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CLASS 11 PHYSICS · NCERT CHAPTER 3 · IMU CET PRACTICE

Motion in a Plane

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Questions: 46 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

- 1 Which of the following is a scalar quantity?
(A) Momentum (B) Work
(C) Displacement (D) Torque
- 2 Two vectors of magnitudes 3 and 4 are at right angles. The magnitude of their resultant is
(A) 7 (B) 12
(C) 1 (D) 5
- 3 Two forces of 5 N and 12 N act on a body. The resultant cannot be
(A) 18 N (B) 7 N
(C) 17 N (D) 13 N
- 4 The angle between $A = \hat{i} + \hat{j}$ and $B = \hat{i} - \hat{j}$ is
(A) 90° (B) 180°
(C) 45° (D) 0°
- 5 The magnitude of the vector $3\hat{i} + 4\hat{j} + 12\hat{k}$ is
(A) 169 (B) 13
(C) 12 (D) 19
- 6 The unit vector along $6\hat{i} - 8\hat{j}$ is
(A) $0.6\hat{i} + 0.8\hat{j}$ (B) $0.8\hat{i} - 0.6\hat{j}$
(C) $0.6\hat{i} - 0.8\hat{j}$ (D) $6\hat{i} - 8\hat{j}$
- 7 Two equal forces F act at an angle of 120° . The magnitude of the resultant is
(A) F (B) $2F$
(C) $F/2$ (D) $\sqrt{3} F$
- 8 If $|A + B| = |A - B|$, the angle between A and B is
(A) 0° (B) 180°
(C) 60° (D) 90°
- 9 For a projectile, which quantity remains constant throughout the motion (no air resistance)?
(A) Kinetic energy (B) Vertical component of velocity
(C) Speed (D) Horizontal component of velocity



- 10 The range of a projectile is maximum when the angle of projection is
(A) 30° (B) 90°
(C) 45° (D) 60°
- 11 A projectile is fired at 20 m/s at 30° to the horizontal. Its time of flight is ($g = 10 \text{ m/s}^2$)
(A) 4 s (B) 1 s
(C) 3.46 s (D) 2 s
- 12 A projectile is thrown at 40 m/s at 45° . Its horizontal range is ($g = 10 \text{ m/s}^2$)
(A) 160 m (B) 320 m
(C) 80 m (D) 40 m
- 13 A ball is projected at 20 m/s at 60° with the horizontal. The maximum height reached is ($g = 10 \text{ m/s}^2$)
(A) 20 m (B) 5 m
(C) 10 m (D) 15 m
- 14 The ranges of a projectile for angles θ and $(90^\circ - \theta)$ with the same speed are
(A) in ratio $\sin \theta : \cos \theta$ (B) equal
(C) in ratio $\tan \theta : 1$ (D) in ratio 1 : 2
- 15 At the highest point of a projectile's path, the angle between velocity and acceleration is
(A) 45° (B) 0°
(C) 90° (D) 180°
- 16 The path of a projectile in a uniform gravitational field is
(A) a circle (B) a straight line
(C) a parabola (D) a hyperbola
- 17 For a projectile, if the maximum height equals the horizontal range, the angle of projection is
(A) 45° (B) $\tan^{-1} 4$
(C) $\tan^{-1} (1/4)$ (D) $\tan^{-1} 2$
- 18 A body is projected horizontally at 10 m/s from the top of a 45 m high tower. It hits the ground at a horizontal distance of ($g = 10 \text{ m/s}^2$)
(A) 45 m (B) 30 m
(C) 15 m (D) 10 m
- 19 A stone is thrown horizontally at 15 m/s from a cliff. Its speed after 2 s is ($g = 10 \text{ m/s}^2$)
(A) 20 m/s (B) 35 m/s
(C) 25 m/s (D) 15 m/s
- 20 The maximum range of a projectile is R. The maximum height attained when projected at 45° is
(A) $R/2$ (B) $R/4$
(C) $2R$ (D) R
- 21 In uniform circular motion, which quantity is constant?
(A) Linear momentum (B) Speed
(C) Velocity (D) Acceleration vector



