat engine working between freezing and boiling point of water is:

- (a) 26.8% (b) 6.25% (c) 12.5% (d) 20%

[2022] pub\_2022 Q10: 1 kilowatt hour is:

- (a)  $3.6 \times 10^6$  J (b)  $36 \times 10^6$  J (c)  $36 \times 10^6$  WS (d) All the above

[2023] pub\_2023 Q3: The graph between volume and temperature in Charles' law is

- (a) a straight line (b) an ellipse (c) a parabola (d) a circle

[2024] pub\_2024 Q12: The SI unit for specific heat capacity is:

- (a)  $\text{J kg}^{-1} \text{K}^{-1}$  (b)  $\text{J kg}^{-1}$  (c)  $\text{K kg}^{-1} \text{J}^{-1}$  (d)  $\text{J kg K}^{-1}$

[2024] pub\_2024 Q14: When a cycle tyre suddenly bursts, the air inside the tyre expands. This process is:

- (a) isobaric (b) isothermal (c) isochoric (d) adiabatic

[2025] pub\_2025 Q6: The graph between volume and temperature in Charles' law is:

- (a) a straight line (b) an ellipse (c) a parabola (d) a circle

[2025] pub\_2025 Q8: A refrigerator has a COP of 4. How much work must be supplied to remove 300 J of heat from its interior?

- (a) 600 J (b) 66.67 J (c) 50 J (d) 75 J

## Two-mark Questions

[2019] • pub\_2019 Q21: State the Stefan–Boltzmann law and write its expression.

[2020] pub\_2020 Q21: During a cyclic process, a heat engine absorbs 500 J of heat from a hot reservoir, does work and ejects an amount of heat 300 J into the surroundings (cold reservoir). Calculate the efficiency of the engine.

[2021] pub\_2021 Q17: State Wien's law.

[2020] pub\_2020 Q32: What are the conditions for a reversible process?

[2023] pub\_2023 Q23: State Zeroth Law of Thermodynamics.

[2024] pub\_2024 Q24: A person does 30 kJ work on 2 kg of water by stirring, using a paddle wheel. While stirring, around 5 kcal of heat is released from water through its container to the surface and surroundings by thermal conduction and radiation. Find the change in internal energy of the system.

[2025] pub\_2025 Q17: What is called a PV diagram?



## Three-mark Questions

[2019] • pub\_2019 Q26: What are the various types of friction? Suggest methods to reduce friction.

[2021] pub\_2021 Q29: State the Stefan–Boltzmann law.

[2023] pub\_2023 Q33: During a cyclic process, a heat engine absorbs 600 J of heat from a hot reservoir, does work and ejects an amount of heat 200 J into the surroundings. Calculate the efficiency of the heat engine.

[2025] pub\_2025 Q29: Explain various modes of heat transfer.

## Five-mark Questions

[2019] • pub\_2019 Q37(a): Derive Mayer's relation for an ideal gas.

[2021] pub\_2021 Q36(b): Explain Newton's law of cooling in detail.

[2022] pub\_2022 Q34(b): Derive an expression for surface tension of a liquid by capillary rise method.

[2023] pub\_2023 Q37(b): Derive Meyer's relation for an ideal gas.

[2025] pub\_2025 Q36(b): Explain the working of a heat engine and derive its efficiency.

## Unit IX: Kinetic Theory of Gases

### One-mark Questions

[2020] pub\_2020 Q4: RMS speed of hydrogen molecule at 27 °C is:

- (a) 193 km/s    (b) 1.93 km/s    (c) 19.3 km/s    (d) 0.193 km/s

[2020] pub\_2020 Q13: The ratio between RMS speed and most probable speed of gas molecules at a given temperature is:

- (a)  $2\sqrt{2} : 1$     (b)  $\sqrt{3} : \sqrt{2}$     (c)  $\sqrt{2} : \sqrt{3}$     (d)  $1 : 2\sqrt{2}$

[2021] pub\_2021 Q14: If the internal energy  $U$  and volume  $V$  of an ideal gas are both doubled (constant  $n$ ), the pressure changes to \_\_\_\_.

- (a) halves    (b) doubles    (c) quadruples    (d) remains same .

