Revision solutions

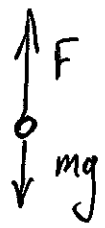
Electronics III
Mechanics

1.(a) $\dim(\ddot{y}) = LT^{-2}$

(b) ms^{-2}

(c) $\ddot{y} = \frac{R_F}{m} = \frac{(F-mg)}{m} = \frac{(1.2\times10^5 - 9.81\times10^4)}{10^4}$

$= \frac{2.19\times10^4}{10^4} = 2.19\,ms^{-2}$



(d) $W = \underline{F}.d\underline{r} = (1.2\times10^5)\times10^3 = 1.2\times10^8\,J = 120\,MJ$

(e) $U = -(-mg\underline{j}).d\underline{r} = 10^4\times9.81\times10^3 = 98.1\,MJ$

(f) $W = W_K + U \Rightarrow W_K = (120-98.1)\times10^6 = 21.9\,MJ$

$W_K = \frac{1}{2}m\dot{y}^2 \Rightarrow \dot{y} = \left(\frac{2\times21.9\times10^6}{9.6\times10^3}\right)^{1/2} = \sqrt{4562.5}$

$\approx 67.5\,ms^{-1}$

2.(a) $\dot{\underline{r}}(t) = 10\omega\sin\omega t\,\underline{i} - 10\omega\cos\omega t\,\underline{j}$

(b) $\dot{\underline{r}}(0) = -10\omega\underline{j} = -20\pi\times10^3\,\underline{j}\ ms^{-1}$

(c) $\dot{\underline{x}}(0) = v\underline{j}$

$\dot{\underline{x}}(0) = \underline{\omega}\times\underline{x}(0) = \omega\underline{k}\times2\underline{i} = 2\omega\underline{j}$

$\Big\}\ v = 2\omega = 4\pi\times10^{-3}\,ms^{-1}$

(d) $\Delta\underline{p} = m_b(\dot{\underline{x}}(0^+) - \dot{\underline{x}}(0^-)) = 10^3\times0.05\,\underline{i} = 50\underline{i}\ kg\,ms^{-1}$

(e) $\Delta\underline{L} = \int_0^d \underline{T}\,dt$ where constant torque $\underline{T}$ is applied for duration d

$\Delta\underline{L} = I(\underline{\omega} - 0)$

$\Rightarrow \underline{T}d = I\underline{\omega} \Rightarrow d = \frac{I\omega}{T} = \frac{8m_b\omega}{3T}$

$= \frac{8\times10^3\times2\pi\times10^{-3}}{3\times10^2} \approx 0.168\,s.$