03 - DESCRIPTION OF MOTION IN TWO AND THREE DIMENSIONS

(Answers at the end of all questions)

1) A particle is moving eastwards with a velocity of 5 ms^{-1}. In 10 seconds the velocity changes to 5 ms^{-1} northwards. The average acceleration in this time is

(a) 1 / 2 ms^{-2} towards north (b) $1/\sqrt{2}$ ms^{-2} towards north-east

(c) $1/\sqrt{2}$ ms^{-2} towards north-west (d) zero [AIEEE 2005]

2) An annular ring with inner and outer radii R_1 and R_2 is rolling without slipping with a uniform angular speed. The ratio of the forces experienced by the two particles situated on the inner and outer parts of the ring, F_1 / F_2 is

(a) $\left[\frac{R_1}{R_2}\right]^2$ (b) $\frac{R_2}{R_1}$ (c) $\frac{R_1}{R2}$ (d) 1 [AIEEE 2005]

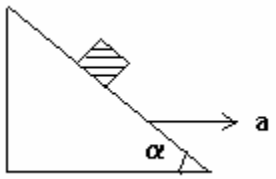
3) A projectile can have the same range 'R' for two angles of projection. If 't_1' and 't_2' be the times of flights in the two cases, then the product of the two times of flights is proportional to

(a) $1/R^2$ (b) R^2 (c) R (d) 1 / R [AIEEE 2005, 2004]

4) A block is kept on a frictionless surface with angle of inclination 'α'. The incline is given an acceleration 'a' to keep the block stationary. Then a is equal to

(a) g cosec α (b) g / tan α

(c) g tan α (g) g [AIEEE 2005]



5) Which of the following statements is false for a particle moving in a circle with a constant angular speed ?

(a) The velocity vector is tangent to the circle.

(b) The acceleration vector is tangent to the circle.

(c) The acceleration vector points to the centre of the circle.

(d) The velocity and acceleration vectors are perpendicular to each other.

[AIEEE 2004]

6) If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle between A and B is

(a) π (b) $\pi / 3$ (c) $\pi / 2$ (d) $\pi / 4$ [AIEEE 2004]

7) A ball is thrown from a point with a speed v_0 at an angle of projection θ. From the same point and at the same instant, a person starts running at a constant speed $v_0 / 2$ to catch the ball. Will the person be able to catch the ball ? If yes, what should be the angle of projection ?

(a) yes, 60° (b) yes, 30° (c) No (d) yes, 45° [AIEEE 2004]

8) The coordinates of a moving particle at any time t are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed of the particle at time t is given by

(a) $\sqrt{\alpha^2 + \beta^2}$ (b) $t^2\sqrt{\alpha^2 + \beta^2}$ (c) $3t\sqrt{\alpha^2 + \beta^2}$ (d) $3t^2\sqrt{\alpha^2 + \beta^2}$

[AIEEE 2003]

(Answers at the end of all questions)

9) A boy playing on the roof of a 10 m high building throws a ball with a speed of 10 m/s at an angle of 30° with the horizontal. How far from the throwing point will the ball be at the height of 10 m from the ground ?
(a) 8.66 m (b) 5.20 m (c) 4.33 m (d) 2.60 m [AIEEE 2003]

10) The horizontal range of a projectile is R, when the angle of projection is 30°. The value of another angle of projection for the same range is
(a) 60° (b) 50° (c) 45° (d) 30° [AIEEE 2003]

11) Two vectors are such that $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$. The angle between the vectors is
(a) 0° (b) 30° (c) 60° (d) 90° [AIEEE 2002]

12) What is the dot product of two vectors of magnitude 3 units and 5 units if angle between them is 60° ?
(a) 9.5 units (b) 8.4 units (c) 7.5 units (d) 5.2 units [AIEEE 2002]

13) A particle is projected at an angle of 45° to the horizontal. The kinetic energy (K) of the particle, at the highest point in its flight is
(a) zero (b) K / 4 (c) K / 2 (d) 3K / 4 [AIEEE 2002]

14) Two particles of masses m_1 and m_2 in projectile motion have velocities $\vec{v}_1 < \vec{v}_2$ respectively at time t = 0. They collide at time t_0. Their velocities become $\vec{v'}_1$ and $\vec{v'}_2$ at time $2t_0$ while still moving in air.
The value of $|(m_1\vec{v'}_1 + m_2\vec{v'}_2) - (m_1\vec{v}_1 + m_2\vec{v}_2)|$ is
(a) zero (b) $(m_1 + m_2)gt_0$
(c) $2(m_1 + m_2)gt_0$ (d) $(1/2)(m_1 + m_2)gt_0$ [IIT 2001]

15) In 1.0 s, a particle goes from point A to point B, moving in a semicircle (see figure). The magnitude of the average velocity is
(a) 3.14 m / s (b) 2.0 m / s (c) 1.0 m / s (d) zero

[IIT 1999]

