PHYSICS – CLASS XI

Chapter 3 : Motion in a Plane

PRACTICE PAPER (Chapter-wise Test)

Time : 1½ Hours **Max. Marks : 35**

General Instructions

(a) All questions are compulsory.

(b) There are 17 questions in total. Section A: Q. 1 to 8 carry 1 mark each. Section B: Q. 9 to 12 carry 2 marks each. Section C: Q. 13 to 15 carry 3 marks each. Section D: Q. 16 and 17 carry 5 marks each.

(c) There is no overall choice. An internal choice is given in one 2-mark question (Q. 11), one 3-mark question (Q. 14) and both 5-mark questions (Q. 16, Q. 17). Attempt only one of the given choices.

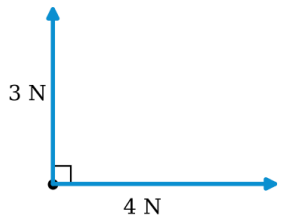
(d) Use of calculators is not permitted. Take g = 9.8 m s^{-2} unless a different value is given in the question.

(e) Figures are schematic and not drawn to scale. Write the unit with every numerical answer.

SECTION A

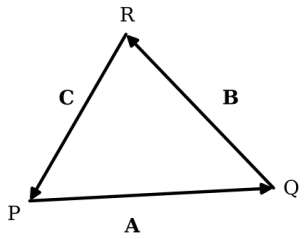
Questions 1 to 8 carry 1 mark each.

1. Two forces of 3 N and 4 N act on a particle at right angles to each other, as shown in the figure. The magnitude of their resultant is **(1)**



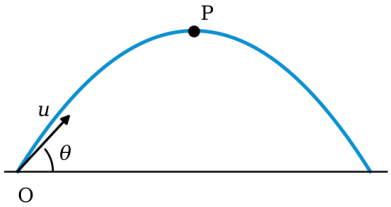
(a) 7 N
(b) 5 N
(c) 1 N
(d) 12 N

2. Three vectors **A**, **B** and **C** are represented by the sides PQ, QR and RP of a triangle taken in order, as shown in the figure. The vector sum **A** + **B** + **C** is **(1)**



(a) a null vector
(b) 2**A**
(c) 2**C**
(d) **A** − **B** + **C**

3. A projectile is thrown with speed u at an angle θ above the horizontal (figure). At the highest point P of its path, neglecting air resistance, its velocity and acceleration are **(1)**

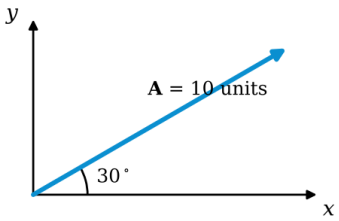


(a) zero and zero
(b) u cos θ (horizontal) and g downwards
(c) u cos θ (horizontal) and zero
(d) u sin θ (vertical) and g downwards

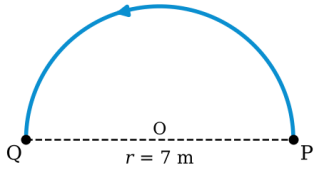
4. **Assertion (A):** A particle moving in a circle with constant speed has a non-zero acceleration. **(1)**
Reason (R): The direction of the velocity of the particle changes continuously.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

5. Two projectiles are launched with the same speed, one at 30° and the other at 60° to the horizontal. Neglecting air resistance, the ratio of their horizontal ranges is **(1)**
(a) 1 : √3
(b) 1 : 1
(c) √3 : 1
(d) 1 : 2

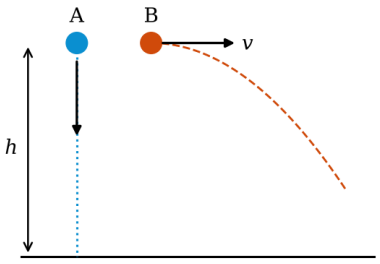
6. A vector **A** of magnitude 10 units makes an angle of 30° with the x-axis (figure). Find its x- and y-components. **(1)**



7. A girl runs from P to Q along a semicircular track of radius 7 m (figure). Find (i) the distance covered by her and (ii) the magnitude of her displacement. (Take π = 22/7.) **(1)**



8. Two identical balls A and B are at the same height h. Ball A is dropped from rest and ball B is projected horizontally with speed v at the same instant (figure). Neglecting air resistance, **(1)**