[2022] pub\_2022 Q9: The ratio  $\gamma$  ( $= C_p/C_v$ ) for a gas mixture consisting of 8 g of helium and 16 g of oxygen is:

- (a) 27/17    (b) 23/15    (c) 17/27    (d) 15/23

**[2023] pub\_2023 Q10:** If the temperature and pressure of a gas is doubled the mean free path of the gas molecules

- (a) tripled      (b) remains same      (c) quadruple      (d) doubled

**[2024] pub\_2024 Q8:** Which of the following gases will have least rms speed at a given temperature?

- (a) Oxygen      (b) Hydrogen      (c) Carbon-dioxide      (d) Nitrogen

**[2025] pub\_2025 Q7:** A sample of ideal gas is at equilibrium. Which of the following quantities is zero?

- (a) average velocity      (b) rms speed      (c) most probable speed      (d) average speed

## Two-mark Questions

**[2019] • pub\_2019 Q32:** Write any six postulates of the kinetic theory of gases.

**[2020] pub\_2020 Q22:** Why is there no hydrogen in the Earth's atmosphere?

**[2021] pub\_2021 Q32:** Define degrees of freedom. Give an example.

**[2022] pub\_2022 Q17:** Define the term "degrees of freedom."

**[2022] pub\_2022 Q19:** State Wien's Displacement Law.

**[2023] pub\_2023 Q32:** Write down the postulates of kinetic theory of gases.

**[2024] pub\_2024 Q19:** What are the factors affecting Brownian motion?

**[2025] pub\_2025 Q19:** What are the factors affecting the mean free path?

## Three-mark Questions

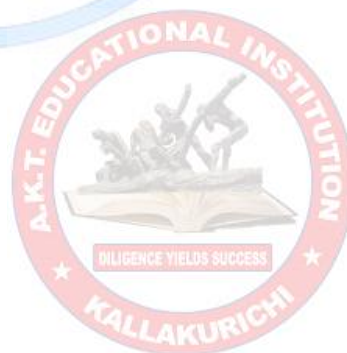
**[2024] pub\_2024 Q28:** What is the relation between average kinetic energy and pressure?

## Five-mark Questions

**[2022] pub\_2022 Q35(a):** State and explain the law of equipartition of energy.

**[2023] pub\_2023 Q38(a):** Derive the expression of pressure exerted by the gas molecules on the walls of the container.

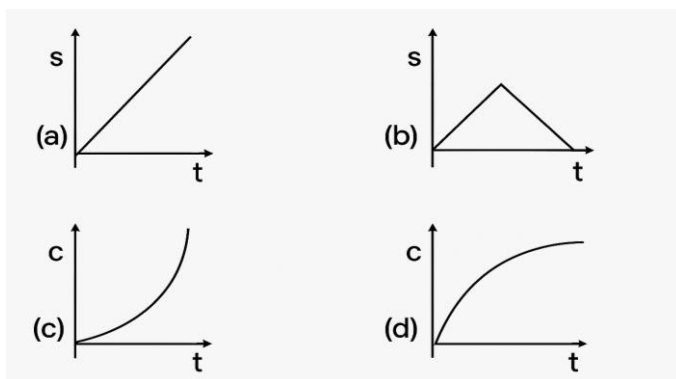
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# Unit X: Oscillations

## One-mark Questions

[2019] • pub\_2019 Q10: Which graph represents uniform acceleration?



[2019] pub\_2019 Q12: The amplitude and time period of a pendulum are 0.05 m and 2 s respectively. Then the maximum velocity of the bob is :

- (a) 0.157 m/s      (b) 0.257 m/s      (c) 0.10 m/s      (d) 0.025 m/s

[2021] pub\_2021 Q3: A hollow sphere is filled with water and suspended by a long thread. As water leaks out from a small hole at the bottom, the period of oscillation will:

- (a) increase continuously      (b) first increase then decrease  
(c) decrease continuously      (d) first decrease then increase

[2021] pub\_2021 Q13: A spring of time-period  $T$  suspends a mass  $m$ . If the spring is cut into two equal halves and the same mass is hung from one half, its new time-period becomes \_\_\_\_\_.