- 22 The centripetal acceleration of a particle moving in a circle of radius 2 m with speed 4 m/s is
(A) 16 m/s^2 (B) 2 m/s^2
(C) 4 m/s^2 (D) 8 m/s^2
- 23 A wheel makes 300 revolutions per minute. Its angular speed is
(A) $10\pi \text{ rad/s}$ (B) $600\pi \text{ rad/s}$
(C) $300\pi \text{ rad/s}$ (D) $5\pi \text{ rad/s}$
- 24 The angular speed of the minute hand of a clock is
(A) $\pi/30 \text{ rad/s}$ (B) $\pi/21600 \text{ rad/s}$
(C) $\pi/1800 \text{ rad/s}$ (D) $2\pi \text{ rad/s}$
- 25 A particle moves in a circle of radius 0.5 m with angular speed 4 rad/s. Its linear speed is
(A) 2 m/s (B) 4 m/s
(C) 8 m/s (D) 0.125 m/s
- 26 A boat crosses a river 100 m wide with velocity 5 m/s relative to water, heading perpendicular to the current. River flows at 3 m/s. Time to cross is
(A) 25 s (B) 20 s
(C) 12.5 s (D) 33.3 s
- 27 In the previous situation (width 100 m, boat 5 m/s across, current 3 m/s), the drift downstream is
(A) 100 m (B) 30 m
(C) 80 m (D) 60 m
- 28 A swimmer with speed 5 m/s in still water wants to cross a river (current 3 m/s) along the shortest path. The angle with the upstream direction measured from the perpendicular is $\sin^{-1}$ of
(A) $4/5$ (B) $5/3$
(C) $3/5$ (D) $3/4$
- 29 Rain is falling vertically at 6 m/s. A man walks at 8 m/s. The speed of rain relative to the man is
(A) 10 m/s (B) 2 m/s
(C) 14 m/s (D) 7 m/s
- 30 Rain falls vertically at 10 m/s. A cyclist moving at 10 m/s should hold his umbrella at an angle of ___ with the vertical.
(A) 30° , tilted forward (B) 45° , tilted backward
(C) 60° , tilted forward (D) 45° , tilted forward
- 31 The dot product of two vectors A and B is zero and their cross product is also zero. Then
(A) at least one of them is a null vector (B) they are equal
(C) they are perpendicular (D) they are parallel
- 32 The cross product $\hat{i} \times \hat{j}$ equals
(A) 0 (B) $-\hat{k}$
(C) $\hat{k}$ (D) 1



- 33 The component of $A = 2\hat{i} + 3\hat{j}$ along $B = \hat{i} + \hat{j}$ is
(A) $5/\sqrt{2}$ (B) 5
(C) $\sqrt{13}$ (D) $5/2$
- 34 Two vectors A and B have magnitudes 6 and 8. Their resultant has magnitude 10. The angle between them is
(A) 60° (B) 90°
(C) 0° (D) 120°
- 35 The horizontal range of a projectile is $4\sqrt{3}$ times its maximum height. The angle of projection is
(A) 30° (B) 60°
(C) 45° (D) 75°
- 36 A projectile has kinetic energy K at the point of projection at 60° . Its kinetic energy at the highest point is
(A) $K/4$ (B) $3K/4$
(C) zero (D) $K/2$
- 37 A projectile is fired at an angle θ . At the highest point its velocity is
(A) $u \sin \theta$ (B) $u \cos \theta$
(C) zero (D) u
- 38 The equation of a projectile is $y = \sqrt{3}x - gx^2/2$ (SI). The angle of projection is
(A) 45° (B) 30°
(C) 90° (D) 60°
- 39 For the projectile $y = \sqrt{3}x - gx^2/2$ (SI), the speed of projection is
(A) $\sqrt{3}$ m/s (B) 1 m/s
(C) 2 m/s (D) 4 m/s
- 40 A particle moves in a circle of radius r with constant speed v. The magnitude of change in velocity after half a revolution is
(A) zero (B) $\sqrt{2}v$
(C) $2v$ (D) v
- 41 A particle moves in a circle with constant speed. The magnitude of change in velocity after a quarter revolution is
(A) zero (B) $2v$
(C) v (D) $\sqrt{2}v$
- 42 The position vector of a particle is $r = 3t\hat{i} + 2t^2\hat{j}$ (SI). Its acceleration is
(A) $4t\hat{j}$ m/s² (B) $3\hat{i} + 4\hat{j}$ m/s²
(C) $3\hat{i}$ m/s² (D) $4\hat{j}$ m/s²
- 43 The velocity of a particle is $v = 2\hat{i} + 3t\hat{j}$ (SI). Its speed at $t = 2$ s is
(A) 6 m/s (B) $2\sqrt{10}$ m/s
(C) $\sqrt{13}$ m/s (D) 8 m/s



