DPP No: 08	competishun	PHYSICS
Maximum Time 50 Min	C^3 (COMPETISHUN CRASH COURSE)	TARGET JEE-MAINS

SYLLABUS : CIRCULAR MOTION

1. A particle moves along a circle of radius R with a constant angular speed ω .Its displacement (only magnitude) in time t will be

(A) ωt (B) 2 R cos ωt (C) 2 R sin ωt (D) 2R sin $\frac{\omega t}{2}$

2. Two racing cars of masses m_1 and m_2 are moving in circles of radii r and 2r respectively and their angular speeds are equal. The ratio of the time taken by cars to complete one revolution is :

(A) $m_1 : m_2$ (B) 1 : 2 (C) 1 : 1 (D) $m_1 : 2m_2$

3. The second's hand of a watch has length 6 cm. Speed of end point and magnitude of difference of velocities at two perpendicular positions will be :

(A) 2π & 0 mm/s (B) $2\sqrt{2}\,\pi$ & 4.44 mm/s

(C) $2\sqrt{2}\,\pi$ & 2π mm/s (D) 2π & $2\sqrt{2}\,\pi$ mm/s

4. A particle moves in a circular path so that its distance travel varies with time t as s = $3t^2 + 6t$. Then its acceleration at t = 1 sec. is (radius of path is 12 m) -

(A) $6\sqrt{5}$ m/s^2 (B) 6 m/s^2 (C) 12 m/s^2 (D) $12\sqrt{3}$ m/s^2

5. A particle is moving in a spiral path on a smooth horizontal plane, with constant angular velocity ω. If the radius is increasing at a constant rate β and the initial radius is zero, then find the magnitude of acceleration of the particle at time 't'.

(A) $\omega^2\beta t$ (B) $\omega\beta\sqrt{1+\omega^2t^2}$ (C) $\omega\beta\sqrt{4+\omega^2t^2}$ (D) $2\omega\beta\sqrt{1+\omega^2t^2}$

6. Two particles P and Q are located at distances r_P and r_Q respectively from the axis of a rotating disc such that $r_P > r_Q$:

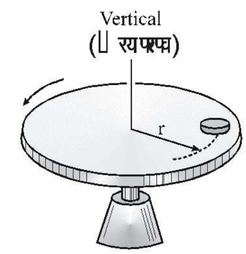
(A) Both P and Q have the same acceleration

(B) Both P and Q do not have any acceleration

(C) P has greater acceleration than Q

(D) Q has greater acceleration than P

7. A small coin of mass 40 g is placed on the horizontal surface of a rotating disc. The disc starts from rest and is given a constant angular acceleration α = 2 rad/s^2. The coefficient of static friction between the coin and the disc is μ_s = 3/4 and coefficient of kinetic friction is μ_k = 0.5. The coin is placed at a distance r = 1 m from the centre of the disc. The magnitude of the resultant force on the coin exerted by the disc just before it starts slipping on the disc is :
(Take g = 10 m/s^2)



(A) 0.2 N (B) 0.3 N (C) 0.4 N (D) 0.5 N

8. In the motorcycle stunt called "the well of death" the track is a vertical cylindrical surface of 18 m radius. Take the motorcycle to be a point mass and μ = 0.8. The minimum angular speed of the motorcycle to prevent him from sliding down should be:

(A) 6/5 rad/s (B) 5/6 rad/s (C) 25/3 rad/s (D) none of these

9. A stone of mass of 16 kg is attached to a string 144 m long and is whirled in a horizontal smooth surface. The maximum tension the string can withstand is 16 N. The maximum speed of revolution of the stone without breaking it, will be :

(A) 20 ms^{-1} (B) 16 ms^{-1} (C) 14 ms^{-1} (D) 12 ms^{-1}

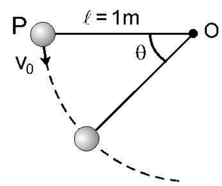
10. A particle is projected at t = 0 with velocity u at angle θ with the horizontal. Then the ratio of the tangential acceleration and the radius of curvature at the point of projection is :

(A) $\frac{g^2 \sin 2\theta}{u^2}$ (B) $\frac{2g^2 \sin\theta}{u^2}$ (C) $\frac{g^2 \sin\theta}{u^2}$ (D) $\frac{g^2 \sin 2\theta}{2u^2}$

