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VOLUME - I

UNIT-1 NATURE OF PHYSICAL WORLD AND MEASUREMENT

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. Briefly explain the types of physical quantities. 2 MARKS

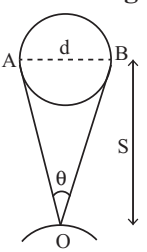
Ans. (i) Physical quantities are classified into two types: fundamental or base and derived quantities.

(ii) Fundamental or base quantities are quantities which cannot be expressed in terms of any other physical quantities. For example length, mass, time, electric current, temperature, luminous intensity and amount of substance.

(iii) Quantities that can be expressed in terms of fundamental quantities are called derived quantities. For example, area, volume, velocity, acceleration, force.

2. How will you measure the diameter of the Moon using parallax method? 3 MARKS

Ans. In diagram, O is the observation point on the earth and *d* is the diameter of moon.



(i) An astronomical telescope held at O is focussed on moon, the image is observed into moon of a circular disc.

(ii) $\angle AOB = \theta$

S - average distance between moon and the surface of earth.

(iii) As 'S' is very large compared to the diameter, the diameter *d* of the moon is considered as a circular arc of radius, S.

$d = S \times \theta$.

Hence *d* can be calculated, when 'S' is known and O is measured.

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Accuracy, Δl = 2mm = 0.2 cm

Time for 50 oscillations T = 40 s

resolution ΔT = 1 s

$$\therefore \frac{\Delta g}{g} = \left(\frac{0.2}{20}\right) + 2\left(\frac{1}{40}\right) = \frac{0.2}{20} + \frac{2}{40} = \frac{1.2}{20}$$

Percentage error,

$$\frac{\Delta g}{g} \times 100 = \frac{1.2}{20} \times 100 = \pm 6\%$$

% accuracy in g = 6%.

CONCEPTUAL QUESTIONS :

1. Why is it convenient to express the distance of stars in terms of light year (or) parsec rather than in km?

3 MARKS

Ans. The distances of astronomical objects like stars, planets, etc from the earth are huge. The distance on the earth are relatively small so it can be measured in km.

For Example :

The distance to be next nearest big galaxy Andromeda is 21,000,000,000,000,000,000 km.

i.e. 21×10^{18} km.

This no. is so large that it becomes hard to write and to interpret. So astronomical units like light year, parsec A.U for large distances.

2. Show that a screw gauge of pitch 1 mm and 100 divisions is more precise than a vernier caliper with 20 divisions on the sliding scale.

3 MARKS

Ans. Least count of screw gauge

$$= \frac{\text{Pitch}}{\text{No. of divisions}}$$

$$= \frac{1}{100} = 0.01 \text{ mm (or) } 0.001\text{cm}$$

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Least count of vernier calipers

$$= 1\text{MSD} - 1\text{VSD} = (1 - {}^{19}\!/_{20})\ \text{MSD}$$

$$= \frac{1}{20} = 0.05\text{cm}.$$

So screw gauge is more precise than vernier.

3. If humans were to settle on other planets, which of the fundamental quantities will be in trouble? Why? **2 MARKS**

Ans. Time will be in trouble. Time becomes irrelevant. Because day and year based on spinning and revolution of the planet. So each planet has its own year length.

Eg. : Uranus and Neptune move too slow.

4. Having all units in atomic standards is more useful. Explain. **2 MARKS**

Ans. All units in atomic standards are more useful because they never change with time.

5. Why dimensional methods are applicable only upto three quantities? **2 MARKS**

Ans. If a quantity depends on more than three factors having dimensional formula cannot be derived.

Because on equating the powers of M, L & T on either side of the dimensional equation, three equations can be obtained, from which only three unknown dimensions can be calculated.

In-Text Questions

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. What is Absolute Error?

Ans. The magnitude of difference between true value and the measured value of a quantity is called absolute error.

$\Delta a_n = a_m - a_n$

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4. Check the correctness of the equation $E = mc^2$ using dimensional analysis method. *[GMQP-2018]*

Ans. Consider the equation, $E = mc^2$

Apply dimensional formula on both sides

$$ML^2T^{-2} = [M] \cdot [LT^{-1}]^2$$
$$ML^2T^{-2} = [M] \cdot [L^2T^{-2}]$$

The equation is dimensionally correct.

5. Two resistances $R_1=(100 \pm 3)\Omega$ and $R_2=(150\pm2)\Omega$ are connected in series. What is their equivalent resistance ?

Ans. $R_1 = 100 \pm 3\ \Omega$; $R_2 = 150 \pm 2\Omega$ *[GMQP-2018]*

Equivalent resistance R = ?

Equivalent resistance $R = R_1 + R_2$

$$= (100 \pm 3)+(150 \pm 2) = (100 + 150) \pm (3 + 2)$$

$$\mathbf{R = (250 \pm 5)\ \Omega}$$

6. Find the dimensional formula of hC/G? *[QY-2018]*

Ans. The dimensional formula for

planck's constant h – $[ML^2T^{-1}]$

c – $[LT^{-1}]$

G – $[M^{-1}L^2T^{-2}]$

$$\frac{hc}{G} = \frac{[ML^2T^{-1}][LT^{-1}]}{[M^{-1}L^3T^{-2}]}$$
$$= [M^2]$$

Board Expected Questions

Very Short Answer Questions : 2 MARKS

1. What is Relative error?

Ans. The ratio of the mean absolute error to the mean value is called relative error. This is also called as fractional error.

$$\text{Relative error} = \frac{\text{Mean absolute error}}{\text{Mean value}} = \frac{\Delta a_m}{a_m}$$

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8. The radius of gold nucleus is 41.3 Fermi. Express its volume in m^3.

Solution: Radius of gold nucleus = 41.3×10^{-15} m

$$\text{Volume } (v) = \frac{4}{3}\pi r^3 = \frac{4}{3} \times 3.14 \times (41.3 \times 10^{-15})^3$$

$$v = 2.95 \times 10^{-40} \text{ m}$$

SHORT ANSWER QUESTIONS : 3 MARKS

1. What are fundamental units and derived units?

Ans. **Fundamental units:**

The units in which the fundamental quantities are measured are called fundamental units. It is also known as base units.

Derived units:

The units of measurements of all other physical quantities, which can be obtained by a suitable multiplication or division of powers of fundamental units are called derived units.

Example:

$$\text{Unit of speed} = \frac{\text{Unit of distance}}{\text{Unit of time}} = \frac{\text{m}}{\text{s}} = \text{ms}^{-1}$$

ms^{-1} is a derived unit.

2. How can the systematic errors be minimised?

Ans. (i) By choosing the instrument carefully.
(ii) Necessary correction is to be made.
(iii) High precision instrument is to be used.
(iv) Proper setting up of experiments is to be done.
(v) Taking proper precautions is a must, while making observations.

Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Why has 'second' been defined in terms of periods of radiations from cesium-133?

Ans. Second has been defined in terms of periods of radiations because

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SI unit of stress = $\frac{\text{Force}}{\text{Area}} = \frac{\text{N}}{\text{m}^2} = \text{Nm}^{-2}$

Strain is dimensionless variable.

So, co-efficient of elasticity of a wire is = $\frac{\text{Stress}}{\text{Strain}}$

$$= \frac{3\ \text{Nm}^{-2}}{2\ (\text{No unit})} = 1.5\ \text{Nm}^{-2}$$

NUMERICAL PROBLEMS : 3 MARKS

1. If mass of an electron is 9.11×10^{-31} kg, how many electrons would weigh in 1 mg?

Mass of an electron = 9.11×10^{-31}kg

9.11×10^{-31}kg is the mass of 1 electron

Solution:

9.11×10^{-31}kg $= 9.11 \times 10^{-31} \times 10^{3}$ g $= 9.11 \times 10^{-28}$ g

$= 9.11 \times 10^{-25}$ mg

1mg is the mass of $\frac{1}{9.11 \times 10^{-25}\ \text{mg}}$ electron

$= 0.1097 \times 10^{25}$electrons

$= 1.097 \times 10^{24}$ electrons

1.097×10^{24} electrons would weigh in 1 mg.

