



GOVERNMENT OF KARNATAKA

DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)

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CHAPTER-WISE MULTIPLE-CHOICE QUESTIONS FOR COMPETITIVE EXAM

SUBJECT: PHYSICS

NAME OF THE CHAPTER: I PUC - MOTION IN A PLANE

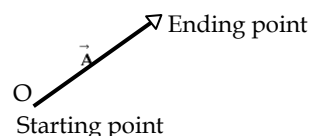
SYNOPSIS

1: Scalars and Vectors

- Physical quantities having magnitude only and no direction are called **scalars**. Eg: mass, time, speed, current, density etc.
- Physical quantities having both magnitude and direction and which can be added using triangle law of addition are called **vectors**. Eg: displacement, velocity, momentum, force etc.

2: Representation of a vector

- A vector quantity is symbolically represented by (say) $\vec{A}$.
- A vector is geometrically represented by a directed line segment in the direction of that quantity with the starting point being the tail of that directed line segment and ending point is given by the arrow head.

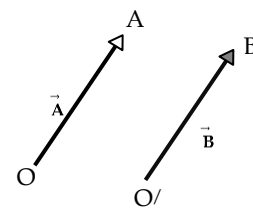


The length of the directed line segment is proportional to the magnitude of the vector quantity.

3: Equality of vectors

- Two vectors representing the same physical quantity, having the same magnitude and direction are called **equal vectors**.

If $\vec{A}$ and $\vec{B}$ are two vectors representing the same physical quantity, have the same direction and magnitude, then they are equal vectors.

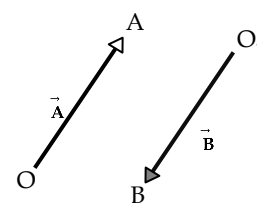


That is $\vec{A} = \vec{B}$.

4: Negative of a vector

- If two vectors represent the same physical quantity, their magnitudes are same, but their directions are opposite to each other, then one vector is said to be **negative** of the other vector.

If $\vec{A}$ and $\vec{B}$ are two vectors representing the same physical quantity, have the same magnitude but opposite directions, then they are negative vectors of each other.

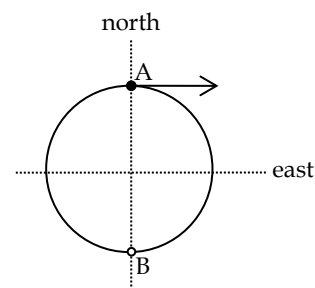


That is $\vec{A} = -\vec{B}$.

EXAMPLE 1

A car is moving with constant speed in a circle as shown. At A and B, the velocity vectors are

- (A) equal
- (B) negative vectors of each other
- (C) unequal vectors
- (D) not comparable.



Ans (B)

5: Multiplication of a vector by a scalar

➤ If a vector $\vec{A}$ is multiplied by a scalar λ , it produces a new vector $\vec{B}$ such that

$$\vec{B} = \lambda \vec{A}$$

Where the magnitude of $\vec{B}$ is λ times the magnitude of $\vec{A}$, while the directions of $\vec{A}$ and $\vec{B}$ are same if λ is positive and $\vec{A}$ and $\vec{B}$ are opposite to each other if λ is negative.

That is $B = |\lambda|A$.

EXAMPLE 2

Identify the correct statement.

- (A) Electric current is a vector because it has direction.
- (B) Acceleration vector of 5 m/s^2 in the horizontal direction is equal to the force vector of 5 N in the same direction.
- (C) When a vector is multiplied by a scalar, the new vector produced does not represent the same physical quantity as initial vector.
- (D) A physical quantity is a vector if it has only magnitude and direction.

Ans (C)

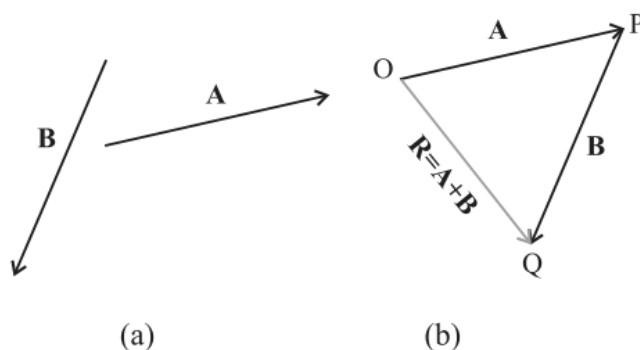
6: Addition and Subtraction of vectors

➤ Vectors can be added/ subtracted using two laws (i) triangle law and (ii) parallelogram law.

Consider two vectors $\vec{A}$ and $\vec{B}$ as shown in the figure (a). They are added using the triangle law as shown in Figure (b).

Hence we can write

$$\vec{R} = \vec{A} + \vec{B}$$

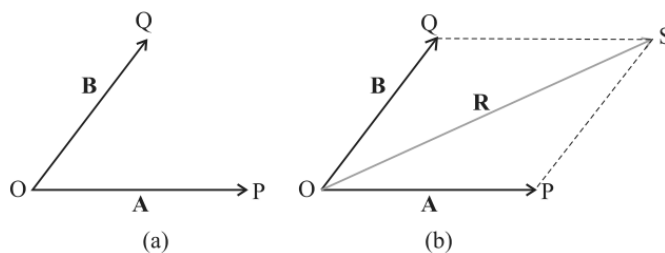


➤ To subtract a vector $\vec{B}$ from $\vec{A}$ we add the negative vector of $\vec{B}$ to get the resultant vector $\vec{D}$.

