P18:

$$|\vec{F}| = 3.7 \times 10^{-16} \, N = q|\vec{E}| = e|\vec{E}|$$

$$|\vec{E}| = \frac{|\vec{F}|}{e} = \frac{3.7 \times 10^{-16} \, N}{1.6 \times 10^{-19} \, C} = \boxed{2312 \, \frac{N}{C}}$$

P20:

$$\vec{F} = \langle 8 \times 10^{-17}, -3.2 \times 10^{-16}, -4.8 \times 10^{-16} \rangle N$$

$$\vec{E} = \frac{\vec{F}}{q} = \frac{\vec{F}}{e} = \frac{\vec{F}}{-1.6 \times 10^{-19} \, C}$$

$$\boxed{\vec{E} = \langle -500, 2000, 3000 \rangle \, \frac{N}{C}}$$

P22:

a) $\vec{E} = \dfrac{\vec{F}}{q}$; $q > 0 \implies \hat{E} = \hat{F}$

(h)

book typo

b) $\vec{E} = \dfrac{\vec{F}}{q} = \langle 4.5 \times 10^{-5}, -4.5 \times 10^{-5}, 0 \rangle_N$

$\underline{\phantom{\langle 4.5 \times 10^{-5}, -4.5 \times 10^{-5}, 0 \rangle}}$

5×10^{-9} C

$$\boxed{\vec{E} = \langle 9 \times 10^{3}, -9 \times 10^{13}, 0 \rangle \ \dfrac{N}{C}}$$

c) $|\vec{E}| = \sqrt{(9 \times 10^{3})^2 + (9 \times 10^{13})^2}$

$$\boxed{|\vec{E}| = 9 \times 10^{13} \ \dfrac{N}{C}}$$

d) $\boxed{d}$, opposite of h

e) $\vec{F} = q\vec{E}$

$\vec{F} = (-6\times10^{-9}C) \langle 9\times10^3, -9\times10^{13}, 0\rangle \frac{N}{C}$

$\boxed{\vec{F} = \langle -5.4\times10^{-5}, 5.4\times10^5, 0\rangle N}$

f) $\boxed{\text{Position } 1}$

P24:

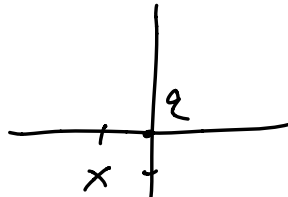$\vec{F_E} = q\vec{E}$

$\vec{F_g} = m\vec{g}$

$\vec{F} = \vec{F_E} + \vec{F_g} = (-4\times10^{-8}C) \langle 2\times10^7, 0, 0\rangle \frac{N}{C}$

$+ \ 0.3 \, kg \langle 0, 5, 0\rangle \frac{N}{kg}$

$\boxed{\vec{F} = \langle -0.8, 1.5, 0\rangle N}$

P29:

$$\vec{r}_{src} = \langle 0,0 \rangle \, m$$

$$\vec{r}_{obs} = \langle -0.1, -0.1 \rangle \, m$$

$$\vec{r} = \vec{r}_{obs} - \vec{r}_{src} = \langle -0.1, -0.1 \rangle \, m$$

$$|\vec{r}| = 0.141 \, m$$

$$\hat{r} = \langle -0.707, -0.707 \rangle$$

$$\vec{E} = \frac{(9 \times 10^9 \, \frac{Nm^2}{c^2})(4 \times 10^{-9} \, C)}{0.141^2 \, m^2} \langle -.707, -.707 \rangle$$

$$\boxed{\vec{E} = \langle -1272.8, -1272.8 \rangle \, \frac{N}{c}}$$

Back of book is wrong!

P33:

$$\vec{r}_{src} = \langle 0.4, 0, 0 \rangle \, m$$

$$\vec{r}_{obs} = \langle 0.2, 0, 0 \rangle \, m$$

$$\vec{r} = \vec{r}_{obs} - \vec{r}_{src} = \langle -0.2, 0, 0 \rangle \, m$$

$$|\vec{r}| = 0.2 \, m, \quad \hat{r} = \langle -1, 0, 0 \rangle$$

$$\vec{E} = \frac{9 \times 10^9 (-1 \times 10^{-9})}{0.2^2} \langle -1, 0, 0 \rangle$$

$$\boxed{\vec{E} = \langle 225, 0, 0 \rangle \, \frac{N}{C}}$$

P36:

$$\vec{r} = \langle 0.12, 0, 0 \rangle \, m$$

$$|\vec{r}| = 0.12 \, m$$

$$\hat{r} = \langle 1, 0, 0 \rangle$$

$$\vec{E} = \frac{Kq}{|\vec{r}|^2} \hat{r} = \langle -1.2 \times 10^3, 0, 0 \rangle \frac{N}{C}$$

