Motion in a Plane

1. **Assertion (A):** The magnitude of velocity of two boats relative to river is same. Both boats start simultaneously from same point on one bank. They may reach opposite bank simultaneously moving along different straight line paths.
Reason (R): For above boats to cross the river in same time, the components of their velocity relative to river in direction normal to flow should be same.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

2. **Assertion (A):** Horizontal component of velocity is constant in projectile motion under gravity.
Reason (R): Two projectiles having same horizontal range must have the same time of flight.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

3. **Assertion (A):** Trajectory of an object moving under a constant acceleration is a straight line.
Reason (R): The shape of trajectory depends only on the acceleration.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

4. **Assertion (A):** In any curved motion magnitude of dot product of unit acceleration vector & unit velocity vector $|\hat{a}\cdot\hat{v}|$ cannot be equal to 1.
Reason (R): In all accelerated straight line motion $|\hat{a}\cdot\hat{v}|$ cannot be less than 1.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

5. **Assertion (A):** Two stones are simultaneously projected from level ground from same point with same speeds but different angles with horizontal. Both stones move in same vertical plane. Then the two stones may collide in mid air.
Reason (R): For two stones projected simultaneously from same point with same speed at different angles with horizontal, their trajectories must intersect at some point except projection point.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

6. **Assertion (A):** The maximum range along the inclined plane, when thrown downward is greater than that when thrown upward along the same inclined plane with same speed at same angle from incline.
Reason (R): The maximum range along inclined plane is independent of angle of inclination.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

11. **Assertion (A):** A particle is projected from ground on a horizontal plane with speed 10 ms^{-1} and angle of projection 37° with horizontal. Its velocity vector will be perpendicular to initial velocity vector after $\frac{4}{3}s$.

Reason (R): Two vectors $\vec{v}$ and $\vec{u}$ are perpendicular then $\vec{u}.\vec{v} = 0$

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

12. **Assertion (A):** A particle moving at constant speed and constant magnitude of radial acceleration must be undergoing uniform circular motion.
Reason (R): In uniform circular motion speed cannot change as there is no tangential acceleration.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

13. **Assertion (A):** If separation between two particles does not change then their relative velocity will be zero.
Reason (R): Relative velocity is the rate of change of position of one particle with respect to another.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

14. **Assertion (A):** The magnitude of velocity of A with respect to B will be always less than V_A.
Reason (R): The velocity of A with respect to B is given by $\vec{V}_{AB} = \vec{V}_A - \vec{V}_B$.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

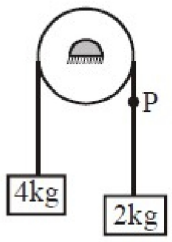
15. **Assertion (A):** In projectile motion (from ground to ground projection), horizontal range is always same for angle of projection θ and (90°– θ).
Reason (R): Horizontal range is independent of angle of projection.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

16. **Assertion (A):** In projectile motion, speed always decreases.
Reason (R): In presence of air drag, projectile motion is a uniformly accelerated motion.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

17. **Assertion (A):** When speed of projection of a body is made n times, its time of flight becomes n times.
Reason (R): At this speed, the range of projectile becomes n^2 times.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

18. **Assertion (A):** When the range of a projectile is maximum, the time of flight is the largest.
Reason (R): Horizontal range is maximum when angle of projection is 90°.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

19. Point P is on a massless thread in an ideal pulley arrangement as shown.



Assertion (A): As point P moves from right side to left side of pulley, the magnitude of it's acceleration changes.

Reason (R): The tension in massless thread remains uniform in magnitude.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

20. **Assertion (A):** In non-uniform circular motion, velocity vector and acceleration vector are not perpendicular to each other.

Reason (R): In non-uniform circular motion, particle has normal as well as tangential acceleration.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

21. **Assertion (A):** If a body is in state of uniform circular motion then its velocity and acceleration both are varying.

Reason (R): If magnitude of velocity is v and radius of uniform circular motion is r then magnitude of acceleration is v^2/r.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

22. **Assertion (A):** A particle is moving in a circle with constant tangential acceleration such that its speed v is increasing. Angle made by resultant acceleration of the particle with tangential acceleration increases with time.

Reason (R): Tangential acceleration = $\left|\frac{d\vec{v}}{dt}\right|$

and centripetal acceleration = $\frac{v^2}{R}$

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

23. **Assertion (A):** The equation of motion can be applied only if the acceleration is along the direction of velocity and is constant.

Reason (R): In circular motion, if velocity is constant then its motion is called uniform circular motion.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

24. **Assertion (A):** In uniform circular motion, angular acceleration is zero.

Reason (R): In uniform circular motion, acceleration is constant.

(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

25. **Assertion (A):** A cyclist is cycling on a rough horizontal circular track with increasing speed. Then the net frictional force on cycle is always directed towards centre of the circular track.

Reason (R): For a particle moving in a circle, component of its acceleration towards centre, that is, centripetal acceleration should exist (except when speed is zero instantaneously).

