

STUDYNEST | CLASS 11 PHYSICS QUESTION PAPER 1

Chapter 3: Motion in a Plane

Maximum Marks: 40 | Suggested time: 60 minutes

Instructions: Answer all questions. Show calculation steps and units. Original practice paper, not an official examination.

Section A 1-mark questions - $8 \times 1 = 8$ marks

1. Is displacement scalar or vector? [1]
2. x-component at angle theta? [1]
3. Horizontal acceleration of an ideal projectile? [1]
4. Direction of centripetal acceleration? [1]
5. Magnitude of perpendicular components 3 and 4? [1]
6. Relation between v and omega? [1]
7. Ideal maximum-range angle at equal heights? [1]
8. Vertical velocity at projectile peak? [1]

Section B 2-mark questions - $6 \times 2 = 12$ marks

9. Resolve 10 N at 60. [2]
10. Displacement after a full circular lap? [2]
11. $v=12$ m/s, $r=6$ m: a_c ? [2]
12. Horizontal launch from 20 m, $g=10$: flight time? [2]
13. Perpendicular vectors 6 and 8: resultant? [2]
14. 120 rpm in rad/s? [2]

Section C 3-mark questions - $4 \times 3 = 12$ marks

15. Projectile at 20 m/s, 30, $g=10$: T,H? [3]
16. Forces 8 N east and 6 N north: resultant? [3]
17. Cyclist at 10 m/s, radius 25 m: a_c ? [3]
18. 25 m/s at 37, $\sin=.6$, $\cos=.8$, $g=10$: time/range? [3]

Section D 4-mark questions - $2 \times 4 = 8$ marks

19. Projectile 20 m/s at 30: time, height, range? [4]
20. 5 kg at 4 m/s in radius 2 m: inward force and work? [4]

End of question paper.

FORMULA AND EQUATION REFERENCE

Chapter-specific equations worth knowing

- Vector components: $A_x = A \cos(\theta)$; $A_y = A \sin(\theta)$.
- Perpendicular resultant magnitude: $R = \sqrt{A_x^2 + A_y^2}$; direction $\theta = \tan^{-1}(A_y/A_x)$.
- Angular speed: $\omega = v/r$; centripetal acceleration $a_c = v^2/r = r \omega^2$.
- Projectile components: $u_x = u \cos(\theta)$; $u_y = u \sin(\theta)$.
- For launch and landing at the same height: $T = 2u \sin(\theta)/g$; $H = u^2 \sin^2(\theta)/(2g)$; $R = u^2 \sin(2\theta)/g$.
- Vertical drop from rest: $h = (1/2)gt^2$; horizontal launch flight time $t = \sqrt{2h/g}$; horizontal range $= u_x t$.
- Angular conversion: 1 revolution = 2π radians; $\omega = 2\pi f$.

Use each equation only when its assumptions apply; keep units consistent.

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STEP-BY-STEP SOLUTIONS

Solutions are grouped here after the question paper and formula reference.

Question 1

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Vector.

Final answer: Vector.

Question 2

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Acostheta.

Final answer: Acostheta.

Question 3

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Zero.

Final answer: Zero.

Question 4

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Inward.

Final answer: Inward.

Question 5

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: 5.

Final answer: 5.

Question 6

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: $v=r\omega$.

Final answer: $v=r\omega$.

Question 7

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: 45.

Final answer: 45.

Question 8

Principle / definition: Recall the relevant definition or equation from the formula reference.

Apply it to this question: Zero.

Final answer: Zero.

Question 9

Working: Resolve the 10 N vector: $A_x = 10 \cos 60^\circ = 10(0.5) = 5 \text{ N}$; $A_y = 10 \sin 60^\circ = 10(0.866) = 8.66 \text{ N}$.

Final answer: $A_x = 5 \text{ N}$; $A_y = 8.66 \text{ N}$.

Question 10

Working: After one complete lap, final position equals initial position. Displacement = final position - initial position = 0.

Final answer: Zero.

Question 11

Working: Centripetal acceleration $a_c = v^2/r = 12^2/6 = 144/6 = 24 \text{ m/s}^2$.

Final answer: 24 m/s^2 .

Question 12

Working: For vertical fall from rest, $h = (1/2)gt^2$. Thus $20 = 5t^2$, $t^2 = 4$ and $t = 2 \text{ s}$.

Final answer: 2 s.

Question 13

Working: For perpendicular components, $R = \sqrt{6^2 + 8^2} = \sqrt{36 + 64} = \sqrt{100} = 10$.

Final answer: 10.

Question 14

Working: $120 \text{ rpm} = 120/60 = 2 \text{ revolutions/s}$. Angular speed = $2\pi f = 2\pi(2) = 4\pi \text{ rad/s}$.

Final answer: $4\pi \text{ rad/s}$.

Question 15

Working: $u_y = 20 \sin 30 = 10 \text{ m/s}$. Time $T = 2u_y/g = 20/10 = 2 \text{ s}$. Maximum height $H = u_y^2/(2g) = 100/20 = 5 \text{ m}$.

Final answer: $T=2 \text{ s}$; $H=5 \text{ m}$.

Question 16

Working: Resultant $R = \sqrt{8^2 + 6^2} = \sqrt{100} = 10 \text{ N}$. Angle north of east $= \tan^{-1}(6/8) = 36.9 \text{ deg}$.

Final answer: 10 N at 36.9 north of east.

Question 17

Working: $a_c = v^2/r = 10^2/25 = 100/25 = 4 \text{ m/s}^2$ toward the centre.

Final answer: 4 m/s^2 inward.

Question 18

Working: Horizontal component $u_x = 25(0.8) = 20 \text{ m/s}$; vertical component $u_y = 25(0.6) = 15 \text{ m/s}$. Flight time $= 2u_y/g = 30/10 = 3 \text{ s}$; range $= u_x t = 20(3) = 60 \text{ m}$.

Final answer: 3 s ; 60 m .

Question 19

Working: Vertical component $= 20 \sin 30 = 10 \text{ m/s}$. Time $= 2(10)/10 = 2 \text{ s}$. Height $= 10^2/(2(10)) = 5 \text{ m}$. Range $= 20 \cos 30 \times 2 = 34.6 \text{ m}$ (equivalently $u^2 \sin 60/g$).

Final answer: 2 s ; 5 m ; 34.6 m .

Question 20

Working: Centripetal force $F = mv^2/r = 5(4^2)/2 = 40 \text{ N}$ inward. The force is perpendicular to instantaneous displacement, so work $W = Fs \cos 90 \text{ deg} = 0 \text{ J}$.

Final answer: 40 N inward; centripetal force does zero work.

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