Chapter 21 – Solutions of even suggested problems

(40) (a) T = 382 N

(b) T = 2.02 x 10^3 N

(56) (a) E_x = 1.14 x 10^5 N/C

(b) E = 8.92 x 10^4 N/C

(c) E = 1.46 x 10^5 N/C

(66) F = 6.58 x 10^{-13} N

(78) $q_2 = -q_1$ = -6.17 x 10^{-8} C

(84) (a) force on the left ball positive

(b) $\theta = 2 \arctan(qE/mg)$

(c) $\theta = 180^\circ$

(90) (a)

$$E_x = \frac{Q}{4\pi\epsilon_0 x}\frac{1}{\sqrt{x^2+a^2}}$$

$$E_y = -\frac{Q}{4\pi\epsilon_0 a}\left(\frac{1}{x}-\frac{1}{\sqrt{x^2+a^2}}\right)$$

(b) $F_x = -q E_x$; $F_y = -q E_y$

(c) $$F_x \approx -\frac{qQ}{4\pi\epsilon_0 x^2},\ F_y \approx \frac{qQ}{4\pi\epsilon_0 a}\left(\frac{1}{x}-\frac{1}{x}+\frac{a^2}{2x^3}\right)=\frac{qQa}{8\pi\epsilon_0 x^3}$$

(104) (a) $Q = A\sigma = \pi(R_2^2 - R_1^2)\sigma$

(b) $$\vec{E}(x) = \frac{-\sigma}{2\epsilon_0}\left(1/\sqrt{(R_1/x)^2+1} - 1/\sqrt{(R_2/x)^2+1}\right)\frac{|x|}{x}\hat{i}$$

(c) $$\vec{E}(x) = \frac{\sigma}{2\epsilon_0}\left(\frac{x}{R_1}-\frac{x}{R_2}\right)\frac{|x|^2}{x}\hat{i} = \frac{\sigma}{2\epsilon_0}\left(\frac{1}{R_1}-\frac{1}{R_2}\right)x\hat{i}$$

(d)

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} = \frac{1}{2\pi}\sqrt{\frac{q\sigma}{2\epsilon_0 m}\left(\frac{1}{R_1}-\frac{1}{R_2}\right)}$$