Physics 4B
Fall 2017

$\boxed{\text{ave.} = 6.8 \quad \sigma = 2.4}$

Name: Answer Key

Lab (circle one): 8:00 am 11:15 am 2:45 pm

Quiz #1: Electric Charge

Problem 1 (2 points)
A wire contains a steady current of 2.0 A. The number of electrons that pass a given point in 2.0 s is:

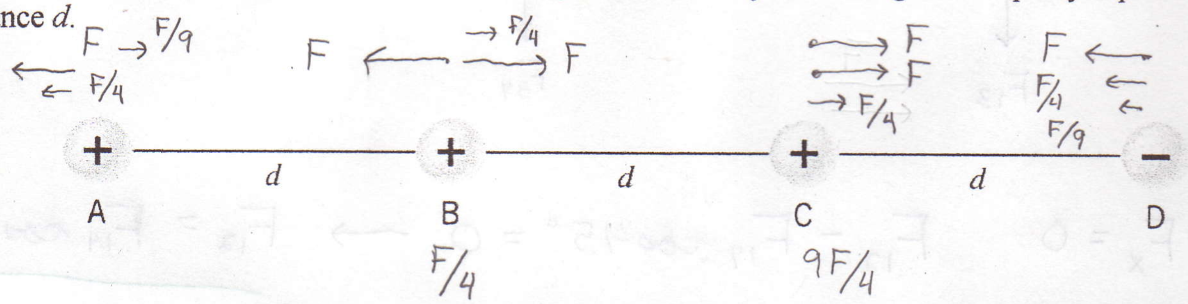
a) 4
b) 1.3×10^{19}
c) 2.5×10^{19}
d) 6.3×10^{18}
e) none of the above

$\boxed{C}$

$$i = dq/dt \longrightarrow q = it = (2.0A)(2.0s) = 4.0C$$

$$q = ne \longrightarrow n = q/e = \frac{4.0C}{1.602\times10^{-19}C} = 2.5\times10^{19}$$

Problem 2 (3 points)
Four point charges have equal magnitudes. Three are positive and one is negative, as shown in the figure below. They are fixed in place on the same straight line, and adjacent charges are equally separated by a distance *d*.



On which of the four charges is the net electrostatic force the weakest? On which of the four charges is the net electrostatic force the strongest?

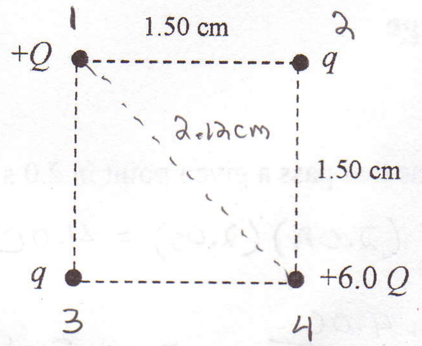
weakest $\longrightarrow \boxed{B}$

strongest $\longrightarrow \boxed{C}$

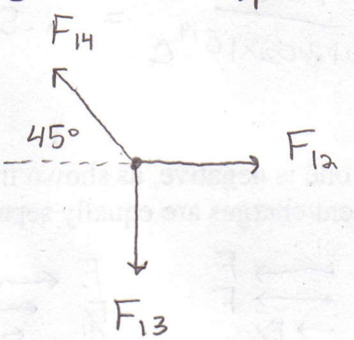
How many times stronger is the strongest force compared to the weakest force?
(i.e. What is $F_{strongest}/F_{weakest}$?)

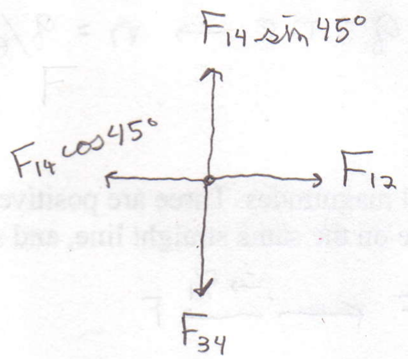
$$\frac{F_{strong}}{F_{weak}} = \frac{9F/4}{F/4} = \boxed{9}$$

Problem 3 (5 points)
Four charged particles are fixed at the corners of a square with sides of length 1.50 cm as shown in the figure below. Assuming $Q = 7.50$ nC, what is the value of q (including sign) if the net electrostatic force on the $+Q$ charge in the upper left corner of the square is zero?



$\Rightarrow$ q must have the opposite charge of Q in order for the net force on +Q to be zero





$$\sum F_x = 0 \qquad F_{12} - F_{14}\cos 45^\circ = 0 \longrightarrow F_{12} = F_{14}\cos 45^\circ$$

$$\frac{K|Q||q|}{r_{12}^2} = \frac{K|Q||6Q|}{r_{14}^2}\cos 45^\circ \longrightarrow \frac{q}{r_{12}^2} = \frac{6Q}{r_{14}^2}\cos 45^\circ$$

$$q = 6Q\left(\frac{r_{12}^2}{r_{14}^2}\right)\cos 45^\circ = 6(7.50\times10^{-9}\,C)\left[\frac{1.50\times10^{-2}\,m}{2.12\times10^{-2}\,m}\right]^2\cos 45^\circ$$

$$= 1.59\times10^{-8}\,C \longrightarrow \boxed{q = -1.59\times10^{-8}\,C}$$

note: you get the same answer from looking at $\sum F_y = 0$