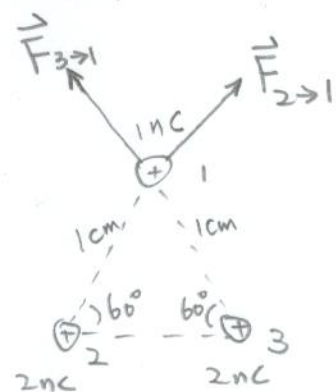


25.38



$$\vec{F}_{2 \rightarrow 1} = \frac{k|q_1||q_2|}{r^2} (\cos 60^\circ \hat{i} + \sin 60^\circ \hat{j})$$

$$= 1.8 \times 10^{-4} \text{ N} (\cos 60^\circ \hat{i} + \sin 60^\circ \hat{j})$$

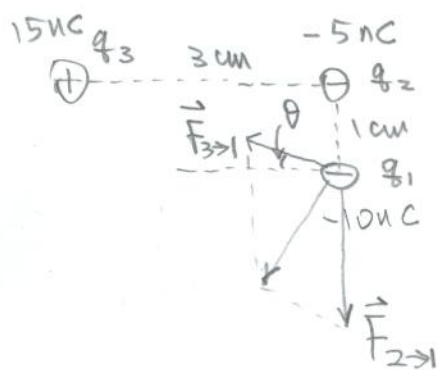
$$\vec{F}_{3 \rightarrow 1} = \frac{k|q_1||q_3|}{r^2} (-\cos 60^\circ \hat{i} + \sin 60^\circ \hat{j})$$

$$= 1.8 \times 10^{-4} \text{ N} (-\cos 60^\circ \hat{i} + \sin 60^\circ \hat{j})$$

$$\vec{F}_{\text{total}} = \vec{F}_{2 \rightarrow 1} + \vec{F}_{3 \rightarrow 1} = 2 \times (1.8 \times 10^{-4} \text{ N} \sin 60^\circ \hat{j})$$

$$= 3.12 \times 10^{-4} \hat{j} \text{ N}$$

25.40



$$\vec{F}_{2 \rightarrow 1} = -\frac{k|q_1||q_2|}{r^2} \hat{j}$$

$$= -4.5 \times 10^{-3} \hat{j} \text{ N}$$

$$\vec{F}_{3 \rightarrow 1} = \frac{k|q_1||q_3|}{r^2} (-\cos \theta \hat{i} + \sin \theta \hat{j})$$

$$= 1.35 \times 10^{-3} \text{ N} (-\cos \theta \hat{i} + \sin \theta \hat{j})$$

$$\theta = \tan^{-1}\left(\frac{1 \text{ cm}}{3 \text{ cm}}\right) = 18.435^\circ \rightarrow \cos \theta = 0.9487$$

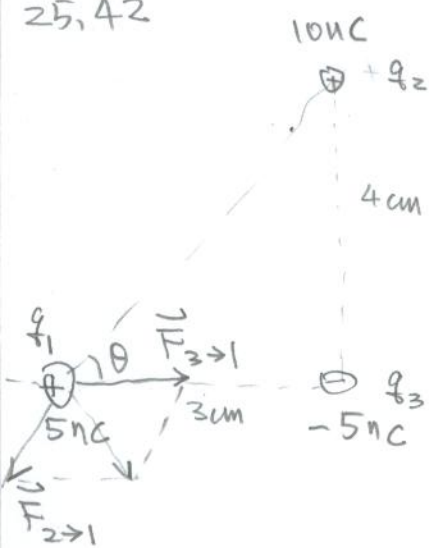
$$\sin \theta = 0.3163$$

$$\vec{F}_{3 \rightarrow 1} = (-1.28 \times 10^{-3} \hat{i} + 0.43 \times 10^{-3} \hat{j}) \text{ N}$$

$$\vec{F}_{\text{on } 1} = \vec{F}_{2 \rightarrow 1} + \vec{F}_{3 \rightarrow 1} = (-1.28 \times 10^{-3} \hat{i} - 4.07 \times 10^{-3} \hat{j}) \text{ N}$$

$$|\vec{F}_{\text{on } 1}| = 4.27 \times 10^{-3} \text{ N}$$

25.42



$$\vec{F}_{2 \rightarrow 1} = \frac{k|q_1||q_2|}{r^2} (-\cos\theta \hat{i} - \sin\theta \hat{j})$$

$$= (1.8 \times 10^{-4} \text{ N}) (-\cos\theta \hat{i} - \sin\theta \hat{j})$$

$$\tan\theta = \frac{4.0 \text{ cm}}{3.0 \text{ cm}} \rightarrow \theta = 53.15^\circ$$

$$\vec{F}_{2 \rightarrow 1} = (1.8 \times 10^{-4} \text{ N}) (-0.6 \hat{i} - 0.8 \hat{j})$$