11. A stone is projected with speed u and angle of projection is θ. Find radius of curvature at t = 0.

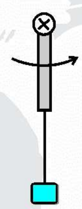
(A) $\frac{u^2 \cos^2\theta}{g}$ (B) $\frac{u^2}{g\sin\theta}$ (C) $\frac{u^2}{g\cos\theta}$ (D) $\frac{u^2 \sin^2\theta}{g}$

12. The sphere at P is given a downward velocity v_0 and swings in a vertical plane at the end of a rope of ℓ = 1m attached to a support at O. The rope breaks at angle 30° from horizontal, knowing that it can withstand a maximum tension equal to three times the weight of the sphere. Then the value of v_0 will be : ($g = \pi^2$ m/s^2)



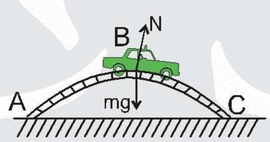
(A) $\frac{g}{2}$ m/s (B) $\frac{2g}{3}$ m/s (C) $\sqrt{\frac{3g}{2}}$ m/s (D) $\frac{g}{3}$ m/s

13. One end of a light rod of length 1 m is attached with a string of length 1m. Other end of the rod is attached at point O such that rod can move in a vertical circle. Other end of the string is attached with a block of mass 2kg. The minimum velocity (m/s) that must be given to the block in horizontal direction so that it can complete the vertical circle is (g = 10 m/s^2).



(A) $4\sqrt{5}$ (B) $5\sqrt{5}$ (C) 10 (D) $3\sqrt{5}$

14. A car is going on an overbridge of radius R, maintaining a constant speed. As the car is descending on the overbridge from point B to C, the normal force on it :



(A) increase (B) decreases

(C) remains constant (D) first increases then decreases.

15. A bucket is whirled in a vertical circle with a string attached to it.The water in bucket does not fall down even when the bucket is inverted at the top of its path. In this position choose most appropiate option if v is the speed at the top.

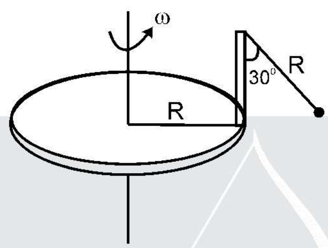
(A) $mg = \frac{mv^2}{r}$ (B) mg is greater than $\frac{mv^2}{r}$

(C) mg is not greater than $\frac{mv^2}{r}$ (D) mg is not less than $\frac{mv^2}{r}$

16. If the apparent weight of the bodies at the equator is to be zero, then the earth should rotate with angular velocity

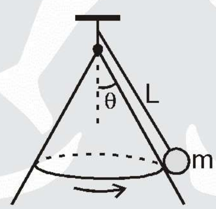
(A) $\sqrt{\frac{g}{R}}$ rad/sec (B) $\sqrt{\frac{2g}{R}}$ rad/sec (C) $\sqrt{\frac{g}{2R}}$ rad/sec (D) $\sqrt{\frac{3g}{2R}}$ rad/sec

17. A disc of radius R has a light pole fixed perpendicular to the disc at the circumference which in turn has a pendulum of length R attached to its other end as shown in figure. The disc is rotated with a constant angular speed ω. The string is making an angle 30^0 with the rod. Then the angular speed ω of disc is:



(A) $\left(\frac{\sqrt{3}\,g}{R}\right)^{1/2}$ (B) $\left(\frac{\sqrt{3}\,g}{2R}\right)^{1/2}$ (C) $\left(\frac{g}{\sqrt{3}\,R}\right)^{1/2}$ (D) $\left(\frac{2g}{3\sqrt{3}\,R}\right)^{1/2}$

18. A small sized mass m is attached by a massless string (of length L) to the top of a fixed frictionless solid cone whose axis is vertical. The half angle at the vertex of the cone is θ. If the mass m moves around in a horizontal circle at speed v, what is the maximum value of v for which mass stays in contact with the cone ? (g is acceleration due to gravity.)



