HORIZONTAL CIRCULAR MOTION

1. **A particle of mass m is tied to a light string and rotated with a speed v along a circular path of radius r. If T is tension in the string and mg is gravitational force on the particle then, the actual forces acting on the particle are**

   1) mg, and T only

   2) mg, T and an additional force of $\frac{mv^2}{r}$ directed inwards

   3) mg, T and an additional force of $\frac{mv^2}{r}$ directed outwards

   4) only a force $\frac{mv^2}{r}$ directed outwards

2. **Many great rivers flow towards the equator, what effect does the sediment they carry to sea have on the rotation of the earth?**

   1) The rotation of the earth slows down 2) The rotation of the earth speeds up

   3) No effect on the rotation of the earth 4) none

3. **Identify the increasing order of angular velocities of following**

   a) Earth rotating about its own axis

   b) Hour's hand of clock

   c) Seconds hand of clock

   d) Fly wheel of radius 2m making 300 r.p.m.

   1) a, b, c, d 2) b, c, d, a 3) c, d, a, b 4) d, a, b, c

4. **A): Centripetal force does no work in circular motion.**

   R): Force and displacements are perpendicular to each other in circular motion.

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

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

   3) (A) is true and (R) is false 4) (A) is false but (R) is true

5. **A) : A coin placed on a rotating disc flies away if the angular velocity is gradually increased**

R) : Friction can not provide the sufficient centripetal force

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

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

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

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

6. **A): A ball connected to a string is in circular motion on a frictionless horizontal table and is in equilibrium**

R): 'Magnitude of the centripetal force is equal to the magnitude of the tension in the string.

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

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

3) (A) is true and (R) is false 4) (A) is false but (R) is true

7. **A particle moves around a circular path in the xy-plane with angular velocity $\vec{\omega}$ and angular acceleration $\vec{\alpha}$**

(A): $\vec{\alpha}$ lies along the z-axis.

(R): The direction of $\vec{\alpha}$ must be the same as the direction of $d\vec{\omega}$

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

(2) both A and R are true but R is not the correct explanation of A

(3) A is true, R is false (4) A is false but R is true

8. **In a conical pendulum, the bob moves on a horizontal circular path, with constant speed and the string makes a fixed angle with vertical.**

(A): The net force due to tension of the string and weight of the bob is non-zero

(R): This must be so because a force is required to keep the bob moving in a circle with constant speed.

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

(2) A is false and R is the true explanation of A

(3) A is true but R is false

(4) Both A and R are true, but R is not the correct explanation of A

9. Match list-I with List-II

List - I	List -II
(a) Centripetal force	**(e) earth's rotation**
(b) Centrifugal force	**(f) steam governors**
(c) Conical Pendulum	**(g) tides**
(d) Foucault's Pendulum	**(h) tension in the string of a simple pendulum**

(1) a-e, b-h, c-f, d-g (2) a-e, b-g, c-f, d-e (3) a-f, b-h, c-e, d-g (4) a-g, b-f, c-e, d-g

10. Match list I with list - II

List - I	List - II
a) Conservation of	**e) Kinetic energy is same angular momentum**
b) Uniform circular	**f) no dimensions**
c) Angular displacement	**g) Torque is zero motion**
	h) Force

(1) a-g, b-e, c-f, d-h (2) a-g, b-h, c-f, d-f (3) a-e, b-h, c-f, d-g (4) a-e, b-f, c-h, d-g

11. A particle of mass m is moving in a horizontal circle of radius r under a centripetal force equal to k/r^2, where k is a constant. Match List-I with List-II

List - I	List - II
(a) Kinetic energy	**(e)** $\sqrt{kmr}$
(b) Total energy	**(f)** $\sqrt{\frac{km}{r}}$
(c) Linear momentum	**(g)** $-\frac{k}{r}$
(d) Angular momentum	**(h)** $\frac{k}{2r}$

(1) a-g, b-h, c-e, d-f (2) a-h, b-e, c-g, d-f (3) a-g, b-h, c-f, d-e (4) a-h, b-g, c-f, d-e

12. Match list-I with list - II

List - I	List - II
a) Centrifugal force	**e) along he axis of rotation**
b) Centripetal force	**f) Towards the centre of rotations**
c) Tangential force	**g) Away from the centre of rotation**
d) Angular velocity	**h) Changes the angular velocity**

(1) a-h, b-g, c-f, d-e (2) a-g, b-f, c-h, d-e (3) a-f, b-g, c-h, d-e (4) a-e, b-h, c-e, d-f