$$\frac{(9 \times 10^9) \, q}{0.12^2} = -1.2 \times 10^3$$

$$\boxed{q = -1.92 \times 10^{-9} \, C}$$

P 48:

a) $\vec{E}_{23} = \vec{E}_2 + \vec{E}_3$

$\vec{r}_{obs} = \langle 0, 0.04 \rangle m$

$E_2:$

$\vec{r}_{src} = \langle 0, 0 \rangle$

$\vec{r} = \langle 0, 0.04 \rangle m$

$q = 8 \times 10^{-6} C$

$\vec{E}_2 = \langle 0, 4.5 \times 10^7 \rangle \frac{N}{C}$

$E_3: \vec{r}_{src} = \langle 0.03, 0 \rangle$

$\vec{r} = \langle -0.03, 0.04 \rangle$

$q = -5 \times 10^{-6} C$

$\vec{E}_3 = \langle 1.08, -1.44 \rangle \times 10^7 \frac{N}{C}$

$$\boxed{\vec{E}_{23} = \vec{E}_2 + \vec{E}_3 = \langle 1.08, 3.06 \rangle \times 10^7 \frac{N}{C}}$$

b) $\vec{F_1} = q\vec{E}_{23} = 3\times10^{-6}\,C\,\langle 1.08, 3.06\rangle \times10^{7}\,\frac{N}{C}$

$$\boxed{\vec{F_1} = \langle 32.4, 91.8\rangle\,N}$$

c) $\vec{E}_{123} = \vec{E_1} + \vec{E_2} + \vec{E_3}$

$\vec{r}_{obs} = \langle 0.03, 0.04\rangle\,m$

$\vec{E_1}:$

$\vec{r}_{src} = \langle 0, 0.04\rangle$

$\vec{r} = \langle 0.03, 0\rangle$

$q = 3\times10^{-6}\,C$

$\vec{E_1} = \frac{kq}{|\vec{r}|^2}\hat{r} = \langle 3.0, 0\rangle \times10^{7}\,\frac{N}{C}$

$\vec{E_2}:$

$\vec{r}_{src} = \langle 0, 0\rangle$

$\vec{r} = \langle 0.03, 0.04\rangle\,m$

$q = 8\times10^{-6}\,C$

$\vec{E_2} = \langle 1.73, 2.30\rangle \times10^{7}\,\frac{N}{C}$

$\vec{E}_3$:

$$\vec{r}_{src} = \langle 0.03, 0 \rangle$$

$$\vec{r} = \vec{r}_{obs} - \vec{r}_{src} = \langle 0, 0.04 \rangle \, m$$

$$q = -5 \times 10^{-6} C$$

$$\vec{E}_3 = \langle 0, -2.81 \rangle \times 10^7 \, \frac{N}{C}$$

$$\boxed{\vec{E} = \langle 4.73, -0.51 \rangle \times 10^7 \, \frac{N}{C}}$$

d) $\vec{F}_\alpha = q_\alpha \vec{E}$

$$\vec{a}_\alpha = \vec{F}_\alpha / m_\alpha$$

$$q_\alpha = 2e, \quad m_\alpha = 4\left(1.7 \times 10^{-27}\right) kg$$

$$m_\alpha = 6.8 \times 10^{-27} \, kg$$

$$\vec{F}_\alpha = (2e)\vec{E} = 3.2 \times 10^{-19} \langle 4.73, -0.51 \rangle \times 10^7 \, \frac{N}{C}$$

$$\vec{F}_\alpha = \langle 1.52 \times 10^{-11}, -1.63 \times 10^{-12} \rangle \, N$$

$$\boxed{\vec{a}_\alpha = \langle 2.2 \times 10^{15}, -2.40 \times 10^{14} \rangle \, m/s^2}$$

P55:

$$P = qs = e(6 \times 10^{-10})m$$

$$P = 9.6 \times 10^{-29} Cm$$

$$\vec{E} = \frac{-2kP}{|\vec{r}|^3} \hat{y}$$

$$= \frac{-2(9 \times 10^9)(9.6 \times 10^{-29})}{(4 \times 10^{-8})^3} \hat{y}$$

$$\vec{E} = \langle 0, -2.7 \rangle \times 10^4 \frac{N}{C}$$

$$\vec{F} = q\vec{E} = e\vec{E} = \langle 0, -4.3 \rangle \times 10^{-15} N$$

$\vec{E}$

$4 \times 10^{-8} m$

$-e$

$+e$

$\hat{y}$