Physics 4B
Fall 2022

ave. = 7.2
σ = 1.9

Name: Answer Key

Lab (circle one): 8:00 am 11:15 am 2:30 pm

Quiz #1: Electric Charge

Problem 1 (1 point)
A positively charged insulating rod is brought close to an object that is suspended by a string. If the object is attracted toward the rod, we can conclude:

E

a) the object is positively charged
b) the object is negatively charged
c) the object is an insulator
d) the object is a conductor
(e) none of the above

The object could be negative or it could be neutral and polarized so that one side is negative and one side is positive. The object could be a conductor or an insulator.

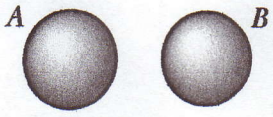
Problem 2 (1 points)
A positively charged insulating rod is brought close to an object that is suspended by a string. If the object is repelled away from the rod, we can conclude:

A

(a) the object is positively charged
b) the object is negatively charged
c) the object is an insulator
d) the object is a conductor
e) none of the above

If the object is repelled, it must have the same sign. A neutral object can not be repelled by a charged object.

Problem 3 (3 points)
The initial charges on two identical metal spheres are $q_A = +3.00\ \mu C$ and $q_B = -1.00\ \mu C$. How many electrons must be transferred from sphere B to sphere A so that they both have the same charge?



sphere B must transfer $-2.00\ \mu C$ of charge so both objects have a charge of $1.00\ \mu C$

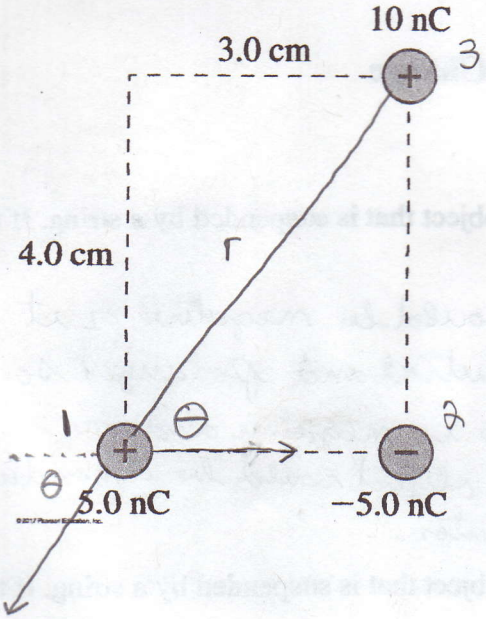
$q_0 = ne \quad n = \pm 1, \pm 2, \pm 3, \ldots \quad n = q/e$

Total charge is $+2.00\ \mu C$ so each must have charge of $1.00\ \mu C$

$$n = \frac{-2.00 \times 10^{-6}\ C}{-1.602 \times 10^{-19}\ C} = -1.25 \times 10^{13}$$

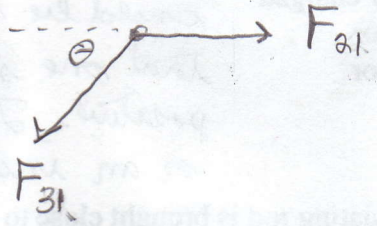
1.25×10^{13} electrons must be transfered

Problem 4 (5 points)
What is the magnitude and direction of the net electric force on the 5.0 nC charge shown in the figure below?



$r = \sqrt{(3.0\,cm)^2 + (4.0\,cm)^2} = 5.0\,cm$

$\theta = \tan^{-1}\left(\frac{4.00\,cm}{3.00\,cm}\right) = 53.1^\circ$



$$F_{21} = \frac{K|q_1||q_2|}{r^2} = \frac{(8.99\times10^9\,N\,m^2/C^2)(5.0\times10^{-9}\,C)(5.0\times10^{-9}\,C)}{(0.03\,m)^2}$$

$$= 2.50\times10^{-4}\,N$$

$$F_{31} = \frac{K|q_1||q_3|}{r^2} = \frac{(8.99\times10^9\,N\,m^2/C^2)(5.0\times10^{-9}\,C)(10\times10^{-9}\,C)}{(0.05\,m)^2}$$

$$= 1.80\times10^{-4}\,N$$

$$\Sigma F_x = F_{21} - F_{31}\cos 53.1^\circ = (2.50\times10^{-4}\,N) - (1.80\times10^{-4}\,N)\cos 53.1^\circ$$

$$= 1.42\times10^{-4}\,N$$

$$\Sigma F_y = -F_{31}\sin 53.1^\circ = -(1.80\times10^{-4}\,N)\sin 53.1^\circ = -1.44\times10^{-4}\,N$$

$$|\vec{F}| = \sqrt{F_x^2 + F_y^2} = \boxed{2.0\times10^{-4}\,N}$$

$$\theta = \tan^{-1}(F_y/F_x) = \boxed{-45.4^\circ}$$