2. When the planet Jupiter is at a distance of 824.7 million kilometers from the earth, its angular diameter is measured to be 35.72 of arc. Calculate the diameter of Jupiter.

Solution:

Distance, D = 824.7×10^{6} km

$$\theta = 35.72'' = \frac{35.72}{60 \times 60} \times \frac{\pi}{180}\ \text{rad}$$

$\theta \rightarrow$ is angular diameter

Diameter, d = ?

$$d = D \times \theta$$

$$= 824.7 \times 10^{6} \times \frac{35.72}{60 \times 60} \times \frac{\pi}{180}\ \text{km}$$

$$= 824.7 \times 10^{6} \times \frac{35.72}{3600} \times \frac{\pi}{180}\ \text{km}$$

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UNIT-2 KINEMATICS

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. Explain what is meant by Cartesian coordinate system? **2 MARKS**

Ans. At any given instant of time, the frame of reference with respect to which the position of the object is described in terms of position coordinates (x, y, z) (i.e., distances of the given position of an object along the x, y, and z–axes.) is called **"Cartesian coordinate system"**.

2. Define a vector. Give examples. **2 MARKS**

Ans. It is a quantity which is described by both magnitude and direction. Geometrically a vector is a directed line segment.

Examples: Force, velocity, displacement, position vector, acceleration, linear momentum and angular momentum.

3. Define a scalar. Give examples **2 MARKS**

Ans. It is a property which can be described only by magnitude.

Examples: Distance, mass, temperature, speed and energy.

4. Write a short note on the scalar product between two vectors. **2 MARKS**

Ans. (i) The scalar product (or dot product) of two vectors is defined as the product of the magnitudes of both the vectors and the cosine of the angle between them.

(ii) Thus if there are two vectors $\vec{A}$ and $\vec{B}$ having an angle θ between them, then their scalar product is defined as $\vec{A} \cdot \vec{B} = \cos\theta$. Here, A and B are magnitudes of $\vec{A}$ and $\vec{B}$.

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In-Text Questions

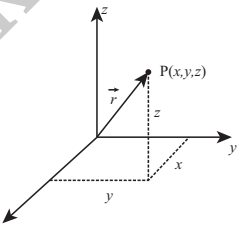
VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. What is meant by frame of reference?

Ans. A co-ordinate system and the position of an object is described relative to it, then such a coordinate system is called frame of reference.

2. What is position vector? Show the position vector for particle in three dimensional motion. Write an expression for this position vector.

Ans. (i) It is a vector which denotes the position of a particle at any instant of time, with respect to some reference frame or coordinate system.



(ii) The position vector $\vec{r}$ of the particle at a point P is given by

$\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$

where x, y and z are components of $\vec{r}$.

3. Define average speed.

Ans. The average speed is defined as the ratio of total path length travelled by the particle in a time interval.

Average speed = total path length / total time

4. Define Time of flight (T_f) of a projectile and derive.

Ans. Time of flight (T_f) Th e total time taken by the projectile from the point of projection till it hits the horizontal plane is called time of flight.

5. Define angular acceleration.

Ans. The rate of change of angular velocity is called angular acceleration.

$$\vec{a} = \frac{d\vec{\omega}}{dt}$$

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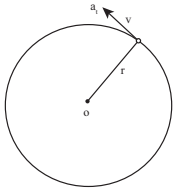
(v) The tangential acceleration at experienced by an object is circular motion as shown in Figure



Tangential acceleration

Note that the tangential acceleration is in the direction of linear velocity.

Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. Find the speed of the projectile when it hits the ground?

Ans. (i) When the projectile hits the ground after initially thrown horizontally from the top of tower of height h, the time of flight is

$$t = \sqrt{\frac{2h}{g}}$$

(ii) The horizontal component velocity of the projectile remains the same, i.e $v_x = u$.

(iii) The vertical component velocity of the projectile at time T is

$$v_y = gt = g\sqrt{\frac{2h}{g}} = \sqrt{2gh}$$

(iv) The speed of the particle when it reaches the ground is

$$v = \sqrt{u^2 + 2gh}$$

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2. (i) Name the quantity which remains unchanged during the flight of an oblique projectile.

(ii) If the velocity of projectile is 10 ms^{-1} at what angle to the horizontal should be projected as that it covers maximum horizontal distance?

Ans. (i) Horizontal component of velocity.

(ii) At an angle of 45º to be horizontal.

3. What are the two quantities which have maximum values when the maximum height attained by the projectile is to the largest?

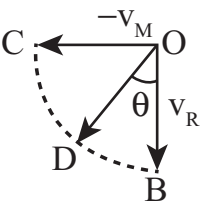
Ans. (i) Vertical component of initial velocity.

(ii) Time of flight.

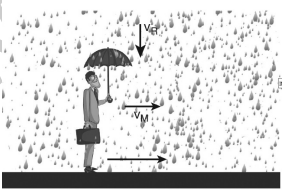
SHORT ANSWER QUESTIONS : 3 MARKS

4. A man moving in rain holds an umbrella inclined to the vertical though the rain drops are falling vertically. Why?

Ans. (i) Consider a person moving horizontally with velocity $\vec{V}_M$. Let rain fall vertically with velocity $\vec{V}_R$.



(ii) An umbrella is held to avoid the rain. Then the relative velocity of the rain with respect to the person is



(iii) $\vec{V}_{RM} = \vec{V}_R - \vec{V}_M = \vec{OB} + \vec{OC} = \vec{OD}$

Which has magnitude

$V_{RM} = \sqrt{V_R^2 + V_M^2}$

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$\tan\theta = \frac{DB}{OB} = \frac{V_M}{V_R}$ and direction $\theta = \tan^{-1}\left(\frac{V_M}{V_R}\right)$ with the vertical as shown in fig.

(iv) In order to save himself from the rain, he should hold an umbrella at an angle θ with the vertical.

NUMERICAL PROBLEMS : 2 MARKS

1. A train 20 m long is moving with a speed of 40 km/h. In what time shall it cross a bridge of 500 m long?

Solution:

Length of the train S_1 = 20 m

Length of the bridge S_2 = 500 m

Time (t) = ?

Total length $S = S_1 + S_2 = 20 + 500 = 520$ m

$$\text{Speed of train } s = 40\,\text{kmh}^{-1} = 40 \times \frac{5}{18}\,\text{m/s} = 11\ \text{m/s}$$

$$\text{Time}(t) = \frac{\text{Distance}}{\text{Speed}} = \frac{520}{11} = 47\,\text{sec}.$$

2. The position of an particle is given by $x = 6t + 2t^3$. Find out that its motion is uniform and non-uniform.

Solution:

The position of an particle $x = 6t + 2t^3$

By differentiating with respect to 't'

$$AB = |A||B|\cos\theta$$

$$\cos\theta = \frac{A \cdot B}{|A||B|}$$

$$A \cdot B = (\hat{i} + 2\hat{j} - k) \cdot (-4\hat{i} + \hat{j} - 2k)$$

$$-4 + 2 + 2k = -4 + 4k = -4 + 4 = 0$$

$$\cos\theta = 0$$

$$\theta = \cos^{-1} 0 = 90°$$

As velocity is time independent, it means that motion is uniform.

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UNIT-3 LAWS OF MOTION

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. Explain the concept of inertia. Write two examples each for inertia of motion, inertia of rest and inertia of direction. **3 MARKS**

Ans. The inability of objects to move on its own or change its state of motion is called inertia. Inertia means resistance to change its states.

Examples for Inertia of motion:

(i) A man jumping from moving bus falls forward.

