ANSWERS TO END-OF-CHAPTER PROBLEMS

CHAPTER – 4

Q 4.2) $\dfrac{\frac{1}{2}mv_0^2}{\left(1+\dfrac{k}{bmg}\right)}$

Q 4.4) $v=\sqrt{\dfrac{2gR}{1+m/M}}$

Q 4.7) $Cos\theta=\dfrac{-4m\pm\sqrt{16m^2-24mM}}{-12m}$

Q 4.9) $\dfrac{\left(m_2\vec{p}_1-m_1\vec{p}_2\right)^2}{2m_1m_2\left(m_1+m_2\right)}=-\Delta E;\quad LHS>0\,and\,RHS<0$

Q 4.10)

a) (1) $T=2\pi\sqrt{\dfrac{M+m}{k}}$, (2) *Amplitude remains same*, (3) *No change in mechanical energy*

b) (2) $T=2\pi\sqrt{\dfrac{M+m}{k}}$, (2) $A=\sqrt{\dfrac{M}{m+M}}A_0$, (3) $\Delta E=-E_0\left(\dfrac{m}{m+M}\right)$

Q 4.11) $\dfrac{3Mgx}{l}$

Q 4.12) **It is SAFE**

Q 4.14) ***a)*** $\dfrac{-2GMm}{\sqrt{x^2+a^2}}$

b) $v=\sqrt{v_0+\dfrac{4GM}{a}\left(1-\dfrac{1}{\sqrt{10}}\right)}$

c) $\sqrt{\dfrac{2GM}{a^3}}$

Q 4.15) $a)\ U(x) = \left(\frac{A}{x} + Bx\right) - \left(\frac{A}{a} + Ba\right)$ reference point is at x = a

$c)\ x_0 = \sqrt{A/B}$

$d)\ \omega = \sqrt{\frac{2A}{m}\left(\frac{B}{A}\right)^{3/2}}$

Q 4.16) **Around 50 hp**

Q 4.18) **Around 6 hp**

Q 4.19) **Around 11 hp**

Q 4.20) $a)\ P = V^2 \frac{dm}{dt}$

$b)\ \frac{dK}{dt} = \frac{1}{2}\frac{dm}{dt}V^2$

Q 4.21) $a)\ F = \lambda g y + \lambda v_0^2$

$b)\ P = \frac{dE}{dt} + \frac{1}{2}\lambda v_0^3$

Q 4.22) $T = \frac{2v_0}{g}\frac{e}{(1-e)}$

Q 4.23) $h' = 9h$

Q 4.24) *16.6%*

Q 4.25) $\mathbf{m = 5\ m_p}$

Q 4.26) $\frac{M}{m} = \frac{1}{3}$

Q 4.27) $\theta = \tan^{-1} 2$