**Topic 7: Circular Motion**

**1) Circular Motion:**

**a) Radians/Sectors:**

**Converting between radians and degrees:**

$$\pi \text{ rads} = 180°$$

**Sector Formulae:**

| $\theta$ in degrees | $\theta$ in radians |
|---|---|
| $l = 2\pi r\left(\frac{\theta}{360}\right)$ | $l = r\theta$ |
| $A = \pi r^2\left(\frac{\theta}{360}\right)$ | $A = \frac{1}{2}r^2\theta$ |

See Tables book pg 9

**Linking Linear Speed and Angular Speed:**

$$v = \omega r$$

See Tables book pg 51

**b) Horizontal Motion:**

**Steps for solving MOST Horizontal Circle questions:**

1) Draw a good-sized diagram.
2) Mark in all forces and resolve into **vertical** and **horizontal directions** always.
3) Generate one equation from Forces Up = Forces Down
4) Generate a second equation using the Centripetal Force (the force acting horizontally towards the centre of the circle) formula from below.

**Centripetal Acceleration and Forces:**

$$Acc = \omega^2 r \qquad F = m\omega^2 r$$

$$Acc = \frac{v^2}{r} \qquad F = \frac{mv^2}{r}$$

See Tables book pg 51

**c) Vertical Motion:**

**Steps for solving MOST Vertical Circle questions:**

1) Draw a first diagram to mark in Position 0 and Position 1, using the question.
2) Find the distance/height between Position 0 and Position 1.
3) Use LCE below between Position 0 and Position 1 to form one equation.
4) Look at forces at Position 1 and form an equation for Centripetal Force using:
5) Solve two equations together to get what's required.

Law of Conservation of Energy:

$$mgh_1 + \frac{1}{2}mv_1{}^2 = mgh_2 + \frac{1}{2}mv_2{}^2$$

**Other useful tips:**

- For vertical circle questions, always resolve the weight of the particle into perpendicular and parallel forces relative to the radius of motion.
- Generally, link the two equations by equating expressions for $v^2$.
- For questions involving strings going slack, generate equations involving T, and then let T = 0.
- For questions involving objects losing contact with a surface, generate equations involving R, and then let R = 0

**2) Hooke's Law:**

**b) Hooke's Law:**

**Notes:**

**6)** The extension of a spring, or elastic material is directly proportional to the force causing the extension.

$$F = k(l - l_0)$$

'k' is known as the elastic constant and has units N/m.

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