Hence we can write
$$\vec{D} = \vec{A} - \vec{B} = \vec{A} + (-\vec{B})$$

➤ Vector addition obeys (a) commutative and associative laws. Vector subtraction neither obeys commutative nor associative laws.

- The two vectors $\vec{A}$ and $\vec{B}$ shown in the Fig(a) can be added using parallelogram law as shown in Fig (b)



- If the angle between vectors $\vec{A}$ and $\vec{B}$ is θ , the angle between the resultant $\vec{C}$ and the vector $\vec{A}$ is α , then

$$C = \sqrt{A^2 + B^2 + 2AB \cos \theta}$$

and

$$\tan \alpha = \frac{B \sin \theta}{A + B \cos \theta}.$$

EXAMPLE 3

A vector $\vec{P}_1$ is of magnitude 10 units in the eastward direction. Another vector $\vec{P}_2$ is of magnitude 20 units 60° to the east. Then the magnitude of the vector $\vec{P}_1 - \vec{P}_2$ is

- (A) 10 units (B) 20 units (C) $10\sqrt{3}$ units (D) $10\sqrt{7}$ units

Ans (C)

Example Solved:

The angle between the vectors $\vec{P}_1$ and $-\vec{P}_2$ is $180^\circ - 60^\circ = 120^\circ$.

Hence
$$D = \sqrt{P_1^2 + P_2^2 + 2P_1P_2 \cos \theta}$$

Substitute $P_1 = 10 \text{ unit}$, $P_2 = 20 \text{ unit}$ and $\theta = 120^\circ$

So,
$$D = \sqrt{10^2 + 20^2 + 2(10)(20) \cos 120^\circ} = 10\sqrt{3} \text{ unit}$$

7: Resolution of a vector

- If a vector $\vec{A}$ is randomly oriented, it can be decomposed into two or three mutually perpendicular components as shown.

- The vector $\vec{A}$ can be rewritten as

$$\vec{A} = A_x \hat{i} + A_y \hat{j}$$

Where A_x and A_y are called the x and y components of $\vec{A}$ respectively.

Also, we may write $A_x = A \cos \theta$

and $A_y = A \sin \theta$

While $A = \sqrt{A_x^2 + A_y^2}$

and $\tan \theta = \frac{A_y}{A_x}.$

EXAMPLE 4

A vector having magnitude 20 units makes an angle of 30° to the y axis. Then the vector can be expressed as

- (A) $10\hat{i} - 10\sqrt{3}\hat{j}$ (B) $10\sqrt{3}\hat{i} + 10\hat{j}$ (C) $10\hat{i} + 10\sqrt{3}\hat{j}$ (D) $10\hat{i} + 10\hat{j}$

Ans (A)

Example Solved

The angle made by the vector with the +x axis is : $\theta = 90^\circ - 30^\circ = 60^\circ$.

So, the x and y components of the given vector is : $A_x = A \cos \theta = 20 \cos 60^\circ = 10$ unit

and : $A_y = A \sin \theta = 20 \sin 60^\circ = 10\sqrt{3}$ unit

Since any vector is expressed as $\vec{A} = A_x \hat{i} + A_y \hat{j}$: $\vec{A} = 10\hat{i} + 10\sqrt{3}\hat{j}$

8: Displacement, average velocity and instantaneous velocity

➤ When a particle moving in a plane moves from a point A (at time instant t_1) to B (at time instant t_2) on a curved path, its displacement is given by

$$\Delta \vec{r} = \vec{r}_2 - \vec{r}_1$$

➤ Its average velocity is given by

$$\vec{v}_{av} = \frac{\Delta \vec{r}}{\Delta t} = \frac{\vec{r}_2 - \vec{r}_1}{t_2 - t_1}$$

The direction of avg velocity is along the direction of displacement itself.

➤ The instantaneous velocity is the rate of change of position: $\vec{v} = \frac{d\vec{r}}{dt}$.

The direction of the instantaneous velocity is along the tangent drawn to the path of the particle (see the figure at point P)

➤ The magnitude of the velocity is called its *speed*.

EXAMPLE 5

A car moves from a point in the west to a point in the east in a semicircular path of radius 100 m. The displacement of the car and distance travelled (in m) by it are respectively

- (A) 100, 100π (B) 100π , 200 (C) 200, 100π (D) 100, 100

Ans (B)

Example Solved:

The displacement is the least distance between the initial and final points : $|\Delta \vec{r}| = 2R = 200$ m

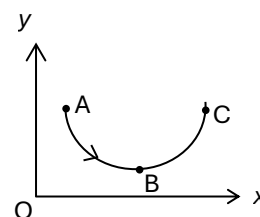
The distance is the path length of the journey : $D = \pi R = 100\pi$ m

EXAMPLE 6

A body moves in semicircular path from A to C with constant speed. The distance between A and B is $10\sqrt{2}$ m. If it takes a time of 2.5π seconds for the body to reach C from A, the average velocity between A and C and instantaneous velocity at C (in m/s) are respectively

- (A) $\frac{8}{\pi}$ along +x axis, 4 along +y axis (B) $\frac{8}{\pi}$ along +x axis, $\frac{8}{\pi}$ along +y axis
(C) 4 along +x axis, 4 along +x axis (D) $\frac{8}{\pi}$ along +x axis, 8 along +y axis

Ans (D)



Example Solved:

The radius of the path is : $R = 10 \text{ m}$

The displacement and distance travelled are : $|\Delta \vec{r}| = 2R = 20 \text{ m}$ and $D = \pi R = 10\pi \text{ m}$

The average velocity is : $|\vec{v}_{av}| = \frac{|\Delta \vec{r}|}{\Delta t} = \frac{20}{2.5\pi} = \frac{8}{\pi} \text{ m/s}$

The direction of this velocity : Along the displacement i.e., along the +x direction

The average speed is : $|s_{av}| = \frac{D}{\Delta t} = \frac{20\pi}{2.5\pi} = 8 \text{ m/s}$

Since the speed is constant, : $|\vec{v}| = |s_{av}| = 8 \text{ m/s}$

Since the direction of the motion is : along the tangent to the path at C

That is : Direction is along + y axis.

