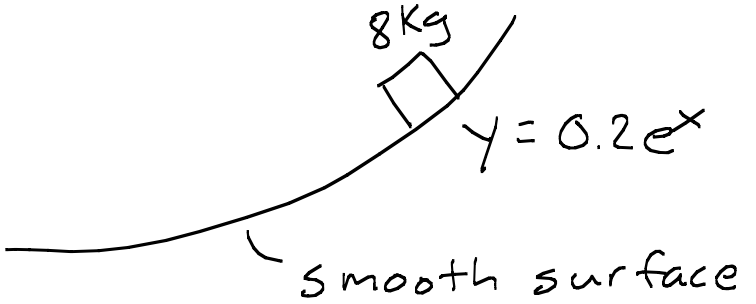
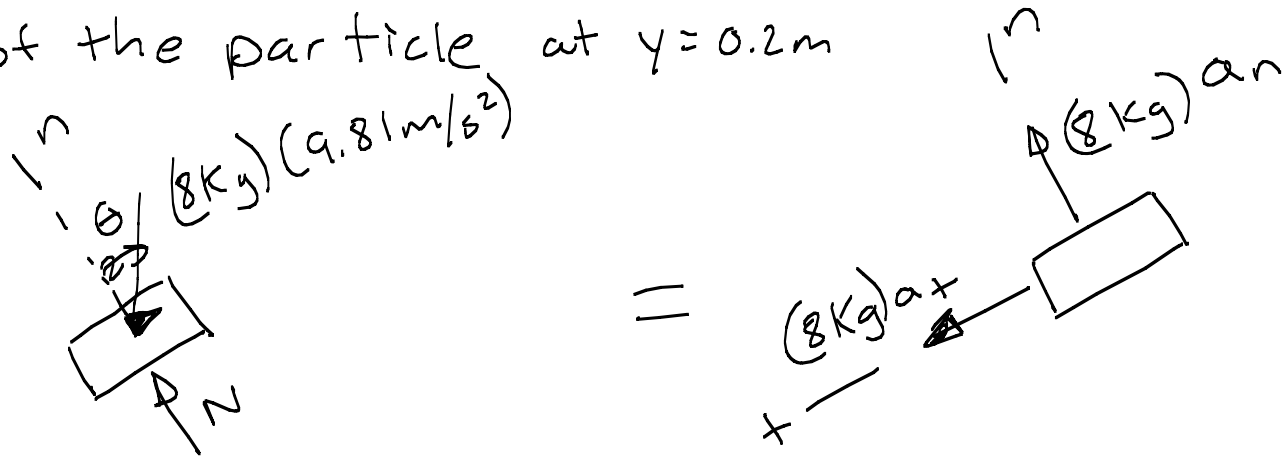
Problem 1

When $y = 0.2\,m$, $v = 1.5\,m/s$



Determine: The normal reaction and the rate of increase in the speed of the particle at $y = 0.2m$



$$\frac{dy}{dx} = 0.2e^x \qquad \frac{d^2y}{dx^2} = 0.2e^x$$

at $y = 0.2\,m$ $\quad y = 0.2e^x$

$0.2 = 0.2e^x \qquad x = 0$

$$\left.\frac{dy}{dx}\right|_{x=0} = 0.2 \quad , \quad \left.\frac{d^2y}{dx^2}\right|_{x=0} = 0.2$$

$$\frac{dy}{dx} = \tan\theta = 0.2 \qquad \theta = 11.31^\circ$$

$$\rho = \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\left|\frac{d^2y}{dx^2}\right|} = \frac{\left[1+(0.2)^2\right]^{3/2}}{0.2} = 5.3\,m$$

$$+\nearrow \Sigma F_n = ma_n = N - (8)(9.81)(\cos 11.31^\circ) = (8)\left(\frac{(1.5\,m/s)^2}{5.3\,m}\right)$$

$$\boxed{N = 80.4 \text{ Newtons}}$$

$$+\searrow \Sigma F_t = ma_t \Rightarrow (8)(9.81)(\sin 11.31^\circ) = 8\,a_t$$

$$\boxed{a_t = 1.92\,m/s^2}$$