MOTION IN A PLANE LEVEL 2
SET 3

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1. If the magnitudes of scalar and vector products of two vectors and are 6 and $6\sqrt{3}$ respectively, then the angle between two vectors is

a) $15°$ b) $30°$ c) $60°$ d) $75°$

2. A wheel is subjected to uniform angular acceleration about its axis. Initially its angular velocity is zero. In the first $2\,sec$, it rotates through an angle $\theta_1$. In the next $2\,sec$, it rotates through an additional angle $\theta_2$. The ratio of $\theta_2/\theta_1$ is

a) 1 b) 2 c) 3 d) 5

3. A force of $(10\hat{i}-3\hat{j}+6\hat{k})$ N acts on a body of mass 100 g and displaces it from $(6\hat{i}+5\hat{j}-3\hat{k})$ m to $(10\hat{i}-2\hat{j}+7\hat{k})$ m. The work done is

a) 21 J b) 121 J c) 361 J d) 1000 J

4. A stone is swinging in a horizontal circle 0.8 m in diameter, at 30rev/min. A distant light causes a shadow of the stone to be formed on a nearby wall. What is the amplitude of the motion of the shadow? What is the frequency?

a) 0.4 m, 1.5 Hz b) 0.4 m, 0.5 Hz c) 0.8 m, 0.5 Hz d) 0.2 m, 0.5 Hz

5. A body starts from rest from the origin with an acceleration of $6\,m/s^2$ along the $x$-axis and $8\,m/s^2$ along the $y$-axis. Its distance from the origin after 4 seconds will be

a) $56\,m$ b) $64\,m$ c) $80\,m$ d) $128\,m$

6. A car rounds an unbanked curve of radius 92 m without skidding at a speed of $26\,m\,s^{-1}$. The smallest possible coefficient of static friction between the tyres and the road is

a) 0.75 b) 0.60 c) 0.45 d) 0.30

7. A particle reaches its highest point when it has covered exactly one half of its horizontal range. The corresponding point on the displacement time graph is characterised by

a) Negative slope and zero curvature b) Zero slope and negative curvature

c) Zero slope and positive curvature d) positive slope and zero curvature

8. A ball is moving to and fro about the lowest point $A$ of a smooth hemispherical bowl. If it is able to rise up to a height of $20\,cm$ on either side of $A$, its speed at $A$ must be ¿massof the body$5\,g$¿

a) $0.2\,m/s$ b) $2\,m/s$ c) $4\,m/s$ d) $4.5\,m\,s^{-1}$

9. Two projectiles $A$ and $B$ thrown with speed in the ratio $1:\sqrt{2}$ acquired the same heights. If $A$ is thrown at an angle of $45°$ with the horizontal, the angle of projection of $B$ will be

a) $0°$ b) $60°$ c) $30°$ d) $45°$

10. A ball is projected with kinetic energy $E$ at an angle of $45°$ to the horizontal. At the highest point during its flight, its kinetic energy will be

a) Zero b) $E/2$ c) $E/\sqrt{2}$ d) $E$

11. One end of a string of length $l$ is connected to a particle of mass $m$ and the other to a small peg on a smooth horizontal table. If the particle moves in a circle with speed $v$, the net force on the particle (directed towards the centre) is

a) $T$ b) $T-\frac{mv^2}{l}$ c) $T+\frac{mv^2}{l}$ d) Zero

12. A force $\vec{F}=-K(y\hat{i}+x\hat{j})$ (where $K$ is a positive constant) acts on a particle moving in the $x-y$ plane. Starting from the origin, the particle is taken along the positive $x$-axis to the point $(a,0)$ and then parallel to the $y$-axis to the $(a,a)$. The total work done by the force $\vec{F}$ on the particle is

a) $-2Ka^2$ b) $2Ka^2$ c) $-Ka^2$ d) $Ka^2$

13. A projectile is thrown in the upward direction making an angle of $60°$ with the horizontal direction with a velocity of $147\,ms^{-1}$. Then the time after which its inclination with the horizontal is $45°$, is

a) $15\,s$ b) $10.98\,s$ c) $5.49\,s$ d) $2.745\,s$

14. The angle between the $z$-axis and the vector $\hat{i}+\hat{j}+\sqrt{2}\hat{k}$ is

a) $30°$ b) $45°$ c) $60°$ d) $90°$

15. A car runs at a constant speed on a circular track of radius $100m$, taking 62.8 *seconds* for every circular loop. The average velocity and average speed for each circular loop respectively is

a) $10m/s, 10\,m/s$ b) $10m/s, 0$ c) $0, 0$ d) $0, 10\,m/s$

16. A particle of mass $m$ is projected with a velocity $v$ making an angle of $45°$ with the horizontal. The magnitude of angular momentum of projectile about the point of projection when the particle is at its maximum height $h$ is

a) Zero b) $\frac{mvh}{\sqrt{2}}$ c) $\frac{mvh^2}{\sqrt{2}}$ d) None of these

17. The tension in the string revolving in a vertical circle with a mass $m$ at the end which is the lowest position

a) $\frac{mv^2}{r}$ b) $\frac{mv^2}{r}-mg$ c) $\frac{mv^2}{r}+mg$ d) $mg$

18. A particle is projected with a velocity $v$ such that its range on the horizontal plane is twice the greatest height attained by it. The range of the projectile is (where $g$ is acceleration due to gravity)

a) $\frac{4v^2}{5g}$ b) $\frac{4g}{5v^2}$ c) $\frac{v^2}{g}$ d) $\frac{4v^2}{\sqrt{5}g}$