9: Average acceleration and instantaneous acceleration

➤ If a body moving in a plane changes its velocity from $\vec{v}_1$ to $\vec{v}_2$ in time Δt , then the change of velocity is

$$\Delta \vec{v} = \vec{v}_1 - \vec{v}_2$$

Thus the average acceleration is $\vec{a}_{av} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1}$.

➤ The instantaneous acceleration is $\vec{a} = \frac{d\vec{v}}{dt}$.

10: Projectile motion

➤ The initial velocity components of the projectile are

$$v_{0x} = v_0 \cos \theta_0 \text{ and } v_{0y} = v_0 \sin \theta_0$$

➤ The horizontal velocity component is always constant:

That is $v_x = v_{0x} = v_0 \cos \theta_0$

The vertical component changes with time and position as

$$v_y = v_0 \sin \theta_0 - gt$$

and $v_y^2 = v_0^2 \sin^2 \theta_0 - 2gy$

➤ The trajectory of the projectile is a parabola given by the equation

$$y = (\tan \theta_0) x - \frac{g}{2v_0^2 \cos^2 \theta_0} x^2$$

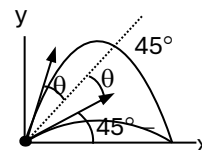
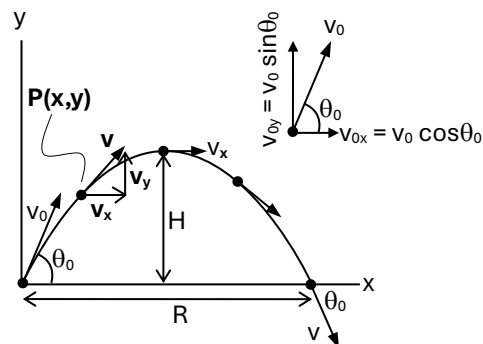
➤ The time of flight of the projectile is $T = \frac{2v_0 \sin \theta_0}{g}$.

➤ The maximum height of the projectile is given by $H = \frac{v_0^2 \sin^2 \theta_0}{2g}$.

➤ The range of the projectile is given by $R = \frac{v_0^2 \sin 2\theta_0}{g}$.

➤ The range is maximum for angle of projection = 45° .

➤ For two angles $45 - \theta$ and $45 + \theta$, the range is same provided the initial speed is constant.



EXAMPLE 7

A ball is thrown into air at a speed of 20 m/s so as to have maximum range. The time of flight (in s) of the projectile is

- (A) $2\sqrt{2}$ (B) $20\sqrt{2}$ (C) 2 (D) $\sqrt{2}$

Ans (A)

Example Solved:

The time of flight for maximum range is $: T = \frac{2v_0 \sin 45^\circ}{g} = \frac{\sqrt{2}v_0}{g}$

Substituting $v_0 = 20 \text{ m/s}$ and $g = 10 \text{ m/s}^2$ $: T = \frac{\sqrt{2} \times 20}{10} = 2\sqrt{2} \text{ s}$

EXAMPLE 8

A projectile fired into air at 30° to the horizontal has a range of $20\sqrt{3} \text{ m}$. The speed (in m/s) of the projectile at its maximum height is

- (A) 10 (B) $10\sqrt{3}$ (C) $20\sqrt{3}$ (D) 401

Ans (B)

Example Solved:

The initial speed of the projectile is found using $: R = v_0^2 \frac{\sin 2\theta_0}{g} \rightarrow v_0^2 = \frac{Rg}{\sin 2\theta_0} \rightarrow v_0 = \sqrt{\frac{Rg}{\sin 2\theta_0}}$

With $\theta_0 = 30^\circ$, $g = 10 \text{ m/s}^2$ and $R = 20\sqrt{3} \text{ m}$, $: v_0 = \sqrt{\frac{20\sqrt{3} \times 10}{\sin 2(30^\circ)}} = 20 \text{ m/s}$

Hence the speed of the projectile

at the highest point is $: v_x = v_0 \cos \theta_0 = 20 \times \cos 30^\circ = 10\sqrt{3} \text{ m/s}$

EXAMPLE 9

The equation for a projectile trajectory is $y = x - \frac{1}{90}x^2$. Then the initial speed (in m/s) and the angle of projection of the projectile are respectively

- (A) 30, 30° (B) 60, 45° (C) 900, 30° (D) 30, 45°

Ans (D)

Example Solved:

Comparing the given equation with the

standard equation $: y = x - \frac{1}{90}x^2 \leftrightarrow y = (\tan \theta_0)x - \frac{g}{2g \cos^2 \theta_0}x^2$

Hence $: \tan \theta_0 = 1 \rightarrow \theta_0 = 45^\circ$ and $\frac{g}{2v_0^2 \cos^2 \theta_0} = \frac{1}{90}$

Or $: \frac{10}{2v_0^2 \cos^2 45^\circ} = \frac{1}{90} \rightarrow v_0 = 30 \text{ m/s}$

