



$$a) PE_I = (70 \text{ kg})(10 \text{ m/s})(40 \text{ m}) = 28000 \text{ J}$$

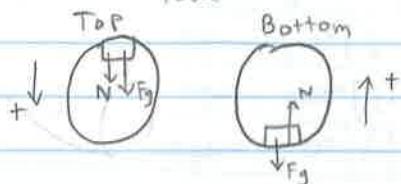
$$PE_{\text{Top of Loop}} = (70 \text{ kg})(10 \text{ m/s})(20 \text{ m}) = 14000 \text{ J}$$

$$28000 \text{ J} = \frac{1}{2}mv^2, V_{\text{bottom}} = 28.28 \text{ m/s}$$

$$14000 \text{ J} = \frac{1}{2}mv^2, V_{\text{top}} = 20 \text{ m/s}$$

$$a_c_{\text{bottom}} = \frac{(28.28 \text{ m/s})^2}{10 \text{ m}} = 80 \text{ m/s}^2$$

$$a_c_{\text{top}} = \frac{(20 \text{ m/s})^2}{10 \text{ m}} = 40 \text{ m/s}^2$$



$$\Sigma F_c = ma_c$$

$$N + F_g = ma_c$$

$$N = ma_c - F_g$$

$$N = (70 \text{ kg})(40 \text{ m/s}^2) - (70 \text{ kg})(10 \text{ m/s}^2) = 2100 \text{ N}$$

$$\Sigma F_c = ma_c$$

$$N - F_g = ma_c$$

$$N = ma_c + F_g$$

$$N = (70 \text{ kg})(80 \text{ m/s}^2) + (70 \text{ kg})(10 \text{ m/s}^2) = 6300 \text{ N}$$

→ As you round the bottom of the loop, you feel more force pushing down on you. This is not a good ride for a pregnant woman!

b) If you start at the height as the top of the loop, you won't have enough velocity to make it around the top of the loop, because if energy is conserved, then KE will be 0 as you approach the top of the loop.

$$c) PE_i = PE_f + KE_i \quad \sum F = ma_c$$

$$mgh = mg(20m) + \frac{1}{2}mv^2 \quad F_g < ma_c$$

$$gh = g(20m) + \frac{1}{2}v^2 \quad mg < ma_c$$

$\Downarrow$

$$(10\text{ m/s})h = (10\text{ m/s})(20\text{ m}) + \frac{1}{2}(10.0\text{ m/s})^2 \quad \frac{v^2}{r} > g$$

$$\boxed{h > 25\text{ m}} \quad v > \sqrt{gr}$$

$$V > 10\text{ m/s}$$

$$d) KE = \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2$$

$$= \frac{1}{2}I\frac{v^2}{r^2} + \frac{1}{2}mv^2$$

$$= \frac{1}{2} \cdot \frac{2}{3}mr^2 \frac{v^2}{r^2} + \frac{1}{2}mv^2$$

$$= \frac{2}{6}mv^2 + \frac{1}{2}mv^2$$

$$= \frac{5}{6}mv^2$$

$$PE = 28000\text{ J at top}$$

$$\text{So, } KE_{bottom} = 28000\text{ J} = \frac{5}{6}(70\text{ kg})v^2, \quad v = 21.9\text{ m/s}, \quad a_c = 48\text{ m/s}^2$$

$$KE_{top} = 14000\text{ J} = \frac{5}{6}(70\text{ kg})v^2, \quad v = 15.49\text{ m/s}, \quad a_c = 24\text{ m/s}^2$$

 $\Sigma F = ma_c$ $-F_g + F_N = (70\text{ kg})(48\text{ m/s}^2)$ $F_N = 3360\text{ N} + 700\text{ N} = \boxed{4060\text{ N}}$	<u>Bottom</u>	 $\Sigma F = ma_c$ $F_g + F_N = ma_c = (70\text{ kg})(24\text{ m/s}^2)$ $F_N = 1680\text{ N} - 700\text{ N} = \boxed{980\text{ N}}$	<u>Top</u>
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