19. A pendulum bob on a $2m$ string is displaced $60°$ from the vertical and then released. What is the speed of the bob as it passes through the lowest point in its path

a) $\sqrt{2}m/s$ b) $\sqrt{9.8}m/s$ c) $4.43\,m/s$ d) $1/\sqrt{2}m/s$

20. An object is moving in a circle of radius $100\,m$ with a constant speed of $31.4\,m/s$. What is its average speed for one complete revolution

a) Zero b) $31.4\,m/s$ c) $3.14\,m/s$ d) $\sqrt{2}\times 31.4\,m/s$

21. Ratio between maximum range and square of time of flight in projectile motion is

a) $10:49$ b) $49:10$ c) $98:10$ d) $10:98$

22. A ball is projected upwards from the top of tower with a velocity $50\,ms^{-1}$ making an angle $30°$ with the horizontal. The height of tower is 70m. After how many seconds from the instant of throwing will the ball reach the ground?

a) 2 s b) 5 s c) 7 s d) 9 s

23. The horizontal range of an oblique projectile is equal to the distance through which a projectile has to fall freely from rest to acquire a velocity equal to the velocity of projection in magnitude. The angle of projection is

a) $75°$ b) $60°$ c) $45°$ d) $30°$

24. A cyclist moves in such a way that he track $60°$ turn after 100 m. What is the displacement when to

takes seventh turn?

a) 100 m b) 200 m c) $100\sqrt{3}$ m d) $100\sqrt{3}$ m

25. When a body moves with a constant speed along a circle

a) No work is done on it b) No acceleration is produced in the body

c) No force acts on the body d) Its velocity remains constant

26. A body of mass $0.5\,kg$ is projected under gravity with a speed of $98\,m/s$ at an angle of $30°$ with the horizontal. The change in momentum (in magnitude) of the body is

a) $24.5\,N-s$ b) $49.0\,N-s$ c) $98.0\,N-s$ d) $50.0\,N-s$

27. A block of mass $m$ at the end of a string is whirled round in a vertical circle of radius $R$. The critical speed of the block at the top of its swing below which the string would slacken before the block reaches the top is

a) $Rg$ b) $(Rg)^2$ c) $R/g$ d) $\sqrt{Rg}$

28. A body of mass 1 kg is rotating in a vertical circle of radius 1m. What will be the difference in its kinetic energy at the top and bottom of the circle? (Take $g=10\,ms^{-2}$)

a) 10 J b) 20 J c) 30 J d) 50 J

29. A motor cyclist moving with a velocity of $72\,km/hour$ on a flat road takes a turn on the road at a point where the radius of curvature of the road is $20\,m$. The acceleration due to gravity is $10\,m/sec^2$. In order to avoid skidding, he must not bend with respect to the vertical plane by an angle greater than

a) $\theta=\tan^{-1}6$ b) $\theta=\tan^{-1}2$ c) $\theta=\tan^{-1}25.92$ d) $\theta=\tan^{-1}4$

30. A cannon on a level plane is aimed at an angle $\theta$ above the horizontal and a shell is fired with a muzzle velocity $v_0$ towards a vertical cliff a distance $D$ away. Then the height from the bottom at which the shell strikes the side walls of the cliff is

a) $D\sin\theta-\frac{gD^2}{2v_0^2\sin^2\theta}$ b) $D\cos\theta-\frac{gD^2}{2v_0^2\cos^2\theta}$ c) $D\tan\theta-\frac{gD^2}{2v_0^2\cos^2\theta}$ d) $D\tan\theta-\frac{gD^2}{2v_0^2\sin^2\theta}$

31 Two stones are projected with the same velocity in magnitude but making different angles with the horizontal. Their ranges are equal. If the angel of projection of one is $\pi/3$ and its maximum height is $y_1$, the maximum height of the other will be

a) $3y_1$ b) $2y_1$ c) $\frac{y_1}{2}$ d) $\frac{y_1}{3}$

32. If the resultant of the vectors $(\hat{i}+2\hat{j}-\hat{k}),(\hat{i}-\hat{j}+2\hat{k})$ and $\vec{C}$ is a unit vector along the $y$-direction, then $\vec{C}$ is

a) $-2\hat{i}-\hat{k}$ b) $-2\hat{i}+\hat{k}$ c) $2\hat{i}-\hat{k}$ d) $2\hat{i}+\hat{k}$