11: Uniform Circular Motion

➤ When a particle moves in a circular path of radius r with uniform speed, its angular speed is given by

$$\omega = \frac{v}{r}.$$

➤ The centripetal acceleration of the same particle is given in terms of speed v and radius r as

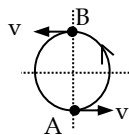
$$a = \frac{v^2}{r}.$$

➤ The centripetal acceleration in terms of angular speed ω and radius r is given by

$$a = \omega^2 r.$$

EXAMPLE 10

A vehicle is moving in a circular road with a constant speed v . Its acceleration at B is 8 m/s^2 . If $AB = 100 \text{ m}$, the speed v (in m/s) and angular speed (in rad/s) of the car are respectively



(A) 10, 0.4

(B) $20\sqrt{2}$, $0.4\sqrt{2}$

(C) 20, 0.4

(D) 0.4, 20

Ans (D)

Example Solved:

The radius of the circular path of the vehicle is : $R = \frac{AB}{2} = \frac{100}{2} = 50 \text{ m}$

The speed v of the vehicle is found using : $a = \frac{v^2}{R} \rightarrow v = \sqrt{ar} = \sqrt{8 \times 50} = 20 \text{ m/s}$

and the angular speed is : $\omega = \frac{v}{R} = \frac{20}{50} = 0.4 \text{ rad/s}$

MOTION IN A PLANE – PRACTICE QUESTIONS

1. Which of the following is a vector?

- (A) Pressure (B) Surface tension
(C) Moment of inertia (D) Gravitational potential

2. Statement I: The difference of two vectors can be treated as sum of two vectors.

Statement II: Subtraction of vectors can be defined in terms of addition of vectors.

- (A) Both the statements are true and statement II is the correct explanation for statement I.
(B) Both the statements are true but statement II is not correct explanation for statement I.
(C) Statement I is true but statement II is false.
(D) Both the statements are false.

3. The vector that must be added to the vector $\hat{i} - 3\hat{j} + 2\hat{k}$ and $3\hat{i} + 6\hat{j} - 7\hat{k}$ so that the resultant vector is a unit vector along the y-axis is

- (A) $-4\hat{i} - 2\hat{j} + 5\hat{k}$ (B) $4\hat{i} + 2\hat{j} + 5\hat{k}$ (C) $3\hat{i} + 4\hat{j} + 5\hat{k}$ (D) Null vector

4. Statement I: Vector addition is commutative.

Statement II: Two vectors may be added graphically using triangle law of vector addition.

- (A) Both the statements are true and statement II is the correct explanation for statement I.
(B) Both the statements are true but statement II is not correct explanation for statement I.
(C) Statement I is true but statement II is false.
(D) Both the statements are false.

5. If $\vec{A} = 4\hat{i} - 3\hat{j}$ and $\vec{B} = 6\hat{i} + 8\hat{j}$ then magnitude and direction (wrt positive X-axis) of $\vec{A} + \vec{B}$ are respectively

- (A) $5, \tan^{-1}(3/4)$ (B) $5\sqrt{5}, \tan^{-1}(1/2)$ (C) $25, \tan^{-1}(3/4)$ (D) $10, \tan^{-1}(5)$

6. How many minimum number of coplanar vectors having different magnitudes should be added to give zero resultant?

- (A) 2 (B) 3 (C) 4 (D) 5

7. If $\vec{P} = \vec{Q}$ then, which of the following is NOT correct?

- (A) $\hat{P} = \hat{Q}$ (B) $|\vec{P}| = |\vec{Q}|$ (C) $P\hat{Q} = Q\hat{P}$ (D) $\vec{P} + \vec{Q} = \hat{P} + \hat{Q}$

8. The unit vector along $\hat{i} + \hat{j} + \hat{k}$ is

- (A) $\hat{i} - \hat{j} - \hat{k}$ (B) $\hat{i} + \hat{j} + \hat{k}$ (C) $\frac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}$ (D) $\frac{\hat{i} + \hat{j} + \hat{k}}{3}$

9. The angle made by the vector $\vec{A} = \hat{i} + \hat{j}$ with x-axis is

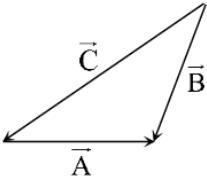
- (A) 30° (B) 45° (C) 60° (D) 90°

10. A unit vector is represented by $0.5\hat{i} + 0.8\hat{j} + c\hat{k}$, then the value of 'c' is

- (A) 1 (B) -0.3 (C) 0.11 (D) $\sqrt{0.11}$

11. Unit vector parallel to the resultant of vectors $\vec{A} = 4\hat{i} - 3\hat{j}$ and $\vec{B} = 8\hat{i} + 8\hat{j}$ will be

- (A) $\frac{12\hat{i} + 5\hat{j}}{13}$ (B) $\frac{12\hat{i} - 5\hat{j}}{13}$ (C) $\frac{6\hat{i} + 5\hat{j}}{13}$ (D) $\frac{6\hat{i} - 5\hat{j}}{13}$

