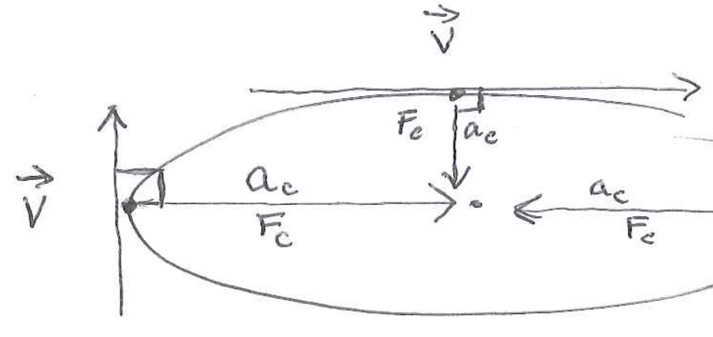
UCM Pt A

1.



horizontal circle

$\vec{V}$ is a tangential path which is perpendicular to the "centre seeking", centripetal acceleration and centripetal force.

2. $\vec{a}_c = \dfrac{\vec{V}^2}{r}$ $\qquad V = \dfrac{2\pi r}{T}$

$V = \sqrt{ar}$ $\qquad T = \dfrac{2\pi r}{V} = \dfrac{2\pi(500)}{100} = 31.4 = 31s$

$V = 100\ m/s$

OR $T = \sqrt{\dfrac{4\pi^2 r}{a}} = 31s$

3. $V = 70\ Km/h = \dfrac{70000m}{3600\ s} = 19.4\ m/s$ $\qquad a_c = \dfrac{V^2}{r} = \dfrac{19.4^2}{250}$

$a_c = 1.51 = 1.5\ m/s^2$

4. a) $r = 1.5cm = 0.015m$

second hand does one circle in 1minute or 60s

$V = \dfrac{2\pi r}{T} = \dfrac{2\pi(0.015m)}{60s} = 0.00157\ m/s = 0.0016\ m/s$

or $1.6 \times 10^{-3}\ m/s$

b) $T \rightarrow 3T$

$a = \dfrac{4\pi^2 r}{T^2} \rightarrow \dfrac{4\pi^2 r}{(3T)^2} \rightarrow \dfrac{4\pi^2 r}{9T^2}$ $\therefore$ a_c drops to one ninth of its original value

5. $T = 27.3\,d \times \frac{24\,h}{d} \times \frac{3600\,s}{h} = 2\,358\,720\,s$

$a_c = \frac{4\pi^2 r}{T^2}$ $\quad r = \frac{a_c T^2}{4\pi^2} = 3.8 \times 10^8\,m$

6. $F_f = F_c$ unbanked (flat track) $F_N = mg$

$\mu F_N = \frac{mv^2}{r}$ $\quad \mu \cancel{m} g = \frac{\cancel{m} v^2}{r}$ divide out mass

$V_{max} = \sqrt{\mu g r} = 25\,m/s$

7. As above $\mu g = \frac{v^2}{r}$ $\quad \mu = \frac{v^2}{gr} = 0.53$ (no units)

8. $F_T = F_c = \frac{mv^2}{r}$ $\quad 300N = \frac{6.00kg \times V^2}{1.50m}$

$V = \sqrt{\frac{300 \times 1.5}{6}} = 8.66\,m/s$

9. In the case of a vertical circle the force of tension continually changes and has a maximum value when the object is at the lowest point.

most likely place for the string to break.

$F_{T_{max}} = F_c + F_g = \frac{mv^2}{r} + mg$

$300N = \frac{6.00Kg \times V_{max}^2}{1.50m} + 6.00\,Kg \times 9.81\,N/Kg$

$300 = 4V^2 + 58.86$

$V = \sqrt{\frac{300 - 58.86}{4}} = 7.76\,m/s$