- 44** A particle starts from origin with initial velocity $5\hat{i}$ m/s and constant acceleration $2\hat{j}$ m/s². Its position at $t = 2$ s is

(A) $10\hat{i} + 4\hat{j}$ m (B) $5\hat{i} + 4\hat{j}$ m
(C) $10\hat{i} + 8\hat{j}$ m (D) $10\hat{i} + 2\hat{j}$ m

45 A body is projected at 45° with speed $20\sqrt{2}$ m/s. Its velocity after 2 s is ($g = 10$ m/s²)

(A) $20\sqrt{2}$ m/s at 45° (B) zero
(C) 20 m/s horizontal (D) 20 m/s vertical

46 Two projectiles are thrown with the same speed at 30° and 60° . The ratio of their maximum heights is

(A) 1 : 2 (B) 1 : 3
(C) 1 : $\sqrt{3}$ (D) 3 : 1

Answer Key

1	2	3	4	5	6	7	8	9	10
B	D	A	A	B	C	A	D	D	C
11	12	13	14	15	16	17	18	19	20
D	A	D	B	C	C	B	B	C	B
21	22	23	24	25	26	27	28	29	30
B	D	A	C	A	B	D	C	A	D
31	32	33	34	35	36	37	38	39	40
A	C	A	B	A	A	B	D	C	C
41	42	43	44	45	46				
D	D	B	A	C	B				

Hints & Solutions

- (B) Work = $\mathbf{F} \cdot \mathbf{s}$ is a dot product, hence a scalar.
- (D) $R = \sqrt{3^2 + 4^2} = 5$.
- (A) The resultant lies between $|5 - 12| = 7$ N and $5 + 12 = 17$ N. 18 N is outside the range.
- (A) $\mathbf{A} \cdot \mathbf{B} = 1 - 1 = 0$, so the vectors are perpendicular.
- (B) $|\mathbf{A}| = \sqrt{9 + 16 + 144} = \sqrt{169} = 13$.
- (C) $|\mathbf{A}| = 10$. Unit vector = $\mathbf{A}/|\mathbf{A}| = 0.6\hat{i} - 0.8\hat{j}$.
- (A) $R = \sqrt{F^2 + F^2 + 2F^2 \cos 120^\circ} = \sqrt{2F^2 - F^2} = F$.
- (D) Squaring: $A^2 + B^2 + 2\mathbf{A} \cdot \mathbf{B} = A^2 + B^2 - 2\mathbf{A} \cdot \mathbf{B} \rightarrow \mathbf{A} \cdot \mathbf{B} = 0 \rightarrow \theta = 90^\circ$.
- (D) No horizontal force acts, so $u \cos \theta$ stays constant.
- (C) $R = u^2 \sin 2\theta / g$ is maximum when $\sin 2\theta = 1$, i.e., $\theta = 45^\circ$.
- (D) $T = 2u \sin \theta / g = 2 \times 20 \times 0.5 / 10 = 2$ s.
- (A) $R = u^2 / g$ (at 45°) = $1600 / 10 = 160$ m.
- (D) $H = u^2 \sin^2 \theta / 2g = 400 \times (3/4) / 20 = 15$ m.
- (B) $\sin 2\theta = \sin(180^\circ - 2\theta) = \sin 2(90^\circ - \theta)$, so the ranges are equal.
- (C) Velocity is horizontal, acceleration g is vertically downward — they are perpendicular.
- (C) $y = x \tan \theta - gx^2 / (2u^2 \cos^2 \theta)$ is quadratic in x — a parabola.
- (B) $u^2 \sin^2 \theta / 2g = 2u^2 \sin \theta \cos \theta / g \rightarrow \tan \theta = 4$.
- (B) $t = \sqrt{2h/g} = 3$ s; $x = 10 \times 3 = 30$ m.
- (C) $v_x = 15$, $v_y = 20 \rightarrow v = \sqrt{225 + 400} = 25$ m/s.
- (B) At 45° , $R = u^2 / g$ and $H = u^2 / (4g) = R/4$.
- (B) Speed is constant; the direction of velocity (and acceleration) changes continuously.
- (D) $a = v^2 / r = 16/2 = 8$ m/s².
- (A) $f = 300/60 = 5$ Hz; $\omega = 2\pi f = 10\pi$ rad/s.