12. If the sum of two unit vectors is a unit vector, then the magnitude of their difference is
 (A) 1 (B) $\sqrt{3}$ (C) $\frac{1}{\sqrt{2}}$ (D) $\sqrt{5}$
13. For the resultant of the two vectors to be maximum, what must be the angle between them?
 (A) 0° (B) 60° (C) 90° (D) 180°
14. A particle is simultaneously acted by two forces 4 N and 3 N. The net force on the particle must be
 (A) 7 N (B) 5 N (C) 1 N (D) between 1 N and 7 N
15. Two forces, each of magnitude F have a resultant of the same magnitude F. The angle between the two forces is
 (A) 45° (B) 120° (C) 150° (D) 90°
16. The sum of the magnitudes of two forces acting at a point is 16 N. If the resultant force is 8 N and its direction is perpendicular to smaller force, then the forces are
 (A) 2 N and 14 N (B) 4 N and 12 N (C) 6 N and 10 N (D) 8 N and 8 N
17. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to the vector $\vec{A}$ and its magnitude is equal to half the magnitude of vector $\vec{B}$. The angle between $\vec{A}$ and $\vec{B}$ is
 (A) 90° (B) 120° (C) 135° (D) 150°
18. If $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = 7\hat{i} + 24\hat{j}$, the vector having the same magnitude as B and parallel to A is
 (A) $5\hat{i} + 20\hat{j}$ (B) $15\hat{i} + 10\hat{j}$ (C) $20\hat{i} + 15\hat{j}$ (D) $15\hat{i} + 20\hat{j}$
19. A force of 10 N acts on a particle along a direction making an angle of 60° with horizontal direction. Its vertical component is
 (A) 6 N (B) 8 N (C) 8.66 N (D) 10 N
20. For the figure given below, which one of the following relations is correct?
 (A) $\vec{A} + \vec{B} = \vec{C}$
 (B) $\vec{B} + \vec{C} = \vec{A}$
 (C) $\vec{C} + \vec{A} = \vec{B}$
 (D) $\vec{A} + \vec{B} + \vec{C} = \vec{O}$
- 
21. Two forces 3 N and 2 N are acting at an angle θ such that their resultant is R. The first force is now increased to 6 N and the resultant become 2R. The value of θ is
 (A) 30° (B) 60° (C) 90° (D) 120°
22. Maximum and minimum values of the resultant of two forces acting at a point are 7 N and 3 N respectively. Then smaller force is equal to
 (A) 2 N (B) 4 N (C) 5 N (D) 1 N
23. Two forces of the same magnitude act at a point. The square of their resultant is 3 times the product of their magnitudes. The angle between them is
 (A) 0° (B) 30° (C) 60° (D) 90°
24. Two forces, F_1 and F_2 are acting on a body. One force is double in magnitude than that of the other force and the resultant is equal to the greater force. Then the angle between the two forces is
 (A) $\cos^{-1}(1/2)$ (B) $\cos^{-1}(-1/2)$ (C) $\cos^{-1}(-1/4)$ (D) $\cos^{-1}(1/4)$

25. If a particle moves from point P (2, 3, 5) to point Q (3, 4, 10). Its displacement vector is
 (A) $\hat{i} + \hat{j} + 10\hat{k}$ (B) $\hat{i} + \hat{j} + 5\hat{k}$ (C) $3\hat{i} + 4\hat{j} + 10\hat{k}$ (D) $5\hat{i} + 7\hat{j} + 15\hat{k}$
26. The position vector of a particle is determined by the expression $\vec{r} = 3t^2\hat{i} + 4t^2\hat{j} + 7\hat{k}$ metre
 The displacement of the particle in first 10 second is
 (A) 500 m (B) 300 m (C) 150 m (D) 100 m
27. What displacement must be added to the displacement $(25\hat{i} - 6\hat{j})$ m to give a displacement of 7.0 m pointing in the x- direction?
 (A) $(18\hat{i} - 6\hat{j})$ m (B) $(32\hat{i} - 13\hat{j})$ m (C) $(-18\hat{i} + 6\hat{j})$ m (D) $(-25\hat{i} + 13\hat{j})$ m
28. A boy walks uniformly along the sides of a rectangular park of size 400 m $\times$ 300 m, starting from one corner to the other corner diagonally opposite. Which of the following statement is incorrect?
 (A) He has travelled a distance of 700 m (B) His displacement is 700 m
 (C) His displacement is 500 m (D) His velocity is not uniform throughout the walk.
29. The position vector of a particle is $\vec{r} = (a \cos \omega t)\hat{i} + (a \sin \omega t)\hat{j}$. The velocity of the particle is
 (A) Parallel to the position vector (B) Perpendicular to the position vector
 (C) Directed towards the origin (D) Directed away from the origin
30. If the resultant of the two forces has a magnitude smaller than the magnitude of larger force, the two forces must be
 (A) Different both in magnitude and direction. (B) Mutually perpendicular to one another.
 (C) Possess extremely small magnitude. (D) Act in opposite directions.
31. A particle is projected with a velocity v so that its horizontal range twice the greatest height attained. The horizontal range is
 (A) $\frac{v^2}{g}$ (B) $\frac{v^2}{2g}$ (C) $\frac{2v^2}{3g}$ (D) $\frac{4v^2}{5g}$
32. The range of a projectile fired at an angle of 15° is 50 m. If it is fired with the same speed at an angle of 45° , its range will be
 (A) 25 m (B) 37 m (C) 50 m (D) 100 m
33. A projectile is projected with an initial velocity $(\hat{i} + 2\hat{j})$ m/s. The equation of trajectory of the projectile is
 (A) $y = x - 5x^2$ (B) $y = 2x - 5x^2$ (C) $4y = 2x - 5x^2$ (D) $4y = 2x - 25x^2$
34. A projectile is projected at 10 m/s by making at an angle 60° to the horizontal. After some time its velocity makes an angle of 30° to the horizontal. Its speed (in m/s) at this instant is:
 (A) $\frac{10}{\sqrt{3}}$ (B) $10\sqrt{3}$ (C) $\frac{5}{\sqrt{3}}$ (D) $5\sqrt{3}$
35. The trajectory of a projectile projected from origin is given by the equation $y = x - \frac{2x^2}{5}$. The initial velocity of the projectile is m/s
 (A) 5 (B) 2.5 (C) 0.4 (D) 25

