Non-uniform Circular Motion

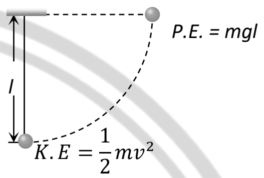
1. (d) Minimum speed at the highest point of vertical circular path $v = \sqrt{gR}$

2. (d) At highest point $\frac{mv^2}{R} = mg \Rightarrow v = \sqrt{gR}$

3. (d) Kinetic energy given to a sphere at lowest point = potential energy at the height of suspension

$\Rightarrow \frac{1}{2}mv^2 = mgl$

$\therefore v = \sqrt{2gl}$



4. (c) Due to less centrifugal force experienced by the bubbles.

5. (a) Critical velocity at highest point= $\sqrt{gR} = \sqrt{10 \times 1.6}$=4*m/s*

6. (c) Using relation $\theta = \omega_0 t + \frac{1}{2}at^2$

$\theta_1 = \frac{1}{2}(\alpha)(2)^2 = 2\alpha$ ...(i) (As $\omega_0 = 0, t = 2sec$)

Now using same equation for *t* = 4 sec, $\omega_0 = 0$

$\theta_1 + \theta_2 = \frac{1}{2}\alpha(4)^2 = 8\alpha$ ...(ii)

From (i) and (ii),$\theta_1 = 2\alpha$and$\theta_2 = 6\alpha \therefore \frac{\theta_2}{\theta_1} = 3$

7. (a) $mg = 1 \times 10 = 10N, \frac{mv^2}{r} = \frac{1\times(4)^2}{1} = 16$

Tension at the top of circle = $\frac{mv^2}{r} - mg = 6N$

Tension at the bottom of circle = $\frac{mv^2}{r} + mg = 26N$

8. (d) For critical condition at the highest point $\omega = \sqrt{g/R}$

$\Rightarrow T = \frac{2\pi}{\omega} = 2\pi\sqrt{R/g} = 2 \times 3.14\sqrt{4/9.8}$= 4 sec.

9. (b) $mg = 20N$ and $\frac{mv^2}{r} = \frac{2\times(4)^2}{1} = 32N$

It is clear that 52 N tension will be at the bottom of the circle. Because we know

that $T_{\text{Bottom}} = mg + \frac{mv^2}{r}$

10. (b) $h = \frac{5}{2}R = \frac{5}{2}\left(\frac{D}{2}\right) = \frac{5D}{4}$

11. (b) Net acceleration in nonuniform circular motion,

$a= \sqrt{a_t^2 + a_c^2} = \sqrt{(2)^2 + \left(\frac{900}{500}\right)^2} = 2.7m \rightleftarrows/\rightleftarrows s^2$

a_t =tangential acceleration

a_c =centripetal acceleration $= \frac{v^2}{r}$

12. (b) $T = mg + \frac{mv^2}{l} = mg + 2mg = 3mg$

where $v = \sqrt{2gl}$ from $\frac{1}{2}mv^2 = mgl$

13. (a) $T^2_{max\,max} \Rightarrow \frac{T_{\max}}{m} = \omega^2 r + g$

$\Rightarrow \frac{30}{0.5} - 10 = \omega^2{}_{max} \Rightarrow \omega\sqrt{\frac{50}{r}}\sqrt{\frac{50}{2}}_{max}$

14. (b)

15. (b) Because here tension is maximum.

16. (a) Max. tension that string can bear = 3.7 *kgwt* = 37*N*

Tension at lowest point of vertical loop $= mg + m\omega^2 r$

$= 0.5 \times 10 + 0.5 \times \omega^2 \times 4 = 5 + 2\omega^2$

$\therefore$ 37 = 5 + 2$\omega^2 \Rightarrow \omega$ = 4 rad/s

17. (c)

18. (c) $\omega = \frac{d\theta}{dt} = \frac{d}{dt}(2t^3 + 0.5) = 6t^2$

at t =2 s, $\omega = 6 \times (2)^2 = 24 rad/s$

19. (a) When body is released from the position *p* (inclined at angle θ from vertical) then velocity at mean position

$v = \sqrt{2gl(1 - cos\,\theta)}$

$\therefore$ Tension at the lowest point = $mg + \frac{mv^2}{l}$

$= mg + \frac{m}{l}[2gl(1 - cos\,6\,0)] = mg + mg = 2mg$

20. (a)

21. (c) Tension = Centrifugal force + weight = $\frac{mv^2}{r} + mg$

22. (a) $v\sqrt{5gr} sec_{min}$

23. (d)

24. (c) $v = \sqrt{2gl(1 - cos\,\theta)} = \sqrt{2 \times 9.8 \times 2(1 - cos\,6\,0°)}$ $= 4.43 m/s$

25. (b) Increment in angular velocity $\omega = 2\pi(n_2 - n_1)$

$$\omega = 2\pi(1200 - 600)\frac{rad}{min} = \frac{2\pi\times600}{60}\frac{rad}{s} = 20\pi\frac{rad}{s}$$