(ii) An athlete runs some distance before taking a long jump.

Examples for Inertia of rest:

(i) Dust particles on a carpet fall if we beat to carpet with a stick.

(ii) Fruits fall down when the branches of a tree is shaken.

Examples for Inertia of direction:

(i) When a stone attached to a string is in whirling motion, and if the string is cut suddenly, the stone will not continue to move in circular motion but moves tangential to the circle.

(ii) The rain drops falling vertically downwards cannot change their direction of motion and so cannot wet us when the umbrella is up.

2. State Newton's second law. ***[First Mid-2018]*** **2 MARKS**

Ans. The force acting on an object is equal to the rate of change of its momentum.

$$\vec{F} = \frac{d\vec{p}}{dt} = m\vec{a}$$

3. Define one newton. **2 MARKS**

Ans. One Newton is defined as the force which acts on 1 kg of mass to give an acceleration 1 m s^{-2} in the direction of the force.

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6. When a person walks on a surface, the frictional force exerted by the surface on the person is opposite to the direction of motion. True or false? **2 MARKS**

Ans. False. The frictional force exerted by the surface is not opposite to the direction of motion.

7. Can the coefficient of friction be more than one? **2 MARKS**

Ans. Yes, $\mu > 1$, friction is stronger than normal force.

8. Can we predict the direction of motion of a body from the direction of force on it? **2 MARKS**

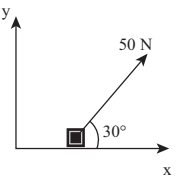
Ans. If an object is thrown vertically upward, the direction of motion is upward, but gravitational force is downward.

9. The momentum of a system of particles is always conserved. True or false? **2 MARKS**

Ans. True. The momentum of a system of particles is always conserved.

NUMERICAL PROBLEMS :

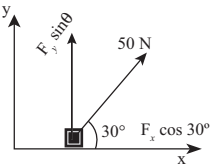
1. A force of 50N act on the object of mass 20 kg shown in the figure. Calculate the acceleration of the object in *x* and *y* directions. **2 MARKS**



Solution:

$$a_x = \frac{F_x \cos 30^\circ}{20} = \frac{50}{20} \times \frac{\sqrt{3}}{2}$$

$$= \frac{25 \times 1.732}{20} = 2.165 \text{ ms}^{-2}$$



$$a_y = \frac{F_y \sin 30^\circ}{20} = \frac{50}{20} \times \frac{1}{2} = 1.25 \text{ ms}^{-2}$$

2. A spider of mass 50 g is hanging on a string of a cob web as shown in the figure. What is the tension in the string?

Solution: **2 MARKS**

$T = mg$

mass (m) = 50 g = 0.050 kg

$g = 9.8 \text{ ms}^{-2}$

$T = 0.050 \times 9.8 = 0.49$ N.

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12. A car takes a turn with velocity 50 ms^{-1} on the circular road of radius of curvature 10 m. calculate the centrifugal force experienced by a person of mass 60kg inside the car?

2 MARKS

Ans.

Velocity v = 50 ms^{-1}

Radius of curvature r = 10 m

Mass m = 60 kg

$$F = \frac{mv^2}{r} = \frac{60 \times 50 \times 50}{10} = \frac{150000}{10}$$

$$\therefore F = 15{,}000 \text{ N}$$

13. A long stick rests on the surface. A person standing 10 m away from the stick. With what minimum speed an object of mass 0.5 kg should he thrown so that it hits the stick. (Assume the coefficient of kinetic friction is 0.7).

Ans. The distance of stick from person, s = 10m **2 MARKS**

Mass of the object, m = 0.5 kg

$$\mu_k = f_k/R$$

$$f_k = \mu_k.R \Rightarrow ma = \mu_k.mg$$

$$a = \mu_k.g$$

$$= 0.7 \times 9.8$$

$$a = 6.86 \text{ ms}^{-2}$$

To find minimum velocity

$$v^2 = u^2 + 2as$$

u = Initial velocity = 0

$$v^2_{min} = 2 \times 6.86 \times 10 = 137.2$$

$$v_{min} = \sqrt{137.2} = 11.71 \text{ ms}^{-1}.$$

In-Text Questions

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. State Newton's First Law.

Ans. Every object continues to be in the state of rest or of uniform motion (constant velocity) unless there is external force acting on it.

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Board Expected Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. How to verify Newton's third law, using spring balances?

Ans. (i) Two spring balances are attached.

(ii) One end is fixed with rigid support and the other free end pulled by the force.

(iii) Pull one end with same force and note the readings on both the balances.

(iv) Repeat it. We can notice same reading in both balances.

2. Find the acceleration when multiple forces act on the body.

Ans. (i) If multiple forces $\vec{F}_1, \vec{F}_2, \vec{F}_3 \ldots \vec{F}_n$ act on the same body, then the total force $\left(\vec{F}_{net}\right)$ is equivalent to the vectorial sum of the individual forces.

(ii) Their net force provides the acceleration.

$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \ldots + \vec{F}_n$$

(iii) Newton's second law for this case is

$$\vec{F}_{net} = m\vec{a}$$

In this case the direction of acceleration is in the direction of net force.

3. (i) What are the forces acting on the sliding object?

(ii) What are the factors are determined by these forces?

Ans. (i) Downward gravitational force (mg), Normal force perpendicular to inclined surface (N).

(ii) Acceleration of the object, Speed of the object when it reaches the bottom.

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2. A book of mass m is at rest on the table.

(1) What are the forces acting on the book?

(2) What are the forces exerted by the book?

(3) Draw the free body diagram for the book.

Ans. (1) There are two forces acting on the book.

(i) Gravitational force (*mg*) acting downwards on the book.

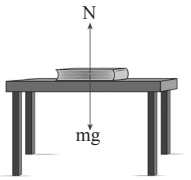
(ii) Normal contact force (N) exerted by the surface of the table on the book. It acts upwards.

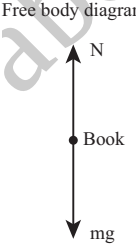
(2) According to Newton's third law, there are two reaction forces exerted by the book.

(i) The book exerts an equal and opposite force (*mg*) on the Earth which acts upwards.

(ii) The book exerts a force which is equal and opposite to normal force on the surface of the table (N) acting downwards.

(3)





Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Why do passengers fall in backward direction when a bus suddenly starts moving from the rest position?

Ans. (i) **Inertia of rest:** When a stationary bus starts to move, the passengers experience a sudden backward push.

(ii) Due to inertia, the body (of a passenger) will try to continue in the state of rest, while the bus moves forward. This appears as a backward push.

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UNIT-4 WORK, ENERGY AND POWER

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. Explain how the definition of work in physics is different from general perception. **2 MARKS**

Ans. (i) Any activity can generally be called as work.

(ii) But in Physics, work is said to be done by the force when the force applied on a body displaces it.

2. Write the various types of potential energy. Explain the formulae. **3 MARKS**

Ans. **Various types of potential energies.**

Each type is associated with a particular force. For example,

(i) The energy possessed by the body due to gravitational force gives rise to **gravitational potential energy**.

$$U = mgh$$

(ii) The energy due to spring force and other similar forces give rise to **elastic potential energy**.

$$U = \frac{1}{2} k (x_f^2 - x_i^2)$$

(iii) The energy due to electrostatic force on charges gives rise to **electrostatic potential energy**.

$$U = \frac{q_1 q_2}{4\pi \sum r}$$

3. Write the differences between conservative and Non-conservative forces. Give two examples each. **3 MARKS** *[QY-2018]*

S.No.	Conservative forces	Non-Conservative forces
1.	Work done is independent of the path	Work done depends upon the path

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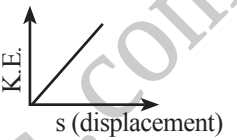
For constant speed $v = u$, then $a = 0$. (a – acceleration)

$F = ma$ ∴ F = zero. i.e. no external force.