36. A ball is projected with a velocity, 10 m/s, at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be m/s
 (A) 10 (B) zero (C) $5\sqrt{3}$ (D) 5
37. A man on a moving cart, facing the direction of motion, throws a ball straight up with respect to himself.
 (A) The ball will always return to him.
 (B) The ball will never return to him.
 (C) The ball will return to him if the cart moves with a constant acceleration.
 (D) The ball will fall behind him if the cart moves with some acceleration
38. A projectile fired from the ground follows a parabolic path. Which of the following is not correct at the top of its path?
 (A) The speed is minimum.
 (B) The velocity is perpendicular to the acceleration.
 (C) The kinetic energy is minimum.
 (D) The velocity is zero but acceleration is non-zero
39. A particle is projected at $t = 0$ with velocity 20 m/s at angle 30° with horizontal. The velocity of the particle at $t = t_0$ is perpendicular to its initial velocity. Then $t_0 = \dots$ s
 (A) 2 (B) 3 (C) 4 (D) 1
40. A shell is fired from a fixed artillery gun with an initial speed u such that it hits the target on the ground at a distance R from it. If t_1 and t_2 are the values of the time taken by it to hit the target in two possible ways, the product $t_1 t_2$ is
 (A) $\frac{R}{4g}$ (B) $\frac{R}{g}$ (C) $\frac{R}{2g}$ (D) $\frac{2R}{g}$
41. The ceiling of a long hall is 20 m high. The maximum horizontal distance that a ball thrown with a speed of 40 m/s can go without hitting the ceiling of the hall is
 (A) 120 m (B) 60 m (C) 138 m (D) 69 m
42. Two seconds after projection, a projectile is travelling in a direction inclined at 30° to the horizontal. After one more second, it is travelling horizontally. Angle of projection of the projectile is degree above the horizontal
 (A) 30 (B) 45 (C) 60 (D) 15
43. A projectile is projected at an angle 60° to the horizontal. If range of the projectile is $30\sqrt{3}$ m, the maximum height reached by the projectile is
 (A) $15\sqrt{3}$ m (B) $60\sqrt{3}$ m (C) 50 m (D) 22.5 m
44. The ranges and heights for two projectiles projected with the same initial velocity at angles 42° and 48° with the horizontal are R_1, R_2 and H_1, H_2 respectively. Choose the correct option.
 (A) $R_1 > R_2$ and $H_1 = H_2$ (B) $R_1 = R_2$ and $H_1 < H_2$
 (C) $R_1 < R_2$ and $H_1 < H_2$ (D) $R_1 = R_2$ and $H_1 = H_2$
45. A projectile is projected with a velocity of $\vec{v} = 10\sqrt{3}\hat{i} + 30\hat{j}$. The angle between the velocity of the projectile and the x-axis at 2s is
 (A) 45° (B) 60° (C) 30° (D) 0°

46. At a height of 0.4 m from the ground the velocity of the projectile is $(6\hat{i} + 2\hat{j})\text{m/s}$. The angle of projection is

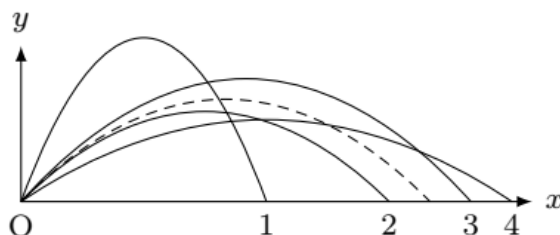
- (A) 45° (B) 30° (C) 60° (D) $\tan^{-1} \frac{3}{4}$

47. The speed of a projectile when it is at its greatest height is $\sqrt{\frac{2}{5}}$ times its speed at half the maximum height.

The angle of projection is

- (A) 45° (B) 30° (C) 60° (D) $\tan^{-1} \frac{3}{4}$

48. The path of a projectile in the absence of air drag is shown in the figure by a dotted line. The path of the same projectile in the presence of air resistance is given by



- (A) 3 (B) 4 (C) 2 (D) 1

49. A projectile is projected with a kinetic energy K such that its horizontal range is equal to the maximum height. The kinetic energy of the projectile at the highest point is

- (A) zero (B) $\frac{K}{2}$ (C) $\frac{K}{4}$ (D) $\frac{K}{17}$

50. A ball rolls horizontally off the top of a stairway with a speed of 1.5 ms^{-1} . The steps are 20 cm high and 20 cm wide. Which step does the ball hit first? ($g = 10 \text{ ms}^{-2}$)

- (A) Fourth step (B) Third step (C) Fifth step (D) Second step

51. Uniform circular motion is an example of motion with

- (A) constant speed and velocity (B) variable speed and variable velocity
(C) variable speed and constant velocity (D) constant speed and variable velocity

52. For a particle performing uniform circular motion, choose the WRONG statement from the following:

- (A) Magnitude of particle velocity (speed) remains constant.
(B) Particle velocity remains directed perpendicular to radius vector.
(C) Direction of acceleration keeps changing as particle moves.
(D) Angular momentum is constant in magnitude but direction keeps changing.

53. A particle is in uniform circular motion. Related to one complete revolution of the particle, which among the statements is incorrect?

