Motion in a Plane

Class 11 Physics · 24 NEET MCQs with answers & explanations

Motion in a Plane covers vectors, projectile motion and uniform circular motion. NEET tests projectile formulas (range, max height, time of flight), vector addition/resolution and centripetal acceleration. Projectile motion numericals and vector-based problems are NEET staples.

Key Formulas

Concept	Key Formula
Projectile — time of flight	$T = 2u \sin\theta / g$
Projectile — max height	$H = u^2 \sin^2\theta / 2g$
Projectile — range	$R = u^2 \sin 2\theta / g$; max at $\theta = 45°$
Centripetal acceleration	$a = v^2/r = \omega^2 r$; directed towards centre
Vector addition	$\lvert R\rvert = \sqrt{(A^2 + B^2 + 2AB\cos\theta)}$; $\tan\alpha = B\sin\theta / (A + B\cos\theta)$
Complementary angles	Same range for θ and $(90° - \theta)$

Questions

Q1. A vector has components $12\hat{i}$ and $5\hat{j}$. Its magnitude is:

(A) 11 units
(B) 12 units
(C) 17 units
(D) 13 units

Q2. Two vectors of magnitudes 6 units and 8 units are inclined at 60°. Their resultant magnitude is:

(A) 10 units
(B) 12 units
(C) $2\sqrt{37}$ units
(D) 14 units

Q3. Vectors $A = 4\hat{i}+3\hat{j}$ and $B = 3\hat{i}-4\hat{j}$. The angle between them is:

(A) 0°
(B) 90°
(C) 60°
(D) 180°

Q4. Which of the following is a scalar quantity?

(A) Displacement
(B) Distance
(C) Velocity
(D) Acceleration

Q5. Which of the following is a vector quantity?

(A) Mass
(B) Temperature
(C) Force
(D) Energy

Q6. A particle travels 12 m east and then 5 m west along a straight line. Its displacement is:

(A) 7 m east
(B) 17 m east
(C) 12 m east
(D) 5 m west

Q7. According to the triangle law of vector addition, two vectors are represented by two sides of a triangle taken in order. The resultant is represented by:

(A) The side opposite to the larger vector
(B) The third side taken in the opposite order
(C) The angle bisector of the included angle
(D) The median from the common vertex

Q8. If two vectors of magnitudes 6 units and 8 units act in the same direction, the magnitude of the resultant is:

(A) 2 units
(B) 7 units
(C) 14 units
(D) 48 units

Q9. Two vectors of magnitudes 10 N and 6 N act in opposite directions. Their resultant magnitude and direction are:

(A) 4 N along the 10 N vector
(B) 4 N along the 6 N vector
(C) 16 N along the 10 N vector
(D) 8 N along the 10 N vector

Q10. A projectile is launched with initial speed u at angle θ to the horizontal. The horizontal component of its velocity is:

(A) $u \sin\theta$
(B) $u \cos\theta$
(C) $u \tan\theta$
(D) $u/\sin\theta$

Q11. A projectile is fired with speed 20 m/s at 30° to the horizontal. Its initial vertical component of velocity is: ($g = 10\ m/s^2$)

(A) 10 m/s
(B) $10\sqrt{3}$ m/s
(C) 20 m/s
(D) 5 m/s

Q12. Which physical quantity remains constant throughout the motion of a projectile (neglecting air resistance)?

(A) Vertical velocity
(B) Speed
(C) Kinetic energy
(D) Horizontal velocity

Q13. A vector has components 6î and 8ĵ. Its magnitude is:

(A) 10 units
(B) 12 units
(C) 14 units
(D) 8 units

Q14. Two vectors of magnitudes 5 units and 12 units are perpendicular. Their resultant magnitude is:

(A) 5 units
(B) 12 units
(C) 13 units
(D) 17 units

Q15. A projectile is projected with speed 20 m/s at 30°. Taking g = 10 m/s², its time of flight is:

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

Q16. A particle moving with constant speed in a circular path undergoes:

(A) No acceleration
(B) Constant velocity
(C) Centripetal acceleration directed towards the centre
(D) Constant tangential acceleration