W = F.S = 0. So net work done is zero.

4. A car starts from rest and moves on a surface with uniform acceleration. Draw the graph of kinetic energy versus displacement. What information you can get from that graph? **2 MARKS**

Ans. K.E. $= \frac{1}{2} mv^2$



$= \frac{1}{2} m (2as)$ [From equation of motion II]

∴K.E. α S.

5. A charged particle moves towards another charged particle. Under what conditions the total momentum and the total energy of the system conserved? **3 MARKS**

Ans. (i) Both charged particles shall be dissimilar charge. (i.e. possitive and negative)

(ii) After collision the charged particles should stick together permanent.

(iii) They should move with common velocity.

In-Text Questions

Very Short Answer Questions : **2 MARKS**

1. What is the work done by the centripetal force in circular motion?

Ans. In circular motion the centripetal force does not do work on the object moving on a circle as it is always perpendicular to the displacement.

F *dr* cos 90° [cos 90° = 0]

∴ W = 0

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2. Define Potential energy. Write the expression of it.

[GMQP-2018]

Ans. (i) Potential energy of an object at a point P is defined as the amount of work done by an external force in moving the object at constant velocity from the point O (initial location) to the point P (final location).

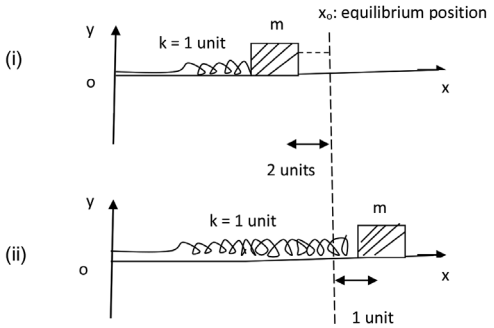
(ii) At initial point O potential energy can be taken as zero.

(iii) Mathematically, potential energy is

defined as $U = \int \vec{F}_a . d\vec{r}$

where the limit of integration ranges from initial location point O to final location point P.

3. Write the spring force acting on the object at the positions given below (surface is frictionless) *[GMQP-2018]*



Ans. (i) $f = -kx = -1 \times 2 = -2$

(ii) $f = -1 \times 1 = -1$

4. What is power? Give its dimensional formula? *[QY-2018]*

Ans. Power is defined as the rate of work done or energy delivered its dimension is $[ML^2T^{-3}]$ (or)

Power P = workdone (W) / time taken (t).

5. What is the condition for perfect inelastic collision?

[QY-2018]

Ans. The two objects should stick together permanently after collision such that they move with common velocity.

In that collision linear momentum is conserved but KE is not conserved.

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7. What is Non-conservative force? Give example.

Ans. A force is said to be non-conservative if the work done by or against the force in moving a body depends upon the path between the initial and final positions. This means that the value of work done is different in different paths.

(i) Frictional forces are non-conservative forces as the work done against friction depends on the length of the path moved by the body.

(ii) The force due to air resistance, viscous force are also non-conservative forces as the work done by or against these forces depends upon the velocity of motion.

Board Expected Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. (i) Can Kinetic energy of a system be changed without changing its momentum?

(ii) Can momentum of a system be changed without changing its kinetic energy? Give example.

Ans. (i) Yes, **Example :** When a bomb explodes momentum is conserved but kinetic energy changes.

(ii) Yes, **Example :** In uniform circular motion kinetic energy remains unchanged but lineal momentum changes because of change in the direction of motion.

2. How can an object move with zero acceleration (constant velocity) when the external force is acting on the object?

Ans. (i) It is possible when there is another force which acts exactly opposite to the external applied force.

(ii) They both cancel each other and the resulting net force becomes zero, hence the object moves with zero acceleration.

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UNIT-5 MOTION OF SYSTEM OF PARTICLES AND RIGID BODIES

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. Define center of mass. **2 MARKS**

Ans. The center of mass of a body is defined as a point where the entire mass of the body appears to be concentrated.

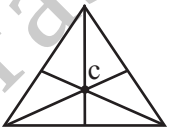
2. Find out the center of mass for the given geometrical structures. **3 MARKS**

(a) Equilateral triangle

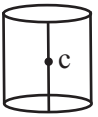
(b) Cylinder

(c) Square

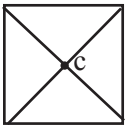
Ans. (a) Point of intersection of the medians



(b) Middle point of the axis.



(c) Point of intersection of diagonals



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NUMERICAL PROBLEMS :

1. A uniform disc of mass 100g has a diameter of 10 cm. Calculate the total energy of the disc when rolling along a horizontal table with a velocity of 20 cms^{-1} (take the surface of table as reference). **3 MARKS**

Solution:

Mass of the disc m = 100 g = 0.1 kg.

Diameter of the disc d = 10 cm

Radius of the disc r = 5 cm = 0.05 m

Rolling with a velocity v = 20 cms^{-1} = 0.20 ms^{-1}

Total energy of the disc E_{Tot} = ?

E_{Tot} = Translational KE. + rotational K.E.

M.I of the disc about its own axis,

$$I = \frac{1}{2} mr^2$$

$$v = r\omega \therefore \omega^2 = \frac{v^2}{r^2}$$

$$\text{Rotational K.E.} = \frac{1}{2} I\omega^2 = \frac{1}{2} \times \left(\frac{1}{2} mr^2\right) \times \left(\frac{v^2}{r^2}\right)$$

$$= \frac{1}{4} mv^2.$$

$$\text{T.E.} = \frac{1}{2} mv^2 + \frac{1}{4} mv^2 = \frac{3}{4} mv^2$$

$$\text{T.E. of the disc } E_{Tot} = \frac{3}{4} \times 0.1 \times 0.20 \times 0.20$$

$$= 0.003 \text{ J}$$

2. A particle of mass 5 units is moving with a uniform speed of $v = 3\sqrt{2}$ units in the XOY plane along the line $y = x + 4$. Find the magnitude of angular momentum. **2 MARKS**

Solution:

Equation of line $x - y + 4 = 0$

Mass of particle = 5 units

Speed $v = 3\sqrt{2}$ units

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In-Text Questions

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. What is meant by an internal force & external force?

Ans. Internal forces are the forces acting among the particles within a system that constitute the body. External forces are the forces acting on the particles of a system from outside.

2. What is rigid body?

Ans. A rigid body is the one which maintains its definite and fixed shape even when an external force acts on it.

3. What is the effect of Torque on Rigid Bodies.

Ans. (i) A rigid body which has non-zero external torque (τ) about the axis of rotation would have an angular acceleration (α) about that axis.

(ii) The scalar relation between the torque and angular acceleration is

$$\tau = I\alpha$$

where I is the moment of inertia of the rigid body. The torque in rotational motion is equivalent to the force in linear motion.

4. What is meant by rolling friction?

Ans. When the round object moves, it always tends to roll on any surface which has a coefficient of friction any value greater than zero ($\mu > 0$). The friction that enabling the rolling motion is called rolling friction.

5. A force of $\vec{F} = (4\hat{i} - 3\hat{j} + 5\hat{k})$ N is applied at a point whose position vector is $\vec{r} = (7\hat{i} + 4\hat{j} - 2\hat{k})$ m. Find the torque of force about the origin. ***[GMQP-2018]***

Ans. $\vec{r} = 7\hat{i} + 4\hat{j} - 2\hat{k}$

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3.	Velocity, $v = \frac{dx}{dt}$	Angular velocity $\omega = \frac{d\theta}{dt}$
4.	Acceleration, $a = \frac{dv}{dt}$	Angular acceleration $\alpha = \frac{d\omega}{dt}$
5.	Mass, m	Moment of inertia, I
6.	Force, F = ma	Torque, $\tau = I\alpha$
7.	Linear momentum, $p = mv$	Angular momentum, $L = I\omega$
8.	Impulse, $F\Delta t = \Delta p$	Impulse, $\tau\Delta t = \Delta L$
9.	Work done, $w = F s$	Work done, $w = \tau\theta$
10.	Kinetic energy $KE = \frac{1}{2} mv^2$	Kinetic energy KE = $\frac{1}{2} I\omega^2$
11.	Power, $P = F v$	Power, $P = \tau\omega$

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 MARKS

1. State the torque about an axis is independent of the origin.

Ans. (i) The torque of a force about an axis is independent of the choice of the origin as long as it is chosen on that axis itself.