24. (C) $T = 3600 \text{ s} \rightarrow \omega = 2\pi/3600 = \pi/1800 \text{ rad/s}$.
25. (A) $v = \omega r = 4 \times 0.5 = 2 \text{ m/s}$.
26. (B) Crossing time depends only on the velocity component across the river: $t = 100/5 = 20 \text{ s}$.
27. (D) Drift = $v_{\text{river}} \times t = 3 \times 20 = 60 \text{ m}$.
28. (C) For zero drift, $v_s \sin \theta = v_r \rightarrow \sin \theta = 3/5$ (θ measured from the perpendicular, towards upstream).
29. (A) $v_{\text{rel}} = \sqrt{6^2 + 8^2} = 10 \text{ m/s}$.
30. (D) Relative velocity of rain makes $\tan \theta = 10/10 = 1 \rightarrow 45^\circ$ with vertical, coming from the front; so tilt forward.
31. (A) $A \cdot B = AB \cos \theta = 0$ and $|A \times B| = AB \sin \theta = 0$ cannot both vanish for non-zero A, B. Hence one must be zero.
32. (C) For a right-handed system, $\hat{i} \times \hat{j} = \hat{k}$.
33. (A) Component = $A \cdot B / |B| = (2 + 3)/\sqrt{2} = 5/\sqrt{2}$.
34. (B) $100 = 36 + 64 + 96 \cos \theta \rightarrow \cos \theta = 0 \rightarrow \theta = 90^\circ$.
35. (A) $R/H = 4/\tan \theta = 4\sqrt{3} \rightarrow \tan \theta = 1/\sqrt{3} \rightarrow \theta = 30^\circ$.
36. (A) At top, $v = u \cos 60^\circ = u/2 \rightarrow KE = K \times (1/2)^2 = K/4$.
37. (B) Only the horizontal component $u \cos \theta$ remains at the top.
38. (D) Comparing with $y = x \tan \theta - \dots$, $\tan \theta = \sqrt{3} \rightarrow \theta = 60^\circ$.
39. (C) $g/(2u^2 \cos^2 \theta) = g/2 \rightarrow u^2 \cos^2 \theta = 1 \rightarrow u^2 \times 1/4 = 1 \rightarrow u = 2 \text{ m/s}$.
40. (C) Velocity reverses direction: $|\Delta v| = |v - (-v)| = 2v$.
41. (D) Velocities are perpendicular: $|\Delta v| = \sqrt{v^2 + v^2} = \sqrt{2} v$.
42. (D) $v = 3\hat{i} + 4t\hat{j}$; $a = 4\hat{j} \text{ m/s}^2$.
43. (B) $v = 2\hat{i} + 6\hat{j} \rightarrow |v| = \sqrt{4 + 36} = \sqrt{40} = 2\sqrt{10} \text{ m/s}$.
44. (A) $r = ut + \frac{1}{2}at^2 = 10\hat{i} + \frac{1}{2}(2)(4)\hat{j} = 10\hat{i} + 4\hat{j} \text{ m}$.
45. (C) $u_x = u_y = 20 \text{ m/s}$. After 2 s, $v_y = 20 - 20 = 0$, so $v = 20 \text{ m/s}$ horizontal (highest point).
46. (B) $H \propto \sin^2 \theta \rightarrow (1/4) : (3/4) = 1 : 3$.

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