returning to

$$\Delta V_e = \tfrac{1}{2}k(l_2^2 - l_1^2)$$

we know $l_1 = 0.225\,m$

$$l_2 = l_1 - \text{relaxation} = 0.225 - \frac{275}{200}x$$

$$\therefore \Delta V_e = \tfrac{1}{2}k\left[\left(0.225 - \tfrac{275}{200}x\right)^2 - (0.225)^2\right]$$

WE NOW HAVE ΔV_e & ΔV_G IN TERMS of x

NOW LOOK @ KINETIC ENERGY:

$$\Delta T = \tfrac{1}{2}mv^2 + \tfrac{1}{2}I_G\omega^2 \qquad \text{NOTE } \omega = \left(\frac{v}{r_o}\right)$$

Rel to zero vel.

$$= \tfrac{1}{2}(10)v^2 + \tfrac{1}{2}(10)(0.125)^2\left(\frac{v}{0.2}\right)^2$$

outer radius of wheel

$$\underline{\Delta T = 6.95\,v^2}$$

OVERALL NO WORK (other than grav & elasticity)

$$\Rightarrow \underline{\Delta T + \Delta V_G + \Delta V_e = 0} \quad *$$

$U'_{1\text{-}2} = 0$ in this case!

$$\Delta V_G = mgx\sin\theta = (10)(9.81)(0.1961)x = 19.24x$$

$$\Delta V_e = \tfrac{1}{2}(600)\left[\left(0.225 - \tfrac{275}{200}x\right)^2 - (0.225)^2\right] = 567.2x^2 - 185.6x$$

* then gives

$$6.95v^2 + 19.24x + 567.2x^2 - 185.6x = 0$$

$$\Rightarrow v^2 = 23.93x - 81.57x^2 \qquad v\ max\ @\ v^2\ max$$

$$\frac{dv^2}{dx} = 0 = 23.93 - (2)(81.57)x$$

$$\Rightarrow x = \underline{0.1467}\,m \quad \text{for } v_{max}$$

$$v_{max}^2 = (23.93)(0.1467) - (81.57)(0.1467)^2$$

$$= 1.755$$

$$\boxed{V_{max} = \sqrt{1.755} = 1.325\,m/s}$$