•3 SSM What must be the distance between point charge $q_1 = 26.0\ \mu C$ and point charge $q_2 = -47.0\ \mu C$ for the electrostatic force between them to have a magnitude of 5.70 N?


$$F = \frac{k|q_1||q_2|}{r^2}$$

$$\sqrt{r^2} = \sqrt{\frac{k|q_1||q_2|}{F}} \qquad r = \sqrt{\frac{k|q_1||q_2|}{F}}$$

$$r = \sqrt{\frac{8.99\times10^{9}\times 26\times10^{-6}\times 47\times10^{-6}}{5.7}}$$

$$r = 1.39\ m$$

•5 A particle of charge $+3.00 \times 10^{-6}$ C is 12.0 cm distant from a second particle of charge $-1.50 \times 10^{-6}$ C. Calculate the magnitude of the electrostatic force between the particles.

$r = 12\,cm = 0.12\,m$

$$F = \frac{k|q_1||q_2|}{r^2} = \frac{8.99\times10^{9}\times 3\times10^{-6}\times 1.5\times10^{-6}}{(0.12)^2}$$

$$= 2.81\ N$$

•24 Two tiny, spherical water drops, with identical charges of $-1.00 \times 10^{-16}$ C, have a center-to-center separation of 1.00 cm. (a) What is the magnitude of the electrostatic force acting between them? (b) How many excess electrons are on each drop, giving it its charge imbalance?

$r = 1\,cm = 0.01\,m$

a) $$F = \frac{k|q_1||q_2|}{r^2} = \frac{8.99\times10^{9}\times 1\times10^{-16}\times 1\times10^{-16}}{(0.01)^2}$$

$$= 8.99\times10^{-19}\ N$$

b) $q = n e$

$$n = \frac{q}{e} = \frac{1 \times 10^{-16}}{1.6 \times 10^{-19}} = 625$$

**46** In Fig. 21-39, four particles are fixed along an $x$ axis, separated by distances $d = 2.00$ cm. The charges are $q_1 = +2e$, $q_2 = -e$, $q_3 = +e$, and $q_4 = +4e$, with $e = 1.60 \times 10^{-19}$ C. In unit-vector notation, what is the net electrostatic force on (a) particle 1 and (b) particle 2 due to the other particles?

$d = 2 cm$
$= 0.02 m$

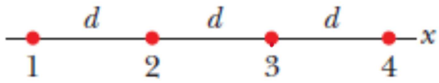



**Fig. 21-39** Problem 46.

a) 1 القوه الكامله المؤثره ع

$$F_{12} = \frac{k q_1 q_2}{d^2} = \frac{8.99\times10^{9} \times 2\times1.6\times10^{-19} \times 1.6\times10^{-9}}{(0.02)^2}$$

$$= 1.15\times10^{-24}\,N$$

$$F_{13} = \frac{k q_1 q_3}{(2d)^2} = \frac{8.99\times10^{9} \times 2\times10^{-19} \times 1.6\times10^{-19}}{(2\times 0.02)^2}$$

$$= 2.88\times10^{-25}\,N$$

$$F_{14} = \frac{k q_1 q_4}{(3d)^2} = \frac{8.99\times10^{9} \times 2\times1.6\times10^{-19} \times 4\times1.6\times10^{-19}}{(3\times0.02)^2}$$

$$= 5.11\times10^{-25}\,N$$

$F_{13} = -2.88\times10^{-25}\,\hat{i}$ $\quad F_{13}$

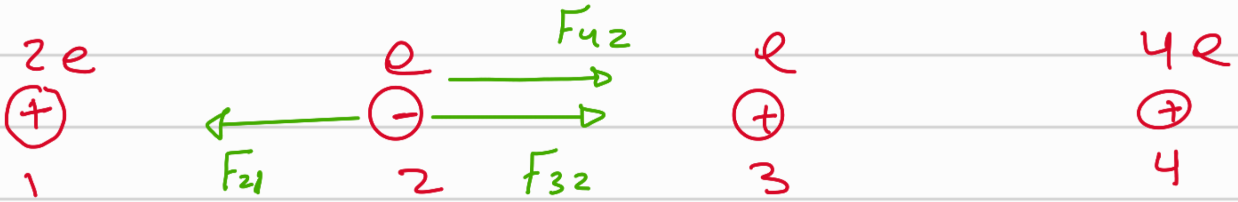
$F_{14} = -5.11\times10^{-25}\,\hat{i}$ $\quad F_{14}$

$F_{12} = 1.15\times10^{-24}$

$$F = F_{12} + F_{13} + F_{14}$$

$$= (1.15\times10^{-24} - 2.88\times10^{-25} - 5.11\times10^{-25})\,\hat{i}$$

$$F = 35\times10^{25}\,\hat{i}\ N$$




$$F_{21} = 1.15 \times 10^{-24} \, N$$

$$F_{32} = \frac{k\, q_2 q_3}{d^2} = \frac{8.99 \times 10^{9} \times 1.6 \times 10^{-19} \times 1.6 \times 10^{-19}}{(0.02)^2}$$

$$= 5.75 \times 10^{-25} \, N$$

$$F_{42} = \frac{k\, q_2 q_4}{(2d)^2} = \frac{8.99 \times 10^{9} \times 1.6 \times 10^{-19} \times 4 \times 1.6 \times 10^{-19}}{(2 \times 0.02)^2}$$

$$= 5.75 \times 10^{-25} \, N$$

$$F = F_{21} + F_{32} + F_{42}$$

$$= -1.15 \times 10^{-24} + 5.75 \times 10^{-25} + 5.75 \times 10^{-25}$$

$$= \text{zero}$$