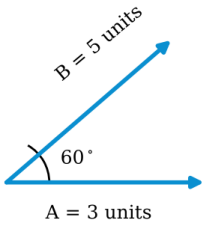


(a) A reaches the ground first
(b) B reaches the ground first
(c) both reach the ground at the same time
(d) it depends on the value of v

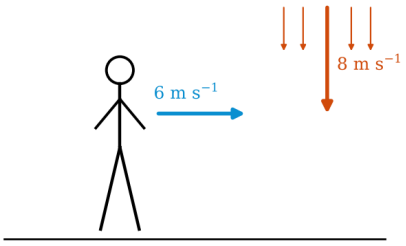
SECTION B

Questions 9 to 12 carry 2 marks each.

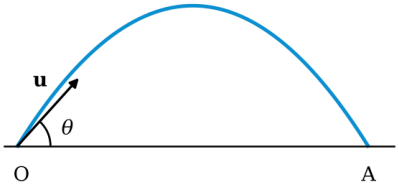
9. Two vectors **A** and **B** of magnitudes 3 units and 5 units act at a point with an angle of 60° between them (figure). Find (i) the magnitude of their resultant and (ii) the tangent of the angle which the resultant makes with **A**. **(2)**



10. Rain is falling vertically with a speed of 8 m s^{-1}. A man walks on a horizontal road with a speed of 6 m s^{-1} (figure). Find (i) the speed of the rain with respect to the man and (ii) the angle with the vertical at which he should hold his umbrella. **(2)**



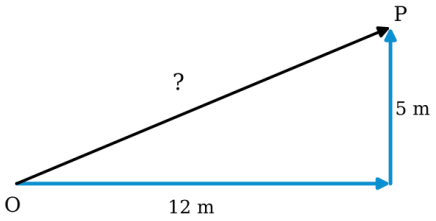
11. A projectile is thrown from the ground with speed u at an angle θ to the horizontal (figure). Derive an expression for its time of flight. **(2)**



OR

Show that the horizontal ranges of a projectile launched with the same speed at angles $(45° + \alpha)$ and $(45° - \alpha)$ are equal.

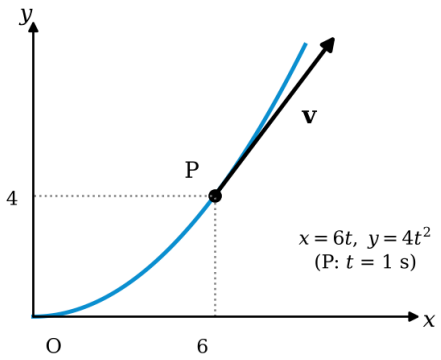
12. A man walks 12 m due east and then 5 m due north (figure). Find (i) the total distance covered, (ii) the magnitude of his displacement and (iii) the direction of the displacement from the starting point O. **(2)**



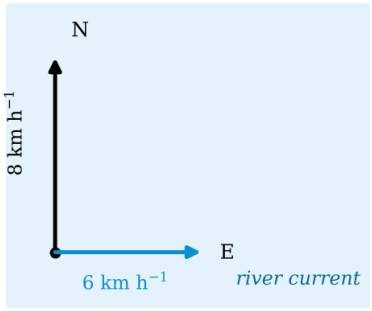
SECTION C

Questions 13 to 15 carry 3 marks each.

13. The position vector of a particle moving in the x–y plane is $\mathbf{r} = (6t)\,\hat{\mathbf{i}} + (4t^2)\,\hat{\mathbf{j}}$ metres, where t is in seconds. Its path is shown in the figure. (i) Obtain the velocity $\mathbf{v}(t)$ and acceleration $\mathbf{a}(t)$ of the particle. (ii) Find the magnitude and direction of the velocity at $t = 1$ s. **(3)**

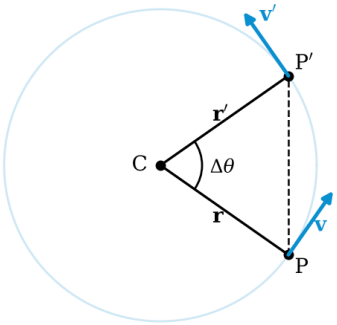


14. A boat is steered due north at 8 km h^{-1} in a river whose water flows due east at 6 km h^{-1} (figure). Find (i) the magnitude of the resultant velocity of the boat, (ii) its direction with respect to north, and (iii) how far it travels in 30 minutes. Use tan 37° = 3/4. **(3)**

