Uniform Circular Motion

21. (b)

22. (a) $\frac{a_R}{a_r} = \frac{\omega_R^2 \times R}{\omega_r^2 \times r} = \frac{T_r^2}{T_R^2} \times \frac{R}{r} = \frac{R}{r}$ [As $T_r = T_R$]

23. (c) $\omega \frac{2\pi}{60} \frac{Rad}{min}_{min}$ and $\omega_{hr} = \frac{2\pi}{12\times 60} \frac{Rad}{min}$

$\therefore \frac{\omega_{min}}{\omega_{hr}\frac{2\pi/60}{2\pi/12\times 60}}$

24. (d) The particle performing circular motion flies off tangentially.

25. (a) The angle of banking, $tan\,\theta = \frac{v^2}{rg}$

$\Rightarrow tan\,1\,2° = \frac{(150)^2}{r\times 10} \Rightarrow r = 10.6 \times 10^3 m = 10.6 km$

26. (c) K.E. $= \frac{1}{2}mv^2$. Which is scalar, so it remains constant.

27. (b) $v = 72 km/hour = 20 m/sec$

$\theta = tan^{-1}\left(\frac{v^2}{rg}\right) = tan^{-1}\left(\frac{20\times 20}{20\times 10}\right) = tan^{-1}(2)$

28. (a)

29. (d) $120 rev/min = 120 \times \frac{2\pi}{60} rad/sec = 4\pi rad/sec$

30. (c) In uniform circular motion, acceleration causes due to change in direction and is directed radially towards centre.

31. (b) Reaction on inner wheel $R_1 = \frac{1}{2}M\left[g - \frac{v^2h}{ra}\right]$

Reaction on outer wheel $R_2 = \frac{1}{2}M\left[g + \frac{v^2h}{ra}\right]$

where, *r* = radius of circular path, 2*a* = distance between two wheels and *h* = height of centre of gravity of car.

32. (d) Maximum tension= $m\omega^2 r = m \times 4\pi^2 \times n^2 \times r$

By substituting the values we get $T_{max} = 87.64N$

33. (d) $\frac{v^2}{rg} = \frac{h}{l} \Rightarrow v = \sqrt{\frac{rgh}{l}} = \sqrt{\frac{50\times1.5\times9.8}{10}} = 8.57m/s$

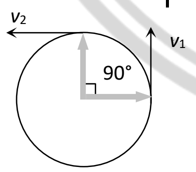
34. (b) $a = \omega^2 r = 4\pi^2 n^2 r = 4\pi^2 \times 1^2 \times 20 \times 10^3$

$\therefore$ a=$8 \times 10^5\ m/sec^2$

35. (c)

36. (d) In 15 second's hand rotate through 90°.

Change in velocity $|\overrightarrow{\Delta v}| = 2v\sin(\theta/2)$



$= 2(r\omega)\sin(90°/2) = 2 \times 1 \times \frac{2\pi}{T} \times \frac{1}{\sqrt{2}}$

$= \frac{4\pi}{60\sqrt{2}} = \frac{\pi\sqrt{2}}{30}\frac{cm}{sec}$ [As *T* = 60 sec]

37. (c) Since $n = 2$, $\omega = 2\pi \times 2 = 4\pi rad/s^2$

So acceleration $= \omega^2 r = (4\pi)^2 \times \frac{25}{100} m/s^2 = 4\pi^2$

38. (b) $\omega^2 r = 4\pi^2 n^2 r = 4\pi^2 \left(\frac{1200}{60}\right)^3 \times 30 = 4740 m/s^2$

39. (a)

40. (c) Particles of cream are lighter so they get deposited near the centre of circular path.