Q17. The direction of the instantaneous velocity of a particle in uniform circular motion is:

(A) Towards the centre
(B) Tangential to the circle at that point
(C) Radially outward from the centre
(D) Along the diameter of the circle

Q18. A particle moves in a circle of radius 5 m with angular velocity 4 rad/s. Its centripetal acceleration is:

(A) 20 m/s²
(B) 40 m/s²
(C) 160 m/s²
(D) 80 m/s²

Q19. Vectors A = 6i + 8j and B = 4i + 3j. The value of A·B is:

(A) 30
(B) 48
(C) 50
(D) 24

Q20. If the dot product of two non-zero vectors is zero, the vectors must be:

(A) Parallel to each other
(B) Anti-parallel to each other
(C) Perpendicular to each other
(D) Equal in magnitude

Q21. Two vectors each of magnitude 10 units have a dot product of 50. The angle between them is:

(A) 30 degrees
(B) 60 degrees
(C) 90 degrees
(D) 120 degrees

Q22. The position vector of a particle is defined as the vector drawn from:

(A) The origin to the particle's location
(B) The particle to the origin
(C) One particle to another particle
(D) The final position to the initial position

Q23. A particle moves from point (2, 3) m to point (7, 8) m. The displacement vector is:

(A) (9, 11) m
(B) (5, 5) m
(C) (−5, −5) m
(D) (2, 3) m

Q24. Which statement correctly distinguishes position vector from displacement vector?

(A) Both always have the same magnitude
(B) Displacement always originates from the origin
(C) Position vector depends on the chosen origin; displacement depends only on initial and final positions
(D) Both are always equal in magnitude and direction

Answer key

1-D	**2-C**	**3-B**	**4-B**	**5-C**	**6-A**	**7-B**	**8-C**
9-A	**10-B**	**11-A**	**12-D**	**13-A**	**14-C**	**15-B**	**16-C**
17-B	**18-D**	**19-B**	**20-C**	**21-B**	**22-A**	**23-B**	**24-C**

Answers with explanations

Q1 — Answer: (D) 13 units
$|A| = \sqrt{(12^2+5^2)} = \sqrt{(144+25)} = \sqrt{169} = 13$ units. Option C (17) is the trap — it comes from adding 12+5 directly instead of using the Pythagorean theorem.

Q2 — Answer: (C) $2\sqrt{37}$ units
$R = \sqrt{(36+64+2\times6\times8\times\cos60°)} = \sqrt{(100+48)} = \sqrt{148} = 2\sqrt{37}$ units. Option A (10) is the trap — it assumes perpendicular vectors, using $R = \sqrt{(6^2+8^2)}$ without the cosine term.

Q3 — Answer: (B) 90°
$A\cdot B = (4)(3)+(3)(-4) = 12-12 = 0$. Zero dot product means vectors are perpendicular, so angle = 90°. Option A (0°) is the trap — students see similar-looking components and assume parallel vectors.

Q4 — Answer: (B) Distance
Distance has magnitude only, with no associated direction. Displacement, velocity, and acceleration all require both magnitude and direction to be fully described.

Q5 — Answer: (C) Force
Force has both magnitude and direction, making it a vector. Mass, temperature, and energy are fully described by magnitude alone and are therefore scalars.

Q6 — Answer: (A) 7 m east
Displacement = net change in position = 12 − 5 = 7 m east. The common error is adding both distances to get 17 m, which gives total path length (distance), not displacement.

Q7 — Answer: (B) The third side taken in the opposite order
Triangle law states the resultant is the third side taken in opposite order (tail of first to head of second). Option A wrongly links resultant to the larger vector, which is a common misread of the law.

Q8 — Answer: (C) 14 units
Vectors in the same direction add directly: 6 + 8 = 14 units. Option A (2 units) is the minimum resultant (opposite direction). Option D (48) is their product, not sum.

Q9 — Answer: (A) 4 N along the 10 N vector
Opposite vectors: resultant = 10 - 6 = 4 N, directed along the larger (10 N) vector. Option B wrongly assigns direction to the smaller vector. Option C adds instead of subtracts.