16) The coordinates of a particle moving in a plane are given by x(t) = a cos (pt) and y(t) = b sin (pt) where a, b (<a) and p are positive constants of appropriate dimensions. Then
(a) the path of the particle is in ellipse
(b) the velocity and acceleration of the particle are normal to each other at $t = \pi / 2p$
(c) the acceleration of the particle is always directed towards a focus
(d) the distance travelled by the particle in time interval t = 0 to $t = \pi / 2p$ is a
[IIT 1999]

17) A boat which has a speed of 5 km / hr in still water crosses a river of width 1 km along the shortest possible path in 15 minutes. The velocity of the river water in km / hr is
(a) 1 (b) 3 (c) 4 (d) $\sqrt{41}$ [IIT 1988]

(Answers at the end of all questions)

18) A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane. It follows that
(a) its velocity is constant (b) its acceleration is constant
(c) its kinetic energy is constant (d) it moves in a circular path [IIT 1987]

19) A river is flowing from west to east at a speed of 5 metres per minute. A man on the south bank of the river, capable of swimming at 10 metres per minute in still water, wants to swim across the river in the shortest time. He should swim in a direction
(a) due north (b) 30° east of north
(c) 30° west of north (d) 60° east of north [IIT 1983]

20) A particle is moving eastwards with a velocity of 5 m / s. In 10 s the velocity changes to 5 m / s northwards. The average acceleration in this time is
(a) zero (b) $1/\sqrt{2}$ m / s^2 towards north-west
(c) $1/\sqrt{2}$ m / s^2 towards north-east (d) 1 / 2 m / s^2 towards north-west
(e) 1 / 2 m / s^2 towards north [IIT 1982]

21) A bus is moving on a straight road towards north with a uniform speed of 50 km / hr. Then it turns left through 90°. If the speed remains unchanged after turning, the increase in the velocity of the bus in the turning process is
(a) 70.7 km / hr along south-west direction (b) 50 km / hr along west
(c) 70.7 km / hr along north-west direction (d) zero [CBSE 1990]

22) A particle moves in a plane with a constant acceleration in a direction different from the initial velocity. The path of the particle is a
(a) straight line (b) arc of a circle (c) parabola (d) ellipse [CPMT 1982]

23) The angle between the vector $\vec{A}$ and $\vec{B}$ is θ. The value of the triple product $\vec{A} . \vec{B} \times \vec{A}$ is
(a) A^2B (b) zero (c) $A^2B \sin\theta$ (d) $A^2B \cos\theta$ [CBSE 1991]

24) A stone A is projected with an initial velocity of 5 m / s in a direction 30° above the horizontal. Another stone B, 2m from the origin on a line 30° above the horizontal, is dropped from rest at an instant A is projected. When B is hit by A, it has traveled a distance of (take g = 10 m/s^2)
(a) 1 m (b) 0.8 m (c) 1.5 m (d) 2 m

25) A projectile is fired at an angle θ with the vertical. It experiences a force due to air resistance. The resistance force is directly proportional to the instantaneous speed of the projectile. Which one of the following statement is correct ?
(a) The path of the projectile is a parabola symmetric about a vertical line passing through the highest point.
(b) At the highest point speed is horizontal.
(c) The time of ascent is 1.5 times the time of descent.
(d) The horizontal range of the projectile remains the same as it would be in the absence of air resistance. [CBSE 1996]

(Answers at the end of all questions)

26) A ball is projected at an angle of 45° to the horizontal with kinetic energy K. The kinetic energy at the maximum height is
(a) K (b) K/2 (c) K 45° (d) zero [CBSE 1997]

27) The position vector of a particle is $\vec{r} = (a\cos\omega t)\,\hat{i} + (a\sin\omega t)\,\hat{j}$. The velocity of the particle is
(a) perpendicular to the position vector (b) directed towards the origin
(c) directed away from the origin (d) parallel to the position vector
[CBSE 1995]

28) A particle starts from rest with constant acceleration (a + b) m/s^2 and after sometime it is decelerated with constant deceleration (a - b) (>0) m/s^2 till it again comes to rest. If the total time taken between the two rest positions is 2a sec, the maximum speed acquired by the particle in m/s is
(a) a + b (b) a - b (c) $a^2 - b^2$ (d) $a^2 + b^2$

29) A body is dropped from rest from a certain height. It takes more than 10 sec to reach the ground. The ratio of distance covered by it in 8th sec to that covered in 3rd sec is
(a) 1 (b) 2 (c) 3 (d) 4

30) A projectile is projected at an angle of 45° from a point lying 2 m from the foot of a wall. It just touches the top of the wall and reaches the ground 4 m from it. The height of the wall is
(a) $\frac{3}{4}$ m (b) $\frac{2}{3}$ m (c) $\frac{4}{3}$ m (d) $\frac{1}{3}$ m

Answers

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
c	c	c	c	b	a	a	d	a	a	d	c	c	c	b	a,b,c	b	c,d	c	b

21	22	23	24	25	26	27	28	29	30
a	c	b	b	b	b	a	c	c	c