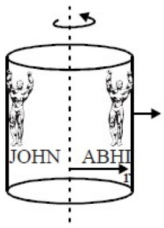
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)

(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)

(3) (A) is true but (R) is false

(4) Both (A) and (R) are false

26. Abhi and John are in a rotor at rest relative to wall of rotor.



Assertion (A): There is no relative motion between John and Abhi.
Reason (R): Angular velocity of Abhi with respect to John is different as compared to angular velocity of Abhi with respect to axis of rotation.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

27. **Assertion (A):** In circular motion acceleration is always towards centre.
Reason (R): In uniform circular motion velocity is constant.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

28. **Assertion (A):** If a particle is moving on a curved path its $\frac{d|\vec{v}|}{dt}$ may be zero.
Reason (R): A particle can move on curved path without any acceleration.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

29. **Assertion (A):** A cyclist must adopt a zig–zag path while ascending a steep hill.
Reason (R): The zig–zag path prevent the cyclist to slip down.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

30. **Assertion (A):** Infinitesimally small angular displacement is a vector quantity.
Reason (R): Angular velocity doesn't depend upon reference frame.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

31. **Assertion (A):** A bob of mass m is freely suspended from a light rod of length L. The minimum speed given to bob at lowest position to complete vertical circle is $2\sqrt{gL}$.
Reason (R): A bob of mass m is freely suspended from a light string of length L. If bob is given speed $\sqrt{6gL}$ at the lower position then bob will be complete vertical circle.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

32. **Assertion (A):** Average angular velocity is a scalar quantity.
Reason (R): Large angular displacements ($\Delta\theta$) is a scalar.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

33. **Assertion (A):** During a safe turn, with constant speed the value of centripetal force should be less than or equal to the limiting frictional force.
Reason (R): The centripetal force is provided by the frictional force between the tyre and the road.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

34. **Assertion (A):** In uniform circular motion of a particle, sum of power delivered to it by all the forces acting on the particle is zero.
Reason (R): In uniform circular motion dot product of two perpendicular vectors, force and velocity is always zero.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

35. **Assertion (A):** A body having uniform speed in circular path has a variable acceleration.
Reason (R): Direction of acceleration is always away from the centre.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

36. **Assertion (A):** In turning a vehicle safely with uniform speed in circular path friction is static in nature and towards centre.
Reason (R): In turning a vehicle in circular path with increasing speed friction is kinetic in nature and tangential in direction.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

37. **Assertion (A):** In uniform circular motion, magnitude of acceleration is $\frac{V^2}{R}$ and direction is always towards the centre.
Reason (R): In uniform circular motion, acceleration is constant.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

38. **Assertion (A):** Whenever a particle moves in a circular path with uniform speed, an acceleration exists which is directed towards the centre.
Reason (R): The net acceleration of a particle in circular motion is always radially inward.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

39. **Assertion (A):** If the speed of a body is constant, the body cannot have a path other than a circular or straight line path.
Reason (R): It is not possible for a body to have a constant speed in an accelerated motion,
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

40. **Assertion (A):** In circular motion, centripetal and centrifugal forces act in opposite directions and balance each other.
Reason (R): Centripetal force is a pseudo force.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

41. **Assertion (A):** In uniform circular motion of a body, its linear speed remains constant.
Reason (R): In uniform circular motion total acceleration of the body has no radial component.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

42. **Assertion (A):** In non-uniform circular motion, linear speed of the body is variable.
Reason (R): In non-uniform circular motion, acceleration of the body is towards the centre.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

43. **Assertion (A):** A body is moving along a circle with a variable angular speed. Work done by centripetal force will be zero.
Reason (R): In non-uniform circular motion, net force on the body is not in the radial direction.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

44. **Assertion (A):** A body tied to an end of a string is whirled along a vertical circle by giving some velocity at the lowest position. If the velocity becomes zero before the tension in the string is zero, the body will leave the circular path at the position of its zero velocity and then fall vertically downward.
Reason (R): In vertical circular motion, tension in the string at the highest position is maximum.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

45. **Assertion (A):** A body tied to an end of a string is whirled along a vertical circle with such a velocity at the lowest point that, at some position, tension in the string is zero but the speed at the position is non-zero. The body will leave the circular path at the position of zero tension.
Reason (R): In vertical circular motion, so as to cross the highest point along the circle, speed at the highest point, $v_H \geq 0$.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

46. **Assertion (A):** Cream gets separated out of milk when it is churned. It is due to gravitational force.
Reason (R): In all circular motions, centripetal force is provided by gravitational force.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

47. **Assertion (A):** When a stone attached to the string just rotates in a vertical circle, its apparent weight is zero at the highest point.
Reason (R): At the highest point, the apparent weight is equal to mg minus tension in string.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

48. **Assertion (A):** The work done during a round trip is always zero.
Reason (R): No force is required to move a body in its round trip.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

49. **Assertion (A):** When an automobile while going too fast around a curve overturns, its inner wheels leave the ground first.
Reason (R): The inner wheels are moving in a circle of smaller radius, the maximum permissible velocity for them is less.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

50. **Assertion (A):** On an unbanked road, as the frictional force increases, the safe velocity limit for taking a turn also increases.
Reason (R): Banking of roads will increase the value of limiting velocity.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

51. **Assertion (A):** A coin is placed on the gramophone. When the motor starts, the coin moves along the gramophone. As the speed goes on increasing, the coin flies off after some time.
Reason (R): The gravitational force of gramophone provides the necessary centripetal force to the coin.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

52. **Assertion (A):** Two identical trains move in opposite sense in equatorial plane with equal speed relative to earth's surface. They have equal magnitude of normal reaction.
Reason (R): The trains require same centripetal force although they have different speeds.
(1) Both (A) & (R) are true and the (R) is the correct explanation of the (A)
(2) Both (A) & (R) are true but the (R) is not the correct explanation of the (A)
(3) (A) is true but (R) is false
(4) Both (A) and (R) are false

ANSWER KEY																				
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	1	3	4	2	4	3	4	1	4	1	4	4	4	4	4	4	2	4	2	1
Que.	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Ans.	2	3	4	3	4	4	4	3	1	3	2	1	1	1	3	3	3	3	4	4
Que.	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**								
Ans.	3	3	2	4	3	4	3	4	2	2	3	4								