Q10 — Answer: (B) u cosθ
Horizontal component $u_x = u\cos\theta$ since θ is measured from horizontal. Option A (u sinθ) is the vertical component — a common sin/cos swap. cos gives the adjacent side to angle θ in the velocity triangle.

Q11 — Answer: (A) 10 m/s
$u_y = u\sin30° = 20 \times 0.5 = 10$ m/s. Option B ($10\sqrt{3}$ m/s) is u cos30°, the horizontal component — the classic sin/cos confusion trap. sin gives the side opposite to θ.

Q12 — Answer: (D) Horizontal velocity
Horizontal acceleration is zero throughout, so the horizontal component of velocity stays constant. Vertical velocity changes continuously due to g, so speed and kinetic energy also change during flight.

Q13 — Answer: (A) 10 units
$|A| = \sqrt{(6^2 + 8^2)} = \sqrt{100} = 10$ units. Options B and C arise from adding components directly instead of using the Pythagorean theorem.

Q14 — Answer: (C) 13 units
$R = \sqrt{(5^2 + 12^2)} = \sqrt{169} = 13$ units. Option D (17) is the trap — it results from simple addition of magnitudes, valid only for parallel vectors.

Q15 — Answer: (B) 2 s
$T = 2u\sin\theta/g = 2\times20\times0.5/10 = 2$ s. Option A (1 s) comes from omitting the factor of 2, i.e., computing only ascent time.

Q16 — Answer: (C) Centripetal acceleration directed towards the centre
Speed is constant but direction of velocity changes, so acceleration exists. This centripetal acceleration points toward the centre and is constant in magnitude. Option B (constant velocity) is wrong because velocity direction changes; Option D confuses centripetal with tangential acceleration.

Q17 — Answer: (B) Tangential to the circle at that point
Velocity is always directed along the tangent to the path at every instant. Option A (toward centre) is the direction of centripetal acceleration, not velocity. Option C (radially outward) is the direction of no physical vector in UCM.

Q18 — Answer: (D) 80 m/s²
$v = \omega r = 4\times5 = 20$ m/s; $a_c = v^2/r = 400/5 = 80$ m/s². Equivalently $a_c = \omega^2 r = 16\times5 = 80$ m/s². Option A uses $a_c = \omega r$ (missing the square). Option C uses $a_c = \omega^2 r^2$ (extra r factor).

Q19 — Answer: (B) 48
A·B = (6 times 4) + (8 times 3) = 24 + 24 = 48. Option C (50) comes from computing magnitudes: |A| = 10, |B| = 5, then multiplying 10 times 5, ignoring the angle between them.

Q20 — Answer: (C) Perpendicular to each other
A·B = AB cosθ = 0 for non-zero vectors implies cosθ = 0, so θ = 90 degrees. Option A (parallel) gives maximum dot product AB, not zero.

Q21 — Answer: (B) 60 degrees
A·B = AB cosθ gives 50 = 100 cosθ, so cosθ = 0.5, θ = 60 degrees. Option C (90 degrees) gives dot product = 0, not 50. Option D gives a negative dot product.

Q22 — Answer: (A) The origin to the particle's location
A position vector always originates at the chosen reference origin and terminates at the particle. Option B reverses the direction, which would give the negative of the position vector.

Q23 — Answer: (B) (5, 5) m
Displacement = $r_2 - r_1 = (7-2)\hat{i} + (8-3)\hat{j} = 5\hat{i} + 5\hat{j}$ m. Option A adds instead of subtracting coordinates. Option C reverses the subtraction order, a common sign-flip error.

Q24 — Answer: (C) Position vector depends on the chosen origin; displacement depends only on initial and final positions
Shifting the origin changes every position vector but leaves displacement unchanged since the shift cancels in $r_2 - r_1$. Students confuse the two by assuming both are measured from the origin.

Practise all 313 questions on Motion in a Plane
RankUp app — 45,000+ NEET questions, 30,000+ flashcards, mock tests. Built by Dr. Deepak Sahu, MBBS Gold Medalist.
Download free on Google Play · Practise online

Questions based on NCERT. RankUp is not affiliated with NTA.