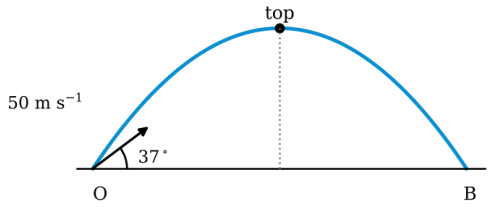


OR

A particle moves with constant speed v in a circle of radius R. Using the figure, which shows its positions P and P′ and the velocities $\mathbf{v}$ and $\mathbf{v}'$ at these positions, derive the expression $a = v^2/R$ for its centripetal acceleration.



15. A cricket ball is thrown with a speed of 50 m s^{-1} at 37° above the horizontal from level ground (figure). Taking g = 10 m s^{-2}, sin 37° = 0.6 and cos 37° = 0.8, find (i) the time taken to reach the highest point, (ii) the maximum height reached and (iii) the horizontal range. **(3)**



SECTION D

Questions 16 and 17 carry 5 marks each.

16. A ball is kicked from the ground with a speed of 20 m s^{-1} at 53° above the horizontal towards a vertical wall 24 m away (figure). Take g = 10 m s^{-2}, sin 53° = 0.8, cos 53° = 0.6 and neglect air resistance. **(5)**

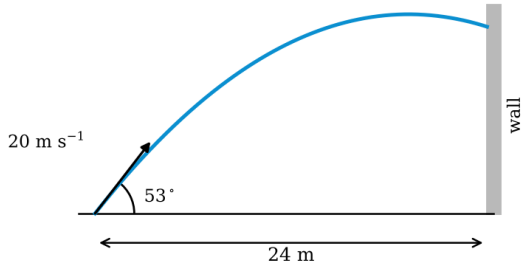
(a) Find the horizontal and vertical components of the initial velocity. (1)

(b) Find the time taken by the ball to reach the wall. (1)

(c) At what height above the ground does the ball hit the wall? (1)

(d) Find the vertical component of velocity at the wall. Is the ball rising or falling at that instant? (1)

(e) Find the maximum height reached by the ball. (1)



OR

(a) Derive the equation of the path of a projectile launched with speed u at angle θ, and show that the path is a parabola. (2)

(b) Obtain the expression for its horizontal range R. (1)

(c) For what angle of projection is the range maximum? Write the maximum range. (1)

(d) A cricketer can throw a ball to a maximum horizontal distance of 100 m. How high above the ground can he throw the same ball with the same speed? (1)

17. The figure shows two vectors **A** and **B** drawn on a square grid in the x–y plane. **(5)**

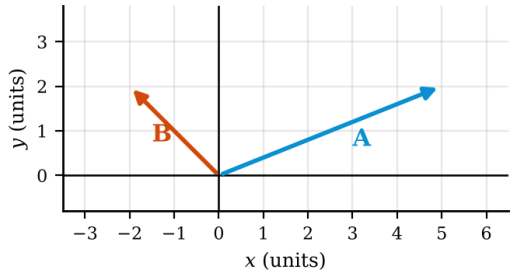
(a) Write **A** and **B** in unit vector notation. (1)

(b) Find **R** = **A** + **B** in unit vector notation. (1)

(c) Find the magnitude of **R** and the angle it makes with the x-axis. Use tan 53° = 4/3. (1)

(d) Find **A** − **B** and its magnitude. (1)

(e) Find the unit vector along **R**. (1)



OR

A particle moves in a circle of radius 20 cm and completes 5 revolutions in 20 s with uniform speed (figure).

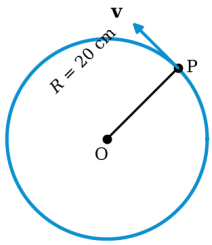
(a) What is the direction of its acceleration at any point? (1)

(b) Find its time period and frequency. (1)

(c) Find its angular speed. (1)

(d) Find its linear speed. (Take π = 3.14.) (1)

(e) Find the magnitude of its centripetal acceleration (take $\pi^2 = 10$). Is the acceleration a constant vector? Give a reason. (1)



— END OF QUESTION PAPER —