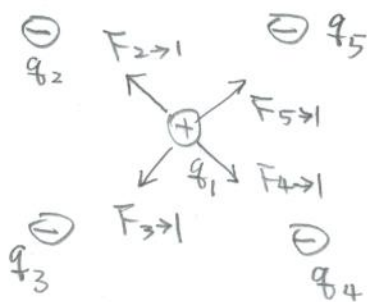
$$\vec{F}_{3 \rightarrow 1} = \frac{k|q_1||q_3|}{r^2} \hat{i}$$

$$= 2.5 \times 10^{-4} \hat{i} \text{ N}$$

$$\Rightarrow \vec{F}_{\text{on } 1} = \vec{F}_{2 \rightarrow 1} + \vec{F}_{3 \rightarrow 1} = (1.42 \times 10^{-4} \hat{i} - 1.44 \times 10^{-4} \hat{j}) \text{ N}$$

$$|\vec{F}_{\text{on } 1}| = 2.02 \times 10^{-4} \text{ N}$$

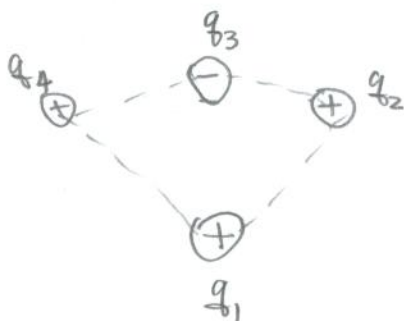
25.44



$$\vec{F}_{2 \rightarrow 1} = -\vec{F}_{4 \rightarrow 1} \quad \vec{F}_{5 \rightarrow 1} = -\vec{F}_{3 \rightarrow 1}$$

$$\text{so } F_x = 0, F_y = 0$$

25.46



$$\vec{F}_{2 \rightarrow 1} = \frac{k|q_1||q_2|}{r^2} (-\cos 45^\circ \hat{i} - \sin 45^\circ \hat{j})$$

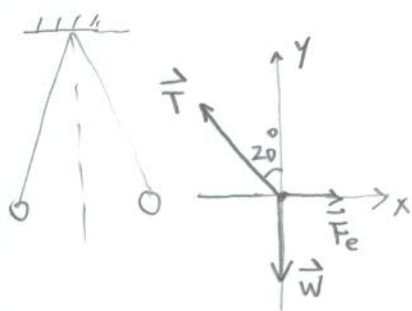
$$= (0.72 \times 10^{-5} \text{ N}) (-\cos 45^\circ \hat{i} - \sin 45^\circ \hat{j})$$

$$\vec{F}_{3 \rightarrow 1} = \frac{k|q_1||q_3|}{r^2} \hat{j} = 2.16 \times 10^{-5} \hat{j} \text{ N}$$

$$\vec{F}_{4 \rightarrow 1} = \frac{k|q_1||q_4|}{r^2} (\cos 45^\circ \hat{i} - \sin 45^\circ \hat{j})$$

$$= (0.72 \times 10^{-5} \text{ N}) (\cos 45^\circ \hat{i} - \sin 45^\circ \hat{j})$$

$$\Rightarrow \vec{F}_{\text{on } 1} = \vec{F}_{2 \rightarrow 1} + \vec{F}_{3 \rightarrow 1} + \vec{F}_{4 \rightarrow 1} = 1.14 \times 10^{-5} \hat{j} \text{ N}$$



$$\vec{F}_{\text{net}} = \vec{T} + \vec{W} + \vec{F}_e = 0$$

$$(F_{\text{net}})_x = T_x + W_x + F_{ex} = 0$$

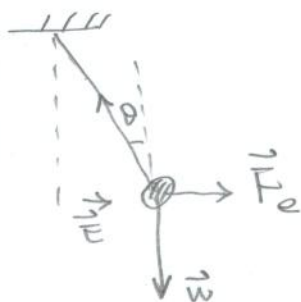
$$\rightarrow -T \sin \theta + \frac{kq^2}{d^2} = 0 \Rightarrow T \sin \theta = \frac{kq^2}{(2L \sin \theta)^2}$$

$$(F_{\text{net}})_y = T_y + W_y + F_{ey} = 0$$

$$\rightarrow T \cos \theta - mg = 0 \Rightarrow T \cos \theta = mg$$

$$\Rightarrow q = \sqrt{\frac{4 \sin^2 \theta + \tan^2 \theta L^2 mg}{k}} = 746 \text{ nC}$$

25.68



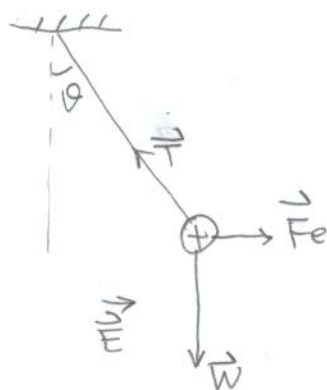
$$\vec{F}_{\text{net}} = \vec{T} + \vec{W} + \vec{F}_e = 0$$

$$F_{\text{net}x} = T_x + W_x + F_{ex} = T_x + qE = 0 \rightarrow T \sin \theta = qE$$

$$F_{\text{net}y} = T_y - mg \rightarrow T \cos \theta = mg$$

$$\Rightarrow \tan \theta = \frac{qE}{mg} \rightarrow q = \frac{mg \tan \theta}{E} = 178 \text{ nC}$$

25.69



$$\vec{F}_{\text{net}} = \vec{T} + \vec{W} + \vec{F}_e = 0$$

$$F_{\text{net}x} = T_x + 0 + qE = 0 \rightarrow T \sin \theta = qE$$

$$F_{\text{net}y} = T_y + mg + 0 = 0 \rightarrow T \cos \theta = mg$$

$$\Rightarrow \tan \theta = \frac{qE}{mg} = 0.255 \Rightarrow \theta = 14.3^\circ$$