- (A) Displacement of the particle is zero. (B) Average speed of the particle is zero.
(C) Average velocity of the particle is zero. (D) Average acceleration of the particle is zero.

54. A body is revolving with a constant speed along a circular path. If the direction of its velocity is reversed, keeping speed unchanged, then

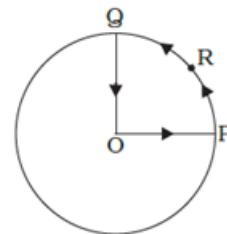
- (A) the centripetal acceleration suffer change in magnitude.
(B) the centripetal acceleration does not suffer any change in direction.
(C) the centripetal acceleration will have its direction reversed.
(D) the magnitude of centripetal acceleration is doubled.

55. A particle under uniform circular motion makes 600 rpm. In how much time, it will complete one revolution?
 (A) 0.2 s (B) 0.1 s (C) 0.4 s (D) 0.3 s
56. A particle is moving uniformly in a circular path of radius r . When it moves through an angular displacement q , then the magnitude of the corresponding linear displacement will be
 (A) $2r \sin\left(\frac{\theta}{2}\right)$ (B) $2r \cot\left(\frac{\theta}{2}\right)$ (C) $2r \tan\left(\frac{\theta}{2}\right)$ (D) $2r \cos\left(\frac{\theta}{2}\right)$
57. A particle is moving in a circle of radius 100 m with a constant speed of 31.4 ms^{-1} . What is its average speed for one complete revolution?
 (A) Zero (B) 31.4 ms^{-1} (C) 3.14 ms^{-1} (D) $\sqrt{2} \times 31.4 \text{ ms}^{-1}$
58. The angular speed of a flywheel making 120 revolutions/minute is
 (A) $4\pi \text{ rad/s}$ (B) $4\pi^2 \text{ rad/s}$ (C) $2\pi^2 \text{ rad/s}$ (D) $2\pi \text{ rad/s}$
59. The ratio of angular speed of a second-hand to the hour-hand of a watch is
 (A) 3600:1 (B) 72:1 (C) 720:1 (D) 60:1
60. The angle between velocity and acceleration of a particle describing uniform circular motion is
 (A) 180° (B) 45° (C) 90° (D) 60°
61. Two particles A and B are moving in uniform circular motion in concentric circles of radii r_A and r_B with speed v_A and v_B respectively. Their time period of rotation is the same. The ratio of angular speed of A to that of B will be
 (A) 1 : 1 (B) $r_A : r_B$ (C) $v_A : v_B$ (D) $r_B : r_A$
62. A particle moves in a circle of radius 5 cm with constant speed and time period $0.2\pi \text{ s}$. The acceleration of the particle is
 (A) 15 m/s^2 (B) 25 m/s^2 (C) 36 m/s^2 (D) 5 m/s^2
63. A body is whirled in a horizontal circle of radius 20 cm. It has an angular velocity of 10 rad/s . What is its linear velocity at any point on circular path?
 (A) 20 m/s (B) 2 m/s (C) 10 m/s (D) 2 m/s
64. Different quantities related to uniform circular motion are in the first column and expressions corresponding to them are in the second column. Choose the correct match: (Symbols have their usual meaning)

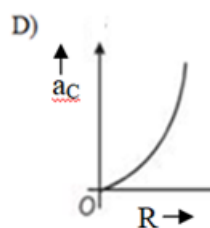
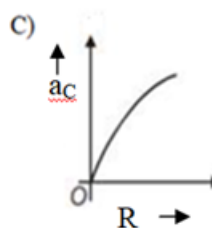
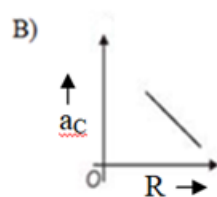
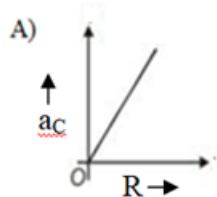
PHYSICAL QUANTITY	MATHEMATICAL EXPRESSION
(i) Period of revolution	(p) $\frac{v^2}{R}$
(ii) Frequency of revolution	(q) $\frac{2\pi R}{v}$
(iii) Angular Velocity	(r) $\frac{\omega}{2\pi}$
(iv) Centripetal acceleration	(s) $\sqrt{\frac{a}{R}}$

- (A) (i) $\rightarrow$ (r); (ii) $\rightarrow$ (q); (iii) $\rightarrow$ (p); (iv) $\rightarrow$ (s) (B) (i) $\rightarrow$ (q); (ii) $\rightarrow$ (r); (iii) $\rightarrow$ (p); (iv) $\rightarrow$ (s)
 (C) (i) $\rightarrow$ (q); (ii) $\rightarrow$ (r); (iii) $\rightarrow$ (s); (iv) $\rightarrow$ (p) (D) (i) $\rightarrow$ (q); (ii) $\rightarrow$ (s); (iii) $\rightarrow$ (r); (iv) $\rightarrow$ (p)
65. A particle is in uniform circular motion. The equation of its trajectory is given by $(x-2)^2 + y^2 = 25$, where x and y are in meter. The speed of the particle is 2 ms^{-1} . When the particle attains the lowest Y co-ordinate, the acceleration of the particle is (in ms^{-2})
 (A) $0.4 \hat{i}$ (B) $0.4 \hat{j}$ (C) $0.8 \hat{i}$ (D) $0.8 \hat{j}$

66. A cyclist starts from centre O of a circular park of radius 1 km and moves along the path OPRQO as shown in figure. If he maintains constant speed of 10 ms^{-1} , his acceleration at point R in magnitude is