- (a)  $T' = \sqrt{2}T$       (b)  $T' = \sqrt{2}T$       (c)  $T' = \sqrt{\frac{T}{2}}$       (d)  $T' = \frac{T}{\sqrt{2}}$

[2022] pub\_2022 Q11: A simple pendulum suspended in a moving bus. Find the time period:

- (a)  $T$       (b)  $T$       (c)  $T$       (d)  $T$

[2023] pub\_2023 Q4: In the given SHM  $y = 2 \sin (20\pi t + 1.5)$ , the frequency of oscillation is:

- (a) 10 Hz      (b) 20 Hz      (c) 15 Hz      (d)  $\pi$  Hz

[2023] pub\_2023 Q9: A particle executing SHM crosses points A and B with the same velocity. Having taken 3 s in passing from A to B, it returns to B after another 3 s. The time period is:

- (a) 12 s      (b) 15 s      (c) 9 s      (d) 6 s



[2024] pub\_2024 Q13: Two masses of ratio 1:2 oscillate on springs  $k_A$  and  $k_B$  with max-speed ratio 1:2. The ratio of their amplitudes is:

(a)  $\sqrt{\frac{2k_B}{k_A}}$  (c)  $\sqrt{\frac{8k_B}{k_A}}$

(b)  $\sqrt{\frac{k_B}{2k_A}}$  (d)  $\sqrt{\frac{k_B}{8k_A}}$

[2025] pub\_2025 Q15: A pendulum hung in a very high building oscillates to and fro like a simple harmonic oscillator. If the acceleration of the bob is  $16 \text{ m/s}^2$  at a distance of 4 m from the mean position, then the time period is:

- (a)  $2\pi \text{ s}$  (b)  $2 \text{ s}$  (c)  $1 \text{ s}$  (d)  $\pi \text{ s}$

## Two-mark Questions

[2019] • pub\_2019 Q23: "Soldiers are not allowed to march on a bridge." Give reason.

[2020] pub\_2020 Q31: Explain resonance. Give an example.

[2021] pub\_2021 Q20: Define the frequency of simple harmonic motion.

[2022] pub\_2022 Q21: What is simple harmonic motion?

[2023] pub\_2023 Q31: State the Laws of Simple Pendulum.

[2024] pub\_2024 Q21: What is meant by free oscillation?

[2025] pub\_2025 Q22: Define resonance. Give an example.

## Three-mark Questions

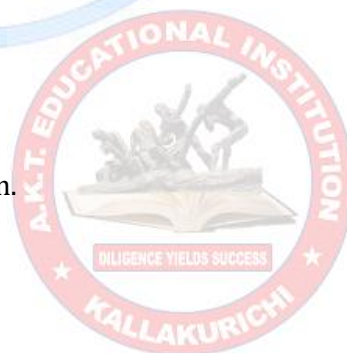
[2019] pub\_2019 Q31: Explain linear expansion of a solid.

[2022] pub\_2022 Q26: Discuss the law of transverse vibrations in stretched strings.

[2022] pub\_2022 Q32: What is meant by periodic and non-periodic motion? Give two examples ,for each motion.

[2023] pub\_2023 Q28: State the various types of potential energy. Explain its formulae.

[2024] pub\_2024 Q29: What is forced oscillation?



## Five-mark Questions

[2019] • pub\_2019 Q37(b): Explain the horizontal oscillations of a spring.

[2020] pub\_2020 Q37(b): Explain in detail the four different types of oscillations.

[2021] pub\_2021 Q34(a): Explain the oscillations of liquid in a U-tube.

[2022] pub\_2022 Q37(a): Explain the horizontal oscillations of a spring. (duplicate—review)

[2023] pub\_2023 Q34(a): Obtain an expression for the time period  $T$  of a simple pendulum. The time period depends on:

(i) mass  $m$  of the bob

(ii) length  $l$  of the pendulum

(iii) acceleration due to gravity  $g$  at the place where the pendulum is suspended.

[2024] pub\_2024 Q34: (a) Using dimensional analysis, prove  $v \propto \sqrt{F/m}$  for a vibrating string

[2025] pub\_2025 Q37(a): Explain the horizontal oscillations of a spring.

## Unit XI: Waves

### One-mark Questions

[2019] • pub\_2019 Q14: Which of the following represents a wave?

