Soluzione del problema 3

(a)

Essendo la guida liscia, la reazione vincolare è sempre normale allo spostamento infinitesimo lungo la traiettoria, dunque:

$$W_{BP} = 0 \ J$$

(b)

$$W_{ad} = -\mu \ N \ d = -\mu \ m \ g \ d$$

$$\frac{1}{2} k \, (\Delta x)^2 + W_{ad} = \frac{1}{2} m v_B^2 \quad \Rightarrow \quad v_B = \sqrt{\frac{k}{m} \, (\Delta x)^2 - 2 \, \mu \, g \, d} = 3.3 \ m/s$$

(c)

$$\frac{1}{2} \, m \, v_B^2 = m \, g \, h \quad \Rightarrow \quad h = \frac{v_B^2}{2 \, g} = \frac{k}{2 \, g \, m} \, (\Delta x)^2 - \mu \, d = 0.56 \ m$$

(d)

$$\frac{1}{2} \ m \ v_P^2 = m \ g \ R \ \cos\theta \quad \Rightarrow \quad \frac{v_P^2}{R} = 2 \ g \ \cos\theta$$

$$N_1 - m \ g \ \cos\theta = 2 \ m \ g \ \cos\theta \quad \Rightarrow \quad N_1 = 3 \ m \ g \ \cos\theta = 38.2 \ N$$

Soluzione del problema 4

(a)

$$a_T = \frac{F_T}{m} = \frac{A}{m}\ t$$

(b)

$$v = \frac{A}{m}\int_0^t t dt = \frac{A}{2\ m}\ t^2$$

$$a_N = \frac{v^2}{R} = \frac{A^2}{4\ m^2\ R}\ t^4$$

$$a = \sqrt{a_T^2 + a_N^2} = \frac{A}{m} t \sqrt{1 + \frac{A^2\ t^6}{16\ m^2\ R^2}}$$

(c)

$$x_1 = \frac{A}{2\ m}\int_0^{t_1} t^2\, dt = \frac{A}{6\ m}\ t_1^3 = n_1\ 2\,\pi\, R$$

$$t_1 = \left(\frac{12\, n_1\, \pi\, m\, R}{A}\right)^{1/3} = 1.5\ s$$

(d)

$$x = \frac{A}{6\ m}\ t^3 \qquad v = \frac{A}{2\ m}\ t^2$$

$$T_{max} = \frac{m\ v^2}{R} = \frac{A^2}{4\ R\ m}\ t^4 \quad \Rightarrow \quad t = \left(\frac{4\, m\, R\, T_{max}}{A^2}\right)^{1/4}$$

$$x_{max} = \frac{A}{6\, m}\left(\frac{4\, m\, R\, T_{max}}{A^2}\right)^{3/4} \quad \Rightarrow \quad n_{max} = \frac{x_{max}}{2\,\pi\, R} = \frac{A}{12\,\pi\, m\, R}\left(\frac{4\, m\, R\, T_{max}}{A^2}\right)^{3/4} = 8.67$$