- (A) 0.1 ms^{-2} (B) 0.01 ms^{-2}
 (C) 1.0 ms^{-2} (D) 0.001 ms^{-2}
67. An electric fan has blades of length 30 cm measured from the axis of rotation. If the fan is rotating at 120 rpm, the acceleration of a point on the tip of the blade is
 (A) 1600 ms^{-2} (B) 47.4 ms^{-2} (C) 23.7 ms^{-2} (D) 50.55 ms^{-2}
68. A stone tied to one end of spring 0.8 m long is whirled in a horizontal circle with a constant speed. If stone makes 14 revolutions in 25 s, the magnitude of acceleration of stone is
 (A) 8.50 ms^{-2} (B) 9.92 ms^{-2} (C) 7.20 ms^{-2} (D) 6.50 ms^{-2}
69. Earth can be thought of as a sphere of radius 6400 km. Any object is performing circular motion around the axis of earth due to earth's rotation (period 1 day). The acceleration of object on the surface of the earth (at equator) towards its centre is
 (A) 0.043 ms^{-2} (B) 0.054 ms^{-2} (C) 0.34 ms^{-2} (D) 0.034 ms^{-2}
70. The graph of the magnitude of centripetal acceleration (a_c) v/s radius of circular path (R) in case of uniform circular motion for constant angular velocity is best represented by



KEY ANSWERS

1	2	3	4	5	6	7	8	9	10	11	12	13	14
B	A	A	B	B	B	D	C	B	D	A	B	A	D
15	16	17	18	19	20	21	22	23	24	25	26	27	28
B	C	D	D	C	C	D	A	C	C	B	A	C	B
29	30	31	32	33	34	35	36	37	38	39	40	41	42
B	A	D	D	B	A	A	C	D	D	C	D	C	C
43	44	45	46	47	48	49	50	51	52	53	54	55	56
D	B	C	B	C	C	D	B	D	D	B	B	B	A
57	58	59	60	61	62	63	64	65	66	67	68	69	70
B	A	C	C	A	D	B	C	B	A	B	B	D	A

PREVIOUS YEAR KCET QUESTIONS (2020 ONWARDS)

1. Rain is falling vertically with a speed of 12 m s^{-1} . A woman rides a bicycle with a speed of 12 m s^{-1} in east to west direction. What is the direction in which she should hold her umbrella? [KCET-2020]
(A) 45° towards East (B) 30° towards West
(C) 45° towards West (D) 30° towards East
2. The maximum range of a gun on horizontal plane is 16 km. If $g = 10 \text{ m s}^{-2}$, then the muzzle velocity of a shell is [KCET-2021]
(A) 160 m s^{-1} (B) $200\sqrt{2} \text{ m s}^{-1}$ (C) 400 m s^{-1} (D) 800 m s^{-1}
3. The trajectory of a projectile is [KCET-2021]
(A) semicircle (B) an ellipse
(C) a parabola always (D) a parabola in the absence of air resistance
4. For a projectile motion, the angle between the velocity and acceleration is minimum and acute at [2021]
(A) only one point (B) two points (C) three points (D) four points
5. A particle starts from the origin at $t = 0 \text{ s}$ with a velocity of $10 \hat{j} \text{ m s}^{-1}$ and moves in the x-y plane with a constant acceleration of $(8\hat{i} + 2\hat{j}) \text{ m s}^{-2}$. At an instant when the x-coordinate of the particle is 16 m, y-coordinate of the particle is [KCET-2021]
(A) 16 m (B) 28 m (C) 36 m (D) 24 m
6. Two objects are projected at an angle of θ° and $(90 - \theta)^\circ$, to the horizontal with the same speed. The ratio of their maximum vertical heights is [KCET-2022]
(A) $1: \tan \theta$ (B) $\tan \theta^2 : 1$ (C) $1: 1$ (D) $\tan \theta : 1$
7. A particle is in uniform circular motion. Related to one complete revolution of the particle, which among the statements is incorrect? [KCET-2023]
(A) displacement of the particle is zero (B) average speed of the particle is zero
(C) average velocity of the particle is zero (D) average acceleration of the particle is zero
8. Among the given pair of vectors, the resultant of two vectors can never be 3 units. The vectors are [2024]
(A) 1 unit and 2 units (B) 2 units and 5 units
(C) 3 units and 6 units (D) 4 units and 8 units
9. In the projectile motion of a particle on a level ground, which of the following remains constant with reference to time and position? [KCET-2025]
(A) vertical component of the velocity of the particle
(B) average velocity between any two points on the path
(C) horizontal component of the velocity of the particle
(D) angle between the instantaneous velocity with the horizontal
10. A particle is in uniform circular motion. The equation of trajectory is given by $(x - 2)^2 + y^2 = 25$, where x and y are in metre. The speed of the particle is 2 m s^{-1} . When the particle attains the lowest y co-ordinate, the acceleration of the particle is (*in m s^{-2}*) [KCET-2025]
(A) $0.4 \hat{i}$ (B) $0.4 \hat{j}$ (C) $0.8 \hat{i}$ (D) $0.8 \hat{j}$

1. Two bodies are projected with the same velocity. If one is projected at an angle of 30° and the other at 45° to the horizontal, then the ratio of maximum heights attained is **[KCET-2026]**

(A) 3: 1

(B) 1: 2

(C) 4: 1

(D) 1: 3

KEY ANSWERS

1	2	3	4	5	6	7	8	9	10	11
A	C	D	A	D	B	B	D	C	D	B