13. The angular velocity of second's hand in a watch clock is: (in rads^{-1})

1) $\frac{\pi}{30}$ 2) $\frac{\pi}{60}$ 3) $\frac{\pi}{1800}$ 4) $\frac{\pi}{3600}$

14. A car is moving with a speed of 30 ms^{-1} on a circular path of radius 500 m. If its speed is increasing at the rate of 2 ms^{-2}, the net acceleration of the car is

1) 3.6 ms^{-2} 2) 2.7 ms^{-2} 3) 1.8 ms^{-2} 4) 2 ms^{-2}

15. The speed of a motor increases from 1200 rpm to 1800 rpm in 20S.Number of revolutions made in this period of time

1) 400 2) 200 3) 500 4) 800

16. A particle of mass 'm' is moving in a horizontal circle of radius 'r' under a centripetal force – k/r^2 where 'K' is a constant. The total energy of the particle is

1) – K/r 2) – K/2r 3) K/2r 4) –2K/r

17. A particle describes a horizontal circle on the smooth surface of an inverted cone. The plane of that circle is at a height of 9.8cm above the vertex. Then the speed of the particle is

1) 0.49 ms^{-1} 2) 0.98 ms^{-1} 3) 1.96 ms^{-1} 4) 3.92 ms^{-1}

18. A chain of 100 links is 1m long and has a mass of 2kg. With the ends fastened together it is set rotating at 3000 rpm, in a horizontal plane. The centripetal force on each link is

1) 3.14 N 2) 31.4N 3) 314 N 4) 3140 N

19. A boy is sitting on a horizontal platform in the shape of a disc at a distance of 5m from its centre. The boy begins to slip when the speed of wheel exceeds 10 rpm. The coefficient of friction between the boy and platform is. (g = 10 ms^{-2})

1) $\pi^2/6$ 2) $\pi^2/18$ 3) $\pi/6$ 4) $\pi/2$

20. Length of seconds hand in a clock, is 15 cm. Change in the linear velocity of the tip of the hand after 15 sec. is

1) $\frac{\pi}{\sqrt{2}} cm/\sec$ 2) $\sqrt{2}\pi\, cm/\sec$ 3) $\frac{\pi}{2\sqrt{2}} cm/\sec$ 4) $\pi/2$ cm/sec

KEY

1) 1 2) 1 3) 1 4) 1 5) 1 6) 4 7) 1 8) 1 9)2

10) 1 11) 4 12) 2 13) 1 14) 2 15) 3 16) 2 17) 2 18)3

19) 2 20) 1

HINTS

13. $\omega = \frac{2\pi}{T} = \frac{2\pi}{60} = \frac{\pi}{30} rad/s$

14. $a = \sqrt{a_r^2 + a_t^2}$

$a_t = 2ms^{-2}$

$a_r = \frac{v^2}{r} = \frac{900}{500} = 1.8 m/s^2$

$a_r = \sqrt{3.26+4} = \sqrt{7.26} = 2.7 m/s^2$

15. $\theta = 2\pi N = \left(\frac{60\pi + 40\pi}{2}\right).20$

$N = 500$

16. $\frac{mv^2}{r} = \frac{k}{r^2} \Rightarrow mv^2 = \frac{k}{r}$

$KE = K/2r$

$TE = -KE = -K/2r$

17. $N\cos\theta = mrw^2 \qquad NSin\theta = mg$

$Tan\theta = \frac{g}{rw^2} = \frac{gr}{v^2} \qquad \frac{r}{h} = \frac{gr}{v^2}$

$v = \sqrt{gh} \qquad = 0.98 ms^{-1}$

18. $F = mrw^2$

$$= \frac{2}{100} \text{x} \frac{1}{2\pi} \text{x} \left(3000 \text{x} \frac{2\pi}{60} \right)^2 = 314N$$

19. $\mu mg = mrw^2$ $\qquad \mu = \dfrac{5\text{x}\left(10\text{x} \dfrac{2\pi}{60} \right)^2}{10} = \dfrac{\pi^2}{18}$

20. $\omega_S = \dfrac{\pi}{30}$

$$\Delta V = 2V \ Sin\frac{\theta}{2} = 2r\omega_S Sin\frac{90}{2} = 2 \times 15 \times \frac{\pi}{30} \times \frac{1}{\sqrt{2}} \rightarrow\rightarrow \Delta V = \frac{\pi}{\sqrt{2}} cm/\sec$$