(ii) Let O be the origin on the axis AB, which is the rotational axis of a rigid body. F is the force acting at the point P. Now, choose another point O′ anywhere on the axis.

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NUMERICAL PROBLEMS : 2 MARKS

1. A constant couple of 500 Nm turns a wheel of moment of inertia 100 kgm^2 about an axis through its centre. What will be the angular velocity gained by the body after 2 seconds.

Solution:

$$\tau = I\alpha = \frac{I(\omega_2 - \omega_1)}{t}$$

$$\omega_2 - \omega_1 = \frac{\tau t}{I} = \frac{500 \times 2}{100} = 5 \times 2 = 10 \text{ rad/s}$$

The gain in angular velocity is 10 rad/s

2. The moment of inertia of a thin rod of mass 'M' and length 'l' about an axis passing through its centre is $\frac{Ml^2}{12}$. Calculate the moment of inertia about a parallel axis through end of rod.

Solution:

According to parallel axis theorem,

$$I = I_0 + mx^2$$

$$= \frac{Ml^2}{12} + M\left(\frac{l}{2}\right)^2 = \frac{Ml^2}{12} + \frac{Ml^2}{4} = Ml^2\left[\frac{1}{12} + \frac{1}{4}\right]$$

$$= Ml^2\left[\frac{1}{3}\right]$$

$$I = \frac{Ml^2}{3}.$$

3. A car of mass 1200 kg is travelling around a circular path of radius 300 m with a constant speed of 54 km/h. Calculate its angular momentum.

Solution:

mass, m = 1200 kg

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VOLUME - II

UNIT-6 GRAVITATION

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. State Kepler's three laws.

Ans. **1. Law of orbits:**
Each planet moves around the Sun in an elliptical orbit with the Sun at one of the foci.

2. Law of area:
The radial vector (line joining the Sun to a planet) sweeps equal areas in equal intervals of time.

3. Law of period:
The square of the time period of revolution of a planet around the Sun in its elliptical orbit is directly proportional to the cube of the semi-major axis of the ellipse.

2. State Newtons Universal law of gravitation.

Ans. Newtons law of gravitation states that a particle of mass M_1 attracts any other particle of mass M_2 in the universe with an attractive force. The strength of this force of attraction was found to be directly proportional to the product of their masses and is inversely proportional to the square of the distance between them.

3. Will the angular momentum of a planet be conserved? Justify your answer.

Ans. Yes, Because

$$\vec{\tau} = \vec{r} \times \vec{F} = \vec{r} \times \left(-\frac{GM_S M_E}{r^2} \hat{r} \right) = 0$$

Since $\vec{r} = r\hat{r}$, $(\hat{r} \times \hat{r}) = 0$

So, $\vec{\tau} = \frac{d\vec{L}}{dt} = 0.$

It implies that angular momentum $\vec{L}$ is a constant vector. The angular momentum of the Earth about the Sun is constant throughout the motion.

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In-Text Questions

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. If the force of gravity acts on all bodies in proportion to their masses, why does heavy body not all faster than a light body?

Ans. **(i)** If F be the gravitational force on a body of mass m then

$$F = \frac{GMm}{R^2} = mg \qquad \therefore g = \frac{GM}{R^2}$$

(ii) $F \propto m$ but g does not depend on m. So all bodies fall with same speed if there is no air resistance.

2. Acceleration to Newton's law of gravitation the apple and the earth experience equal & opposite forces due to gravitation. But it is the apple falls towards the earth and not vice-versa. Why?

Ans. Acceleration to Newton's III law, the force with which the earth is attracted towards the apple is equal to the force with which earth attracts the apple. However the mass of the earth is extremely large as compared to that of apple. So acceleration of the earth is very small & is not noticeable.

3. Why does a tennis ball bounce higher on a hall than on plains?

Ans. The value of g is less on hills because they are comparatively at a greater distance from the centre of the earth.

∴ The gravitational pull on the tennis bell is less on hill tops and so it bounces higher on hills than on plains.

4. What is the effect of rotation of the earth on the acceleration due to gravity?

Ans. The acceleration due to gravity decreases due to rotation of the earth. This effect is zero at poles and maximum at the equator.

5. By which law is the Kepler's law of areas identical? Is this Kepler's law kinematic?

Ans. **(i)** The law of conservation of angular momentum.

(ii) Yes. Since Kepler's III law is the relation between distance and time.

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$$\frac{Mv^2}{(R_E + h)} = \frac{GMM_E}{(R_e + h)^2}$$

$$v^2 = \frac{GM_E}{(R_E + h)}$$

$$v = \sqrt{\frac{GM_E}{(R_E + h)}}$$

As h increases, the speed of the satellite decreases.

Board Expected Questions

Very Short Answer Questions : 2 MARKS

1. Explain why high & low tide are formed on seas.

Ans. The gravitational attraction of moon on sea water causes high tides. Tides at one place cause low tides at another. Attraction by sun also causes trodes but only half of the magnitude. Hence on new moon & fall moon days. When both effects add, trodes are very high.

2. A satellite does not need any fuel to aide around the earth. Why?

Ans. The gravitational force between satellite & earth provides the centripetal force required by the satellite to move in a circular orbit.

Short Answer Questions : 3 MARKS

1. Why the gravitational force between the Earth and the Sun is so great while the same force between two small objects is negligible?

Ans. **(i)** The force experienced by a mass 'm' which is on the surface of the Earth is given by

$$F = \frac{GM_E m}{R_E^2}$$

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(ii) M_E-mass of the Earth, m - mass of the object, R_E- radius of the Earth.

Equating Newton's second law, F= mg, to equation we get,

$$m_g = \frac{GM_E m}{R_E^2}$$

$$g = \frac{GM_E}{R_E}$$

(iii) Now the force experienced by some other object of mass M at a distance r from the center of the Earth is given by,

$$F = \frac{GM_E M}{r^2}$$

Using the value of g in equation, the force F will be,

$$F = -gM\frac{R_E^2}{r^2}$$

From this it is clear that the force can be calculated simply by knowing the value of g. It is to be noted that in the above calculation G is not required.

Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. A mass M is broken into two parts, m & (M–m). How is m related to M so that the gravitational force between two parts is maximum?

Solution:

Let $m_1 = m$; $m_2 = M - m$

$$R = \frac{G(M-m).m}{r^2} = \frac{G(Mm-m^2)}{r^2}$$

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UNIT-7 PROPERTIES OF MATTER

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. Define stress and strain.

Ans. The force per unit area is called as stress.

$$\text{Stress, } \sigma = \frac{\text{Force}}{\text{Area}} = \frac{F}{A}$$

The fractional change in the size of the object, when a force is applied, strain measures the degree of deformation.

$$\text{Strain, } \varepsilon = \frac{\text{change in size}}{\text{original size}} = \frac{\Delta l}{l}$$

2. State Hooke's law of elasticity.

Ans. Hooke's law is for a small deformation, when the stress and strain are proportional to each other.

