CHAPTER 4

Motion in a plane

I. <u>One mark questions (PART – A):</u>

- 1. What is a scalar quantity? (K)
- 2. Give an example for scalar quantity. (U)
- 3. Give an example to show that scalar addition obey ordinary addition rules (U).
- 4. What is a vector quantity? (K)
- 5. Give an example for vector quantity. (U)
- 6. How does vector quantity is different from scalar quantity. (U)
- 7. Graphically represent a vector. (S)
- 8. What is a position vector? (K)
- 9. What is a displacement vector? (K)
- 10. What are equal vectors? (K)
- 11. \vec{A} is multiplied by-1.5, graphically represent \vec{A} the resultant vector. (S)
- 12. Give an example for vector multiplied by a scalar. (U)
- 13. What is a negative vector? (K)
- 14. State triangle law of vector addition. (K)
- 15. Does the vector addition obey the commutative law? (K)
- 16. Does the vector addition obey the associative law? (K)
- 17. Define a null vector. (K)
- 18. What do you mean by resolution of a vector? (K)
- 19. Define a unit vector. (K)
- 20. Graphically represent the unit vectors along X, Y, Z axes of a rectangular co-ordinate system. (S)
- 21. What are components of a vector? (K)
- 22. What should be the angle between two vectors for their resultant to be maxi mum? (A)
- 23. What should be the angle between two vectors for their resultant to be minimum? (A)
- 24. What is the magnitude of resultant of two equal vectors acting right angles to each other? (A)
- 25. Mention the expression for position vector in X-Y plane. (K)
- 26. What is a projectile? (K)
- 27. Give an example for projectile. (U)
- 28. What is the trajectory of a projectile motion? (K)
- 29. Define time of flight of a projectile motion. (K)
- 30. Define maximum height of a projectile motion. (K)
- 31. Define horizontal range of a projectile motion. (K)
- 32. If velocity of projection is doubled what happens to the maximum height of projectile? (U)
- 33. Which component of velocity of a projectile is constant? (U)
- 34. Which component of velocity of a projectile is zero at the maximum height? (U)
- 35. Which component of acceleration of a projectile is zero? (U)
- 36. Mention the expression for time of flight of a projectile θ =90°. (U)
- 37. What is the horizontal range of a projectile if θ =90°. (U)

- 38. What is the angle between direction of velocity and acceleration at the maximum height of a projectile? (U)
- 39. For what angle of projection, horizontal range is maxi mum? (A)
- 40. For what angle of projection, height is maxi mum? (A)
- 41. Mention the expression for maximum horizontal range of a projectile. (U)
- 42. For a given velocity of projection, height and horizontal range are maxi mum. Mention the relation between range and height of projectile. (A)
- 43. If Velocity of projection is same, then for which two angles of projection horizontal range is same? (A)
- 44. How does air resistance affects the maximum height of a projectile? (A)
- 45. What happens to range, if velocity of projection is doubled keeping the same angle of projection? (A)
- 46. Which physical quantity remains the constant for a particle in uniform circular motion? (K)
- 47. At what point of trajectory of projectile, speed is minimum. (U)
- 48. What is the angle between direction of velocity and acceleration of a particle in uniform circular motion? (A)
- 49. Define centripetal acceleration (K).
- 50. Mention the expression for centripetal acceleration. (U)

Two mark questions (PART – B):

- 1. Give two differences between scalar and vector quantity. (U)
- Classify the following into scalar and vector quantity. Mass, speed, velocity, displacement, weight, acceleration, time. (U)
- 3. Write two properties of vector addition. (K)
- 4. What is two dimensional motion? Give one example. (K)
- 51. Write the expression for X and Y component of \vec{A} when \vec{A} makes an angle θ with the X axis. (U)
- 52. Given $\vec{P} = 2\hat{\imath} + 4\hat{\jmath}$ and $\vec{Q} = 3\hat{\imath} \hat{\jmath}$ determine (a) $\vec{P} + \vec{Q}$ (b) $\vec{P} 2\vec{Q}$. (S)
- 53. Graphically show the subtraction of \vec{B} from \vec{A} . (S)
- 54. Explain triangular law of vector addition. (U)
- 55. Explain parallelogram law of vector addition. (U)
- 56. What is the unit vector of $\overrightarrow{P} = 2\hat{\imath} + 3\hat{\jmath}$. (S)
- 57. Graphically represent the displacement vector in X-Y plane. (S)
- 58. A boy moves from point P (1, 2) to point P (3, 4) in X-Y plane in t seconds. Find the magnitude of the displacement vector of the boy in t seconds. (S)
- 59. Write the expression for magnitude of the resultant of two vectors making an angle θ between them. Explain the terms. (U)
- 60. Write the expression for direction of the resultant of two vectors making an angle θ between them. Explain the terms. (U)
- 61. Draw the graph showing the variation of component of velocity with time during the motion of a projectile. (S)
- 62. Write the expression for trajectory of projectile. Explain the symbols used. (U)