33. 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 point to the center of the circle

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

34. The horizontal range of a projectile $4\sqrt{3}$ times the maximum height achieved by it, then the angle of

projection is

a) $30^\circ$ b) $45^\circ$ c) $60^\circ$ d) $90^\circ$

35. An object is moving in a circle of radius 100 m with a constant speed of $31.4\,ms^{-1}$. What is its average speed for one complete revolution?

a) Zero b) $31.4\,ms^{-1}$ c) $3.14\,ms^{-1}$ d) $\sqrt{2}\times 31.4\,ms^{-1}$

36. A projectile is thrown in the upward direction making an angle of $60^\circ$ with the horizontal direction with a velocity of $147\,ms^{-1}$. Then the time after which its inclination with the horizontal is $45^\circ$, is

a) 15 s b) 10.98 s c) 5.49 s d) 2.745 s

37. The position of a particle moving in the $xy$- plane at any time $t$ is given by $x=(3t^2-6t)\ metres$, $y=(t^2-2t)\ metres$. Select the correct statement about the moving particle from the following

a) The acceleration of the particle is zero at $t=0$ second

b) The velocity of the particle is zero at $t=0$ second

c) The velocity of the particle is zero at $t=1$ second

d) The velocity and acceleration of the particle are never zero

38. *A particle of mass m is moving ∈ a horizontal o͡f radius r , under a centripetal force ¿ $\frac{k}{r^2}$, where k is a constant .*

a) The potential energy of the particle is zero

b) *The potential energy of the particle is* $\frac{k}{r}$

c) *The total energy of the particle is* $-\frac{k}{2r}$

d) *The Kinetic energy of the particle is* $-\frac{k}{r}$

39. A mass of 2 kg is whirle‘d in a horizontal circle by means of a string at an initial speed of 5 revolutions per minute. Keeping the radius constant, the tension in the string is double. The new speed is nearly

a) 2.25 rpm b) 7 rpm c) 10 rpm d) 14 rpm

40. Consider a vector $\vec{F}=4\hat{i}-3\hat{j}$. Another vector that is perpendicular to $\vec{F}$ is

a) $4\hat{i}+3\hat{j}$ b) $6\hat{j}$ c) $7\hat{j}$ d) $3\hat{i}-4\hat{j}$

41. What should be the coefficient of friction between the tyres and the road, when a car travelling at 60 $km\,h^{-1}$ makes a level turn of radius 40 m?

a) 0.5 b) 0.66 c) 0.71 d) 0.80

42. In above question, if the centripetal force $F$ is kept constant but the angular velocity is doubled, the new radius of the path (original radius $R$) will be

a) $2R$ b) $R/2$ c) $R/4$ d) $4R$

43. A projectile is thrown with velocity $v$ making an angle $\theta$ with the horizontal. It just crosses the tops of two poles, each of height $h$, after 1s and 3s respectively. The time of flight of the projectile is

a) 1 s b) 3 s c) 4 s d) 7.8 s

44. An unbanked curve has a radius of $60\,m$. The maximum speed at which car can make a turn if the coefficient of static friction is 0.75, is

a) $2.1\,m/s$ b) $14\,m/s$ c) $21\,m/s$ d) $7\,m/s$

45. A particle is moving along a circular path with a uniform speed. How does its angular velocity change when it completes half of the circular path?
a) No change b) Increases c) Decreases d) Cannot say

46. A bullet is to be fired with a speed of $2000\,ms^{-1}$ to hit a target $200\,m$ away on a level ground. If $g=10\,ms^{-2}$, the gun should be aimed
a) Directly at the target
b) $5\,cm$ below the target
c) $5\,cm$ above the target
d) $2\,cm$ above the target

47. A particle is projected up an inclined plane with initial speed $v=20\,ms^{-1}$ at an angle $\theta=30°$ with plane. The component of its velocity perpendicular to plane when it strikes the plane is
a) $10\sqrt{3}ms^{-1}$
b) $10\,ms^{-1}$
c) $5\sqrt{3}ms^{-1}$
d) Data is insufficient

48. A stone is projected from the ground with velocity $50\,m/s$ at an angle of $30°$. It crosses a wall after $3\,sec$. How far beyond the wall the stone will strike the ground ¿
a) $90.2\,m$ b) $89.6\,m$ c) $86.6\,m$ d) $70.2\,m$

49. The angle of banking is independent of
a) speed of vehicle
b) radius of curvature of road
c) height of inclination
d) None of the above

50. A ball of mass 0.1 $kg$. Is whirled in a horizontal circle of radius 1 $m$. By means of a string at an initial speed of 10 $R.P.M.$ Keeping the radius constant, the tension in the string is reduced to one quarter of its initial value. The new speed is
a) $5r.p.m.$ b) $10r.p.m.$ c) $20r.p.m.$ d) $14r.p.m.$