3. Define Poisson's ratio.

Ans. It is defined as the ratio of relative contraction (lateral strain) to relative expansion (longitudinal strain). It is denoted by the symbol μ.

$$\text{poisson's ratio, } \mu = \frac{\text{lateral strain}}{\text{longitudinal strain}}$$

4. Explain elasticity using intermolecular forces.

Ans. In a solid, interatomic forces bind two or more atoms together and the atoms occupy the positions of stable equilibrium. When a deforming force is applied on a body, its atoms are pulled apart or pushed closer. When the deforming force is removed, interatomic forces of attraction or repulsion restore the atoms to their equilibrium positions. If a body regains its original shape and size after the removal of deforming force, it is said to be elastic and the property is called elasticity.

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3. Why does the velocity increase when liquid flowing in a wider tube enters a narrow tube?

Ans. This is due to equation of continuity,

$a_1 V_1 = a_2 V_2$

$\therefore a_1 > a_2$ $\therefore V_1 > V_2$

Short Answer Questions : 3 MARKS

1. How do you differentiate solid, liquid & gas?

Ans. **(i) Solid:** Atoms or molecules are tightly fixed.

(ii) Liquid: Atoms get bound together through various types of bonding.

(iii) Gas: Due to the interaction between the atoms, they position themselves at a particular interatomic distance. Their mean positions.

2. A capillary tube is dipped first in cold water and then in hot water. Comment on the capillary rise in the second case.

Ans. We know that $h = \dfrac{2s\cos\theta}{r\rho g}$

Surface tension of hot water is less than the surface tension of cold water. Moreover, due to thermal expansion the radius of the capillary tube will increase in hot water. Due to both reasons, the height of capillary rise will be less in hot water as compared to cold water.

Board Expected Questions

Very Short Answer Questions : 2 MARKS

1. On a hot way, a car is left in sunlight with all windows closed. Explain why it is considerably warmer than outside, after sometime.

Ans. Glass transmits 50% of heat radiation coming from a hot source like sun but does not allow the radiation from moderately hot bodies to pass through it.

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Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. What is the origin of interatomic force?

Ans. It arises due to the electrostatic interaction between the nuclei of 2 atoms, their electron clouds of the atom and between the nuclease of one atom & the electron cloud.

2. What is the origin of intermolecular force?

Ans. Intermolecular force arises due to the electrostatic interaction between the opposite charged ends of molecular dipoles.

3. Are the intermolecular forces involved in the formation of liquid & solids different in nature? If yes how?

Ans. Yes, the intermolecular forces involved in the formation of liquids are attractive in nature while in the formation of solids, the repulsive intermolecular forces are more important.

4. What is a perfectly elastic body? Give example?

Ans. If on removal of deforming force, a body completely regains its original configuration, then it is said to be perfectly elastic.
Example: quartic

5. What does slope of stress versus strain graph give?

Ans. It gives the modulus of elasticity.

6. How does youngs modulus change with the rise of temperature?

Ans. Young's modulus decreases with the rise of temperature.

7. Why are springs made of steel & not of copper?

Ans. Young's modulus of steel is greater than that of copper. So steel spring is stretched lesser than a copper spring under the same deforming force. Moreover, steel returns to its original state more quickly than copper on the removal of deforming force.

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UNIT-8

HEAT AND THERMODYNAMICS

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. 'An object contains more heat'- is it a right statement? If not why?

Ans. 'Heat' is the energy in transit and which flows from an object at higher temperature to an object at lower temperature. Heat is not a quantity. So the statement **'An object has more heat'** is wrong, instead **'object is hot'** will be appropriate.

2. Obtain an ideal gas law from Boyle's and Charles' law.

Ans. **(i)** Acceleration to Boyle's law $P \propto \frac{1}{V}$

(ii) Acceleration to Charles' law $V \propto T$. By combining these two equations we have $PV = CT$. Here C is a positive constant.

(iii) So we can write the constant C as k times the number of particles N.

Here k is the Boltzmann constant (1.381×10^{-23} JK^{-1}) and it is found to be a universal constant.

So the ideal gas law can be stated as follows

$$PV = NkT$$

3. Define one mole.

Ans. One mole of any substance is the amount of that substance which contains Avogadro number (N_A) of particles (such as atoms or molecules).

4. Define specific heat capacity and give its unit.

Ans. Specific heat capacity of a substance is defined as the amount of heat energy required to raise the temperature of 1kg of a substance by 1 Kelvin or 1°C

$$\Delta Q = ms\Delta T$$

Therefore,

$$s = \frac{1}{m}\left(\frac{\Delta Q}{\Delta T}\right),$$

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In-Text Questions

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. What is meant by heating?

Ans. This process of energy transfer from higher temperature object to lower temperature object is called heating. Due to flow of heat sometimes the temperature of the body will increase or sometimes it may not increase.

2. What is meant by triple point of substance?

Ans. The triple point of a substance is the temperature and pressure at which the three phases (gas, liquid and solid) of that substance coexist in thermodynamic equilibrium.

3. What is steady state?

Ans. The state at which temperature attains constant value everywhere and there is no further transfer of heat anywhere is called steady state.

4. State Prevost theory of heat exchange.

Ans. Prevost theory states that all bodies emit thermal radiation at all temperatures above absolute zero irrespective of the nature of the surroundings

5. Define molar specific heat capacities.

Ans. **(i)** The amount of heat required to raise the temperature of one mole of a substance by 1K or 1°C at constant volume is called molar specific heat capacity at constant volume (C_v).

(ii) If pressure is kept constant, it is called molar specific heat capacity at constant pressure (C_p).

6. What is relegation?

Ans. It is a phenomenon of refraining the water into ice (on the surface of ice formed due to increase in pressure) on removing the increased pressure.

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sub in $PV^{\gamma} = K$,

$$P\left(\frac{RT}{P}\right)^{\gamma} = K$$

$$P^{1-\gamma} \cdot T^{\gamma} = \frac{K}{R^{\gamma}} = \text{constant.}$$

$P^{1-\gamma} T^{\gamma} = \text{constant}$ i.e. $\frac{T^{\gamma}}{P^{\gamma-1}} = \text{constant.}$

14. Derive the equation of state $TV^{\gamma-1}$ = constant.

Ans. For one mole of gas PV = RT.

$$\therefore\ P = \frac{RT}{V}.$$

sub. in PV^{γ} = constant.

$$\frac{RT}{V}.V^{\gamma} = \text{constant} \Rightarrow TV^{\gamma-1} = \text{constant}$$

This is the adiabatic relation between volume & temperature of an ideal gas.

Board Expected Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Define the Avogadro's number?

Ans. The Avogadro's number N_A is defined as the number of carbon atoms contained in exactly 12 g of ^{12}C .

2. Define heat capacity.

Ans. 'Heat capacity' is defined as the amount of heat energy required to raise the temperature of the given body from T to T + ΔT .

Heat capacity $S = \frac{\Delta Q}{\Delta T}$

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3. As air is a bad conductor of heat, why do we not feel warm without clothes?

Ans. This is conductor when we are without clothes air carries away heat from our body due to convection & hence we feel cold.

4. Why is it hotter at the same distance over the top of a fire than in front of it?

Ans. At a point infront of fire, heat is received due to the process of radiation only, while at a point above the fire, heat reaches both due to radiation & convection. Hence the result.

Short Answer Questions : 3 MARKS

1. What is meant by triple point? Give the values of triple point pressure & triple point temperature of water.

Ans. **(i)** It is a point in phase diagram, representing a particular pressure & temperature at which the solid, liquid & vapour phases of the substance can co-exist.

(ii) Triple point pressure of water is 0.46cm of mercury column or 0.066 atm & triple point temperature of water is 273.16K or 0.01°C.

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 MARKS

1. When a bottle of cold carbonated drink is opened, a slight fog is formed around the opening. Why?

Ans. In opening of bottle, adiabatic expansion of gas causes lowering of temperature.

2. Why air quickly leaving out of a bottom becomes cooler?

Ans. Leaking of air is adiabatic expansion and adiabatic expansion produces cooling.

3. Calorimeters are made of metals not glass. Why?

Ans. This is because metals are good conductors of heat and have low specific heat capacity.

