Motion in a Plane

Assertion Reason Questions

Two statements are given one labelled Assertion
(A) and the other labelled Reason (R). Select the correct answer to these question from the codes
(a), (b), (c) and (d) as given below:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true and R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

1. Assertion (A): Minimum number of non- equal vectors in a plane to give zero resultant is three.
Reason (R): If A+B+C=O, then they must lie in one plane.

Ans. (b) Both A and R are true and R is not the correct explanation of A.
Explanation: For a zero resultant, the provided vectors must be arranged along the sides of a closed polygon, and the least number of sides of a polygon is three.

2. Assertion (A): A physical quantity cannot be called as a vector if it has zero magnitude.
Reason (R): A scalar has both magnitude and direction.

Ans. (d) A is false and R is also false. Explanation: A physical quantity with no magnitude is known as a vector, and more specifically, a null vector. A scalar quantity just has magnitude and no direction. For instance, speed, time, and so on.

3. Assertion (A): The magnitude of the sum of two vectors is always greater than the magnitude of their subtraction.
Reason (R): At $\theta = 90°$, addition and subtraction of vectors are unequal.

Ans. (d) A is false and R is also false.
Explanation: The addition of two vectors is,

$$|A+B|=\sqrt{A^2+B^2+2AB\cos\theta}$$

Its subtraction is,

$$|A-B|=\sqrt{A^2+B^2-2AB\cos\theta}$$

So, when then $90° < \theta < 270°$,

Then, $|A + B| < |A - B|$

Thus, the vector addition of two vectors is not always greater than their vector subtraction.

Also $\theta = 90°$

$$|A + B| = |A - B| = \sqrt{A^2+B^2}$$

4. Assertion (A): When a particle moves with uniform velocity, its displacement may increase or decrease.

Reason (R): In successive time intervals, if the average velocities of a particle are equal then the particle are equal then the particle must be moving with constant velocity.

Ans. (c) A is true but R is false.

Explanation: For a moving body, velocity is non-zero. If velocity is constant, displacement will keep increasing and hence, average velocity cannot be zero for a body under uniform motion. For average velocity to be zero, the body should either be at rest which is false as per the statement of the reason or it should be able to return to its initial position which requires a change in velocity. Average velocity is given by the ratio of change in displacement to change in time. When a particle is thrown upwards, it is under a uniform acceleration equal to the acceleration of gravity. After some time, it returns to its point of projection. In this time interval, net displacement is zero and hence average velocity is zero.

5. Assertion (A): Horizontal range is same for angle of projection $\rightarrow$ and $(90-\theta)$.

Reason (R): Horizontal range is independent of angle of projection.

Ans. (c) A is true and R is false.

Explanation: Range of projectile is given by

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$R_1 = \frac{u^2 \sin 2\theta}{g}$$

$$R_2 = \frac{u^2 \sin 2(90° - \theta)}{g}$$

$$= \frac{u^2 \sin 2\theta}{g}$$

$\Rightarrow \quad R_1 = R_2$

Horizontal range depends upon angle of projection and it is same for complementary angles i.e., and (90°-0).

26. Assertion (A): A man cross river of width d in minimum time. On increasing the river velocity, the minimum time to cross the river by man will remain unchanged.
Reason (R): As velocity of a river is perpendicular to its width, so time to cross the river by man will remain unchanged.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: If the direction of river flow and direction of swimming is perpendicular to each other, the component speed of the swimmer will be maximum and it would be V sin 90°.

27. Assertion (A): Two balls of different masses are thrown vertically upward with the same speed. They will pass through their I point of projection in the downward direction with the same speed.
Reason (R): The maximum height and downward velocity attained at the point of projection are independent of the mass of the ball.

Ans. (a) Both A and R are true and R is the correct explanation of A.
Explanation: Let the balls be thrown vertically upward with speed u.

Using $\quad S = ut + \frac{1}{2}at^2,$
where $\quad a = -g$

$\therefore$ The maximum height, $H = ut - \frac{gt^2}{2}$

Also using $v^2 - u^2 = 2aS$

$\therefore \quad v^2 - u^2 = 2(-g)(0)$

$\Rightarrow \quad v = u$

Thus, the balls will pass through the point of projection in downward direction with same speed (v).

Also, from the equation used, the maximum height and the downward velocity attained are independent of mass of the ball.

28. Assertion (A): If a body is dropped from the top of a tower of a height h and another body is thrown up simultaneously with uniform velocity v from the foot of the tower then both of them would meet after a

time $\frac{h}{u}$.

Reason (R): For a body projected upwards, the distance covered by the body in the last second of its upward journey is always 4.9 m irrespective of velocity of projection

Ans. (b) Both A and R are true and R is not the correct explanation of A.

Explanation: A body thrown upwards will decelerate downwards at 1 g = 9.8 m/s^2 When it reaches the apex of the throw, it will be at rest. During the last second, it decelerated at 1 g for 1 second. To calculate how far it travelled in the 1 second at 1 g deceleration, we can calculate how far it would travel from rest in 1 s at 9.8 m/s^2 using the formula:

$$s = ut + \frac{1}{2}at^2$$

s = distance travelled, u = start speed (0)
a = acceleration = 9.8 m/s^2, t = time = 1 sec
which gives value of,

$$= 0 \times 1 + \frac{1}{2} \times 9.8 \times 1^2$$

$$= 4.9 \text{ m}$$

29. Assertion (A): The magnitude of the resultant of two vectors may be less than the magnitude of either vector.

Reason (R): Vector addition is commutative.

Ans. (a) Both A and R are true and R is the correct explanation of A.

Explanation: The resultant of two vectors is: If is an obtuse angle, then the magnitude of R will be less than the magnitude of either vector A or B. If vectors are in opposite

directions and are equal in magnitude, then also the magnitude of R will be less than the magnitude of either vectors A or B. And vector addition is always commutative in nature.

$$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

30. Assertion (A): In projectile motion, when the horizontal range is n times the maximum height, the angle of projection is given by

$$\tan\theta = \frac{4}{n}.$$

Reason (R): In the case of horizontal projection the magnitude of vertical velocity increases with time.

Ans. (b) Both A and R are true and R is not the correct explanation of A.

Explanation:

$$\vec{u} = u\,\hat{i} + u\,\hat{j}$$

$$\vec{vt} = u\hat{i} + (o - g(t))\hat{j}$$

$$= u\hat{i} - g(t)\hat{j}$$

$$\text{Range} = \frac{2v^2\sin\theta\cos\theta}{g}$$

$$\text{Maximum height} = \frac{v^2\sin 2\theta}{2g}$$

$$\frac{2v^2\sin\theta\cos\theta}{g} = \frac{n(v^2\sin^2\theta)}{2g}$$

$$\tan\theta = \frac{4}{n}$$