(a)  $\frac{1}{x+vt}$

(b)  $\sin(x+vt)$

(c)  $(x - vt)^3$

(d)  $x(x+vt)$

[2020] pub\_2020 Q2: Human audible wavelength range (velocity of sound in air = 340 m/s) is:

(a) 17 m to 170 m

(b) 0.17 m to 17 m

(c) 0.017 m to 17 m

(d) 1.7 m to 17 m

[2020] pub\_2020 Q3: An air column in a pipe which is closed at one end, is in resonance with a vibrating body of frequency 83 Hz. If the speed of sound in air is 332 m/s, the length of the air column is:

(a) 1.5 m

(b) 0.5 m

(c) 2.0 m

(d) 1.0 m

[2021] pub\_2021 Q9: A transverse wave in medium A has speed 500 m/s and wavelength 5 m. On entering medium B its speed becomes 600 m/s. The frequency and wavelength in B are \_\_\_\_.

(a) 120 Hz and 6 m

(b) 120 Hz and 5m

(c) 100 Hz and 6m

(d) 100 Hz, 5 m

**[2022] pub\_2022 Q1:** A transverse wave changes medium. In medium B, velocity is 600 m/s. Frequency and wavelength are:

- (a) 120 Hz, 6 m      (b) 120 Hz, 5 m      (c) 100 Hz, 6 m      (d) 100 Hz, 5 m

**[2022] pub\_2022 Q8:** A particle executes circular motion in clockwise direction in the XY plane. Angular velocity is in:

- (a)  $-x$       (b)  $+x$       (c)  $-z$       (d)  $+z$

**[2023] pub\_2023 Q8:** The fundamental frequency of a closed organ pipe whose length is 10 cm is:

- (a) 4.5 vHz      (b) 2.5 vHz      (c) 10 vHz      (d) 2 vHz

**[2023] pub\_2023 Q15:** A sound wave whose frequency is 5000 Hz travels in air and then hits the water surface. The ratio of its wavelengths in water and air is:

- (a) 5.30      (b) 4.30      (c) 1.23      (d) 0.23

**[2024] pub\_2024 Q4:** An air column (closed at one end) resonates at 83 Hz. Its length is: (a) 1.0 m (b) 1.5 m (c) 2.0 m (d) 0.5 m

**[2024] pub\_2024 Q5:** A transverse wave goes from medium A ( $v=500$  m/s,  $\lambda=5$  m) to B ( $v=600$  m/s). Find  $f$  and  $\lambda$  in B:

- (a) 120 Hz & 6 m      (b) 120 Hz & 5 m      (c) 100 Hz & 6 m      (d) 100 Hz & 5 m

**[2025] pub\_2025 Q3:** Which of the following represents a wave?

- (a)  $\frac{1}{x+vt}$       (b)  $(x - vt)^3$       (c)  $\sin(x + vt)$       (d)  $x(x + vt)$

## Two-mark Questions

**[2020] pub\_2020 Q23:** Write down the factors affecting the velocity of sound in gases.

**[2021] pub\_2021 Q22:** Compute the distance between a node and its neighbouring antinode in a standing wave.

**[2022] pub\_2022 Q18:** In a submarine equipped with sonar, the time delay between the generation of a pulse and its echo after reflection from an enemy submarine is observed to be 80 s. If the speed of sound in water is 1460 m/s, what is the distance of the enemy submarine?

**[2025] pub\_2025 Q24:** The speed of a wave in a certain medium is 900 m/s. If 3000 waves pass over a certain point in 2 minutes, compute its wavelength.

### Three-mark Questions

[2019] • pub\_2019 Q33: Two waves of wavelength 99 cm and 100 cm both travelling with the velocity of 396 m/s are made to interfere. Calculate the number of beats produced by them per second.

[2020] pub\_2020 Q29: Write the differences between transverse and longitudinal waves.

[2021] pub\_2021 Q26: State the law of transverse vibrations in stretched strings.

[2024] pub\_2024 Q30: Two tuning forks vibrate as  $y_1 = 5 \sin(240\pi t)$  and  $y_2 = 4 \sin(244\pi t)$ . Compute the number of beats per second.

### Five-mark Questions

[2021] pub\_2021 Q35(b): Explain how overtones are formed in a closed organ pipe.

[2022] pub\_2022 Q38(b): Explain how overtones are formed in a closed organ pipe.

[2023] pub\_2023 Q38(b): Derive Newton's formula for velocity of sound waves in air. Explain the Laplace's correction in it.

[2024] pub\_2024 Q34 (b): State and prove Bernoulli's theorem for incompressible, non-viscous, streamlined flow.

[2025] pub\_2025 Q34(b): Describe Newton's formula for the velocity of sound in air and discuss Laplace's correction.