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UNIT-9
KINETIC THEORY OF GASES

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. What is the microscopic origin of pressure?

Ans. With the help of kinetic theory of gases, the pressure is linked to the velocity of molecules.

$$P = \frac{1}{3}\frac{N}{V} mV^{-2}$$

m- mass of a molecule ; N = Avogadro number

V - volume, V^{-2} Avogadro velocity molecules.

2. What is the microscopic origin of temperature?

Ans. Average K.E / molecule

$$K.E = \varepsilon = \frac{3}{2} Nk T$$

3. Why moon has no atmosphere?

Ans. The escape speed of gases on the surface of Moon is much less than the root mean square speeds of gases due to low gravity. Due to this, all the gases escape from the surface of the Moon.

4. Write the expression for rms speed, average speed and most probable speed of a gas molecule.

Ans.

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$V_{ave} = \sqrt{\frac{8RT}{\pi M}} ; \quad V_{mp} = \sqrt{\frac{2RT}{M}}$$

5. What is the relation between the average kinetic energy and pressure?

Ans. The internal energy of the gas is given by

$$U = \frac{3}{2} Nk T$$

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In-Text Questions

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. On reducing the volume of a gas at constant temperature, the pressure of the gas increases. Explain it on the basis of kinectic theory.

Ans. **(i)** On reducing the volume the number of molecules per unit volume increases.

(ii) Hence a large number collide with the walls of the vessel per second and a larger momentum is transferred to the wall per second. This increases the pressure of the gas.

2. At what temperature does all molecular motion cease? Explain all molecule motion ceases at absolute zero or at 0 K.

Ans. Acceleration to kinectic interpretation of temperature

$$E = \frac{3}{2} k_B T \text{ (or) } T = \frac{2}{3} \cdot \frac{E}{k_B}$$

Absolute temperature × average K.E of molecules.

∴ The temperature = 0 K, average K.E = 0.

3. A box contains equal number of molecules of H_2& O_2. If there is a fine hole in the box, which gas will leave rapidly? Why?

Ans. $V_{rms} \times \frac{1}{\sqrt{M}}$ so H_2 will leak more rapidly.

Because of its smaller molecular mass.

4. Although the velocity of air molecule is nearly 0.5 *km/s*, yet the smell of scent spreads at a much slower rate. Why?

Ans. **(i)** The air molecule travel along a zig–zag path due to frequent collisions.

(ii) As a result their displacement per unit time is very small. Hence the smell of scent spreads very slowly.

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2. What is an ideal gas? Why do the real gases show deviations from ideal behaviour?

Ans. **(i)** A gas which obeys the ideal gas equation $pv = nRT$, at all temperature and pressure is called an ideal or perfect gas.

(ii) Following two assumptions are used to drive the ideal gas equation.

(iii) The size of the gas molecules is negligibly small.

(iv) There is no force of attraction amongst the molecules of a gas.

(v) No real or actual gas fulfills the above conditions. Hence the behaviour of a real gas differs from that of an ideal gas.

(vi) At low pressure and high temperature the above assumptions are valid and some real gases like H_2, O_2, N_2, H_e etc. almost behave like an ideal gel.

Board Expected Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. When a gas is heated, its temp. increases. Explain it on the basis of K.T. of gases.

Ans. When a gas is heated, the rms Velocity of its molecule increases. As $V_{rms} \times \sqrt{T}$, so the temperature of the gas increases.

2. On which factors does the average K.E. of gas molecules depend?

Ans. The average K.E of a gas molecule depends only on the absolute temperature of the gas and is directly proportional to it.

3. What type of motion is associated with the molecule of a gas?

Ans. Brownian motion. In this motion any particular molecule will follow a zig–zag path due to be collision with the other molecule or with the walls of the container.

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Combining (1) & (2)

$$v \times \frac{T}{p} \quad \text{(or)} \quad v = \text{constant}\ \frac{T}{p} \quad \text{(or)} \quad \frac{pv}{T} = \text{constant}$$

constant is called universal gas constant R.

$pv = RT$.

For one molecule of a gas, the constant has same value for all gases.

For n moles of a gas $pv = nRT$.

This is perfect (or) ideal gas equation.

Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Mention the different ways of increasing the number of molecular collisions per unit time in a gas.

Ans. The numbers of collisions per unit time can be increased by

(i) increasing the temperature of the gas.

(ii) increasing the number of molecules, and

(iii) decreasing the volume of the gas.

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UNIT-10 OSCILLATIONS

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. What is meant by periodic and non-periodic motion? Give any two examples, for each motion.

Ans. **1. Periodic motion :**
Any motion which repeats itself in a fixed time interval is known as periodic motion.
Examples : Hands in pendulum clock, swing of a cradle, Heart beat of a person the revolution of the Earth around the Sun, waxing and waning of Moon, etc.

2. Non-Periodic motion :
Any motion which does not repeat itself after a regular interval of time is known as non-periodic motion.
Example : Occurance of Earth quake, eruption of volcano, etc.

2. What is meant by force constant of a spring?

Ans. Force constant is defined as force per unit displacement.
Force constant= force/displacement.

Eg. : (i) Oscillations of a loaded spring
(ii) Vibrations of a turning force.

3. Define time period of simple harmonic motion.

Ans. The time period is defined as the time taken by a particle to complete one oscillation. It is usually denoted by T. For one complete revolution, the time taken is t = T, therefore

$$T = \frac{2\pi}{\omega}$$

4. Define frequency of simple harmonic motion.

Ans. **(i)** The number of oscillations produced by the particle per second is called frequency.

(ii) It is denoted by f. SI unit for frequency is $\mathbf{s^{-1}}$ or hertz (In symbol, Hz).

(iii) Angular frequency is related to time period by $f = \frac{1}{T}$

(iv) The number of cycles (or revolutions) per second is called angular frequency.

(v) Angular frequency and frequency are related by $\omega = 2\pi f$

(vi) SI unit for angular frequency is rad s^{-1}.

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4. Compute the time period for the following system if the block of mass m is slightly displaced vertically down from its equilibrium position and then released. Assume that the pulley is light and smooth, strings and springs are light.

Solution:

Case (a) :

Pulley is fixed rigidly here. When the mass displace by y and the spring will also stretch by *y*. Therefore, F = T = *ky*

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Case (b) :

Mass displace by *y*, pulley also displaces by *y*. T = 4*ky*.

$$T = 2\pi\sqrt{\frac{m}{4k}}$$

In-Text Questions

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. Define simple harmonic motion (S.H.M.)

Ans. S.H.M is the motion in which the restoring force is proportional to the displacement from the mean position and opposes its increase. Such a motion the displacement varies harmonically with time.

2. Why the amplitude of the vibrating pendulum should be small?

Ans. **(i)** When amplitudes of the vibrating pendulum is small then pendulum is small. Here the restoring force F = *mg* sin θ = *mg* θ = *mg x*/*l*.

(ii) Where *x* is the displacement of the bob and *l* is the length of pendulum. Hence F × *x*. Since F is directed towards mean position.

(iii) Therefore the motion of the bob of simple pendulum will be S.H.M. if θ is small.

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3. When a pendulum clock gains time, what adjustments should be made?

Ans. **(i)** When a pendulum clock gains time, it means it has gone fast, it makes more vibrations per day them required.

(ii) This shows that the time period of oscillations has decreased. Therefore, to correct it, the length of pendulum should be properly increased.

4. The displacement of harmonic oscillator is given by $x = \alpha \sin wt + \beta \cos wt$. what is the amplitude of the oscillation?

Ans.

$$x = \alpha \sin wt + \beta \cos wt$$

$$\alpha = r \cos \theta \text{ and } \beta = r \sin \theta$$

$$x = r \cos \theta \sin wt + r \sin \theta \cos wt$$

$$wt = r \sin (wt + \theta)$$

Short Answer Questions : 3 MARKS

1. The bob of vibrating simple pendulum is made of ice. How will the period of swing will change when the ice starts melting?

