ANSWERS TO END-OF-CHAPTER PROBLEMS

CHAPTER – 2

Q 2.1) $\vec{v}(t)=\left(\frac{4}{15}t^3\hat{i}-\frac{3}{10}t^2\hat{j}\right)$ m/s ; $\vec{r}(t)=\left(\frac{1}{15}t^4\hat{i}-\frac{1}{10}t^3\hat{j}\right)$ m

Q 2.2) $x = M_2gt^2 \big/ 2(M_1+M_2)$

Q 2.3) *Force of contact* = $1\ N = \frac{Fm_2}{m_1+m_2}$

Q 2.5) $T=\frac{2mMg}{m+M}$; $a=\left(\frac{M-m}{M+m}\right)g$

Q 2.6) $\omega < \sqrt{\frac{g}{R}}$

Q 2.7) (a) $F_{max}=(M_1+M_2)\frac{\mu M_1 g}{M_2}$

(b) $F_{max}=\mu g(M_1+M_2)$

Q 2.9) $R=\frac{v_0^2\tan\theta}{g}$

Q 2.11) $T_1=\frac{1}{2}\left[\sqrt{2}\,mg+ml\omega^2\right]$; $T_2=\frac{1}{2}\left[-\sqrt{2}\,mg+ml\omega^2\right]$

Q 2.12) $t=\sqrt{L/\mu g}$; $L = 6\ in, \mu = 0.5 \rightarrow t = 0.1768\ secs$

Q 2.13) $a_1=\frac{2M_2-M_1}{M_1+4M_2}g$

Q 2.14) $a_A=\frac{2M_C g}{4M_A+M_C+\frac{M_A M_C}{M_B}}$ in + ve x direction

$$a_B = \frac{M_A}{M_B} a_A \text{ in + ve x direction}$$

$$a_C = \left(1 + \frac{M_A}{M_B}\right) a_A \text{ in - ve y direction}$$

Q 2.16) *With respect to ground,*

$$a_x = \frac{(g + A)}{2} \quad ; \quad a_y = \frac{(A - g)}{2}$$

Q 2.17) **(b)** $a_{\min} = \dfrac{g(\sin\theta - \mu\cos\theta)}{\mu\sin\theta + \cos\theta}$

(c) $a_{\min} = \dfrac{g(\sin\theta + \mu\cos\theta)}{\mu\sin\theta - \cos\theta}$

Q 2.18) $a = \dfrac{4F}{M + m} - g$

Q 2.19) $F = \dfrac{M_3(M_1 + M_2 + M_3)}{M_2} g$

Q 2.20) $a_1 = -[M_2M_3/(M_2M_3 + M_1M_3 + 2M_2M_3 + M_3M_3)]g$

Q 2.21) $T = \dfrac{\left[M + \dfrac{m}{l}(l - x)\right]F}{M + m}$

Q 2.22) $T_{end} = \dfrac{W}{2\cos\theta}$, $T_{middle} = \dfrac{W}{2}\tan\theta$

Q 2.26) $T = 2\pi\sqrt{\dfrac{R^3}{GM}}$

Q 2.28) $V_{\min} = \sqrt{gR\left(\dfrac{\sin\theta - \mu\cos\theta}{\cos\theta + \mu\sin\theta}\right)}$

$$V_{\max} = \sqrt{gR\left(\frac{\sin\theta + \mu\cos\theta}{\cos\theta - \mu\sin\theta}\right)}$$

Q 2.29) $a_r = -r\varpi^2$, $a_\theta = 2v_o\varpi$

$t_{skidding} = \dfrac{1}{v_o\varpi^2}\sqrt{\mu^2g^2 - 4v_o^2\varpi^2}$

Q 2.30) $\dfrac{d^2r_A}{dt^2} = \varpi^2 r_A + \dfrac{\varpi^2 M_B l}{M_A - M_B}$

Q 2.33) $\gamma = \varpi,\ A = \frac{1}{2}\left(r_0 - \frac{v_0}{\varpi}\right),\ B = \frac{1}{2}\left(r_0 + \frac{v_0}{\varpi}\right)$

Q 2.34) $\varpi = \frac{\varpi_0 r_0^2}{(r_0 - vt)^2}$

$F_r = -\frac{m\varpi_0^2 r_0^4}{(r_0 - vt)^3}$

Q 2.35) $\theta = \frac{1}{\mu}\ln\frac{l + \mu v_0 t}{l}$

Q 2.37) $y = \frac{4\pi^2}{gT^2}x^2$