(A) $\sqrt{gL\cos\theta}$ (B) $\sqrt{gL\sin\theta}$ (C) $\sqrt{gL\sin\theta\tan\theta}$ (D) $\sqrt{gL\tan\theta}$

19. A car is travelling at 57.6 km/hr on an unbanked (horizontal) circular road of radius $\frac{160}{3}$ m. If the coefficient of friction between the road and the car is 0.8, then the maximum tangential deceleration that driver of car can achieve by applying the brakes at this moment is : (g = 10 m/s^2)

(A) 8 m/s^2 (B) 4.8 m/s^2 (C) 6.4 m/s^2 (D) 16 m/s^2

20. A car moving on a horizontal road may be thrown out of the road in taking a turn :

(A) By the gravitational force

(B) Due to lack of sufficient centripetal force

(C) Due to friction between road and the tyre

(D) Due to reaction of earth

21. A train A runs from east to west and another train B of the same mass runs from west to east at the same speed with respect to earth along the equator. Normal force by the track on train A is N_1 and that on train B is N_2:

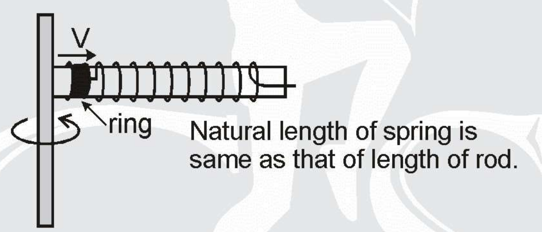
(A) $N_1 > N_2$

(B) $N_1 < N_2$

(C) $N_1 = N_2$

(D) the information is insufficient to find the relation between N_1 and N_2.

22. A ring attached with a spring is fitted in a smooth rod. The spring is fixed at the outer end of the rod. The mass of the ring is 3kg & spring constant of spring is 300 N/m. The ring is given a velocity 'V' towards the outer end of the rod. And the rod is set to be rotating with an angular velocity ω. Then ring will move with constant speed with respect to the rod if :



(A) ω = 10 rad/s

(B) angular velocity of rod is increased continuously

(C) angular velocity of rod is decreased continuously.

(D) constant velocity of ring is not possible.

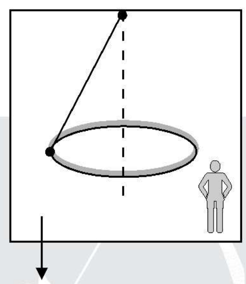
23. A cyclist moving with a speed of 4.9 m/s on a level road can take a sharp circular turn of radius 4 m, then find the minimum value of coefficient of friction between the cycle tyres and road. ($g = 9.8\ m/s^2$)

(A) $\frac{25}{40}$ (B) $\frac{29}{80}$ (C) $\frac{49}{80}$ (D) $\frac{80}{49}$

24. A road surrounds a circular playing field having radius of 10 m. If a vehical goes around it at an average speed of 18 km/hr, find proper angle of banking for the road. If the road is horizontal (no banking), what should be the minimum friction coefficient so that a scooter going at 18 km/hr does not skid.

(A) $\tan^{-1}(1/4)$, 1/2 (B) $\tan^{-1}(1/4)$, 1/4 (C) $\tan^{-1}(1/2)$, 1/4 (D) $\tan^{-1}(2/4)$, 1/4

25. In the figure shown a lift goes downwards with a constant retardation. An observer in the lift observers a conical pendulum in the lift, revolving in a horizontal circle with time period 2 seconds. The distance between the centre of the circle and the point of suspension is 2.0 m. Find the retardation of the lift in m/s^2. Use π^2 = 10 and g = 10 m/s^2



(A) 5 m/s^2 (B) 10 m/s^2 (C) 15 m/s^2 (D) 20 m/s^2

ANSWER KEY

1.	(D)	**2.**	(C)	**3.**	(D)	**4.**	(A)	**5.**	(B)
6.	(C)	**7.**	(D)	**8.**	(B)	**9.**	(D)	**10.**	(D)
11.	(C)	**12.**	(C)	**13.**	(C)	**14.**	(B)	**15.**	(C)
16.	(A)	**17.**	(D)	**18.**	(C)	**19.**	(C)	**20.**	(B)
21.	(A)	**22.**	(A)	**23.**	(C)	**24.**	(B)	**25.**	(B)