- 63. Define time of flight of a projectile motion .Write the expression for it. (U)
- 64. Define horizontal range of a projectile motion. Write the expression for it. (U)
- 65. Define maximum height of a projectile motion. Write the expression for it. (U)
- 66. What is the direction of velocity and acceleration of a particle in uniform circular motion? (U)
- 67. For a particle in uniform circular motion speed is uniform, but its velocity is non uniform, explain.
- (U)
- 68. Define centripetal acceleration. Write the expression for it. (U)

<u>Three mark questions (PART – C):</u>

- 1. Given $\vec{V} = 4\hat{i}+4\hat{j}$. Find the magnitude and direction of velocity vector. (S)
- 2. Explain resolution of a vector in a plane. (U)
- 3. A vector having a magnitude of 15unit makes an angle 60° with the X axis. Find the horizontal and vertical component? (S)
- 4. Derive the expression for time of flight of a projectile. (U)
- 5. Derive the expression for horizontal range of a projectile. (U)
- 6. Derive the expression for maximum height of a projectile. (U)
- 7. Find the angle of projection at which maximum height and range are equal? (A) (120°)

8. Two vectors both equal in magnitude have their resultant equal to magnitude of either vector. Find the angle between the two vectors. (S)

9. Find the angle between two vectors of magnitude 4 unit and 6unit, so that their resultant is 8unit.
(S) (14°02¹)

- 10. Stone of mass 0.5 kg tied to a string of length 2m is rotated in horizontal plane with a speed of
- 5ms⁻¹.Calculate centripetal acceleration and centripetal force. (S) (12.5 ms⁻¹, 6.25N)
- 11. A ball is projected with a velocity of $20ms^{-1}$. After two seconds its vertical displacement is 10m.Calculate the angle of projection. g= $10ms^{-2}(S)$ ($48^{0}35^{-1}$)

12. From the top a building of height 200m, a projectile is fired horizontally with a velocity of $6ms^{-1}$. Find the time taken to reach the ground. g=10ms⁻² (S) (6.32S)

Five mark questions (PART – D):

1. Obtain the expression for magnitude and direction for the resultant of two vectors making an angle θ between them. (U)

- 2. What is a projectile? Derive the equation for path of a projectile. (U).
- 3. Show that the trajectory of projectile is parabola. (U)
- 4. Define centripetal acceleration .Derive the expression for it. (U)

Problems

- 1. The position of a particle is given by $\vec{r} = (4t\hat{\iota} + 2t^2\hat{j} + 2\hat{k})$ m. Where 't' is in second.
- (a) What is the velocity and acceleration of the particle?
 (b)Calculate the magnitude and direction of velocity at t=2s. (S) (8.94ms⁻¹, 63⁰26¹ with the X axis)

- 2. The position vector of the particle is $(2\hat{\imath} + 3\hat{\jmath})$ m at t=0. Velocity of the particle becomes $(3\hat{\imath} + 6\hat{\jmath})$ ms⁻¹ at t=2s. Then find the position vector of the particle at t=2s. What is the X and Y co ordinate? (S) ($\vec{r} = 8\hat{\imath} + 15\hat{\jmath}$), (8, 15)
- 3. The greatest and least resultant of two forces acting at a point are20N and 4N respectively. If each force is increased by 4N, the new forces are perpendicular to each other. Find the resultant of new forces. (S) (20N)
- 4. On a rainy day rain is falling vertically with a speed of 10ms^{-1} . Wind starts blowing with a speed of 5ms^{-1} in east to west. What is the magnitude of the resultant velocity? At what angle should a girl waiting at a bus stop hold her umbrella? (S) $(5\sqrt{5}, 26^{0}33^{1})$
- 5. A bullet is fired with a speed of 40ms⁻¹at an angle 30° with horizontal .Calculate the maximum height, time of flight, horizontal range of the bullet. g=10ms⁻²(S) (20m, 4s, 138.5m)
- A body is projected with a velocity of 40ms⁻¹ at an angle 30° with the vertical. Calculate the maximum height, time of flight, horizontal range of the bullet. g=10ms⁻²(S) (60m, 6.9s, 138.5m)
- 7. A ball is thrown with velocity 45ms^{-1} . The horizontal distance reached by the ball is 30m. Calculate (1) Angle of projection (2) Maximum height reached by the ball. g= $10 \text{ms}^{-2}(\text{S})$ ($32^{0}58^{1}$)
- 8. A projectile has a horizontal range of 52m and maximum height of 12m. Calculate the angle at which the projectile is fired? $g=10ms^{-2}(S)$ ($12^{0}59^{1}$)
- 9. From the top a building of height 450m, a projectile is fired horizontally with a velocity of 25ms^{-1} . g=10ms⁻²
- (a) Find the velocity with which projectile hits the ground.

(b)Find the time taken to reach the ground.

(c) Find the horizontal distance between base of the building and point where it hits the ground. (S) (98.10ms⁻¹, 9.48s, 237N)

10. A cricketer can throw a ball to maximum horizontal distance of 125m, calculate maximum height moved by ball. g=10ms⁻² (S) (31.25m)