Ans. **(i)** The period of swing of simple pendulum will remains unchanged till the location of the center of gravity of the bob left after melting the ice remains at a fixed distance from the point of suspension.

(ii) If the centre of gravity of ice bob after melting is raised upwards, then the effective length of pendulum decreases and hence the time period of swing decreases. If the centre of gravity of ice shifts on lower side, the time period of swing increases.

Board Expected Questions

Very Short Answer Questions : 2 MARKS

1. What is oscillatory motion? Give any two examples.

Ans. If a body moves to and fro repeatedly about a mean position it is called oscillatory motion.

Examples:

(i) Oscillations of a simple pendulum.

(ii) Vibrations of a mass attached to spring.

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Short Answer Questions : 3 MARKS

1. State five characteristics of SHM.

Ans. **(i) Displacement:**
The displacement of a particle executing linear SHM, at an instant is defined as the distance of the particle from the mean position at that instant.

(ii) Velocity:
Is defined as the time rate of change of the displacement of the particle at the given instant.

(iii) Amplitude:
The maximum displacement on either side of mean position.

(iv) Acceleration:
It is defined as the time rate of change of the velocity of the particle at the given instant.

(v) Time period:
It is defined as the time taken by the particle executing S.H.M to complete one vibration.

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 MARKS

1. Can a motion be oscillatory, but not simple hormonic. If your answer is yes, give an explanation and if not explain why?

Ans. Yes, when a ball is dropped from a height on a perfectly elastic surface, the motion is oscillatory but not simple harmonic as restoring force F = mg = constant and not Fa – x, which is an essential condition for S.H.M.

2. Every simple harmonic motion is periodic motion but every periodic motion need not be simple harmonic motion. Do you agree? Give example.

Ans. Yes, every periodic motion need not be simple harmonic motion explain the motion of the earth round the sun is a period motion, but not simple harmonic motion as the back and forth motion is not taking place.

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UNIT-11 WAVES

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. What is meant by waves?

Ans. The disturbance which carries energy and momentum from one point in space to another point in space without the transfer of the medium is known as a wave.

2. Write down the types of waves.

Ans. **(a) Mechanical wave:** Waves which require a medium for propagation are known as mechanical waves.

Examples : sound waves, ripples formed on the surface of water, etc.

(b) Non-mechanical wave: Waves which do not require any medium for propagation are known as non-mechanical waves.

Example : light

Further, waves can be classified into two types

a. Transverse waves

b. Longitudinal waves

3. What are transverse waves? Give one example.

Ans. In transverse wave motion, the constituents of the medium oscillate or vibrate about their mean positions in a direction perpendicular to the direction of propagation (direction of energy transfer) of waves.

Example: light (electromagnetic waves)

4. What are longitudinal waves? Give one example.

Ans. In longitudinal wave motion, the constituent of the medium oscillate or vibrate about their mean positions in a direction parallel to the direction of propagation (direction of energy transfer) of waves.

Example: Sound waves travelling in air.

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3. A sound source and listener are both stationary and a strong wind is blowing. Is there a Doppler effect?

Ans. Yes. It does not matter whether be sound source or be transmission media are in motion.

4. In an empty room why is it that a tone sounds louder than in the room having things like furniture etc.

Ans. Sound is a form of energy. The furniture which act as obstacles absorbs most of energy. So the intensity of sound become low but in empty room, due to the obsence of obstacles the intensity of sound remain mostly same but we feel it louder.

5. How do animals sense impending danger of hurricane?

Ans. Some animals are believed to be sensitive to be low frequency sound waves emitted by hurricanes. They can also detect the slight drops in air and water pressure that signal a storm's approach.

6. Is it possible to realize whether a vessel kept under the tap is about to fill with water?

Ans. The frequency of the note produced by an air column is inversely proportional to its length. As the level of water in the vessel rises, the length of the air column above it decreases. It produces sound of decreasing frequency. i.e., the sound becames shorter. From the shrillness of sound, it is possible to realize whether the vessel is fulled which water.

v_{min} = =11.71 ms^{-1}

In-Text Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. What is persistence of hearing?

Ans. $\text{Velocity} = \frac{\text{Distance travelled}}{\text{time taken}} = \frac{2d}{t}$

$2d = 344 \times 0.1 = 34.4$ m

$d = 17.2$ m.

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Board Expected Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Discuss about the formation of waves on stretched string?

Ans. Take a long string and tie one end of the string to the wall. A quick jerk, is 92 a bump (like pulse) is produced in the string. Such a disturbance is sudden and it lasts for a short duration, hence it is known as a wave pulse. If jerks are given continuously then the waves produced are standing waves. Similar waves are produced by a plucked string in a guitar.

2. Mention the important properties which medium should possess for propagation of waves.

Ans. The medium possesses both inertia and elasticity for propagation of waves.

3. Define frequency and time period.

Ans. Frequency is defined as "the number of waves crossing a point per second" It is measured in hertz.

Frequency and time period are inversely related i.e.,

$$T = \frac{1}{f}$$

Time period is defined as the time taken by one wave to cross a point.

4. Give the relation between velocity *v*, angular frequency ω and wave number λ?

Ans. Velocity, $v = \lambda f \frac{\lambda}{2\pi}(2\pi f) = \frac{(2\pi f)}{2\pi / \lambda} = \omega / k$

5. Define amplitude of the wave.

Ans. An amplitude of the wave is defined as the maximum displacement of the medium with respect to a reference axis (for example in this case *x*-axis). Here, it is denoted by A.

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9. Define angular frequency, wave number and wave vector.

Ans. **(i)** The number of cycles (or revolutions) per unit time is called **angular frequency**. **Angular frequency**, $\omega = \frac{2\pi}{T}$ $= 2\pi f$ (unit is radians/second)

(ii) The number of cycles per unit distance or number of waves per unit distance is called **wave number**.

wave number, $k = \frac{2\pi}{\lambda}$ (unit is radians/meter)

(iii) In two, three or higher dimensional case, the wave number is the magnitude of a vector called wave vector. The points in space of wave vectors are called reciprocal vectors, $\vec{k}$.

Dimensions of $\vec{k}$ is L^{-1}.

Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Two astronauts on the surface of the moon cannot talk to each other why?

Ans. Sound waves require material medium for their propagation. As there is no atmosphere on the moon, hence the sound wave cannot propagate on the moon.

2. How does the frequency of a tunning fork change, when the temperature is increased?

Ans. As the temperature increases, the length of the prong of the tuning fork increases. This increases the wavelength of the stationary waves set up in the tunning fork, As frequency, $v \propto \frac{1}{\lambda}$ so frequency of the tunning fork decreases.

3. Explain why we cannot here an echo in a small room?

Ans. For an echo of a simple sound to be heard, the minimum distance between speaker and the walls should be 17m. As the length of a room is less then 17m, so we do not hear on echo.

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SHORT ANSWER QUESTIONS : 3 MARKS

1. Tube A has both ends open, while tube B has one end closed, otherwise they are identical the ratio of fundamental frequency of tubes A & B?

Ans. The fundamental frequency for tube A with both into open is

$$V_B = \frac{V}{2L}$$

The fundamental frequency for tube B with one end closed is

$$V_B = \frac{V}{4L}$$

$$\frac{VA}{VB} = \frac{V/2L}{V/4L} = 2$$

2. The beats are not heard if the difference in frequencies of the two sounding notes is more than 10. Why?

Ans. If the difference in frequencies of the two waves is more than 10, we shall hear more then 10 beats for second. Due to persistence of hearing, our ear is not able to distinguish between two sounds as separate, If the time internal between them is less then $\left(\frac{1}{10}\right)^{th}$ of a second. Hence beats heard will not be distinct if the number of beats produced per second is more than 10.

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