PHY 102 Quiz #1 Name _____

Score _____

Instructions:
1. Do all of your work on this sheet.
2. **Show all of your steps** in problems for full credit.
3. **Be clear and neat** in your work. Any illegible work, or scribbling in the margins, will not be graded.
4. Place your **answers in a box.**
5. If you need more space, you may use the back of the page and write **On back** in the problem space.

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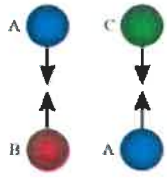
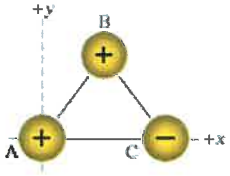
1. **Multiple Guess (3 pts)** Find the answer which best fits the question and write it in the space provided.

a) An electron, free to move when placed in an electric field, moves
a) along the field line, opposite to the field. b) along the field line, in the field direction. c) perpendicular to the field line. d) unaffected by the field. a

b) When a glass rod is rubbed with a piece of silk,
a) electrons move onto the rod; b) protons move onto the rod; c) electrons move onto the silk; c) protons move onto the silk.
c

c) Charge A (blue) is attracted to B (red) and A is attracted to charge C (green). What is true about B and C?
a) They attract each other. b) They repel each other. c) They neither attract nor repel each other. d) This question cannot be answered. b

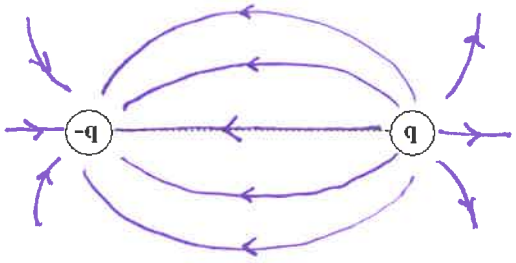




2. **Definition/Principle (3 pts)**

a) Three equal magnitude point charges (above right) are fixed to the corners of an equilateral triangle. At which corner is the net force acting on the charge directed parallel to the x axis, A, B, or C? B

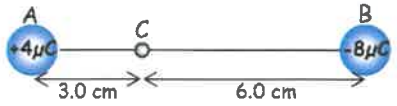
b) Sketch the electric field lines all around the charges.



Constants:

$\varepsilon_0 = 8.85\times10^{-12}$ C²/N-m² $\quad m_e = 9.11\times10^{-31}$ kg

3. **Problems (14 pts)**



a) What is the **magnitude and direction** of the force on the left charge due to the right charge? Direction to right

$F = K\frac{q_1 q_2}{r^2} = 9\times10^9\frac{(4\times10^{-6})(8\times10^{-6})}{(9\times10^{-2})^2} = 36$ N

b) What is the **magnitude and direction** of the electric field at point C due to both charges? Direction _____

$E_1 = K\frac{q_1}{r_1^2} = 9\times10^9\frac{4\times10^{-6}}{(3\times10^{-2})^2} = 4.0\times10^7$ N/C

$E_2 = K\frac{q_2}{r_2^2} = 9\times10^9\frac{(-8\times10^{-6})}{(6\times10^{-2})^2} = -2.0\times10^7$ N/C

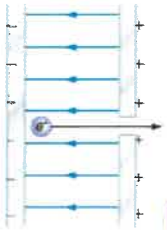
$E = E_1 + E_2 = 6.0\times10^7$ N/C

c) Two metal spheres, one with charge 3.0 μC and the other with charge −6.0 μC are brought together until the excess charge is distributed between them. How many electrons are on each sphere after they are separated?

3μC, -6μC → -1.5, -1.5 After, each has -1.5μC

$\#e = \frac{-1.5\times10^{-6}\,C}{1.6\times10^{-19}\,C/e^-} = 9.4\times10^{12}\ e^-$'s

d) Two large metal parallel plates are separated by 0.40 cm. the electric field between the plates is 4.0×10^4 N/C. Find the speed that an electron would attain if it were released from rest at the negative plate.



$v^2 = v_0^2 + 2ax$, $a = \frac{F}{m} = \frac{qE}{m}$

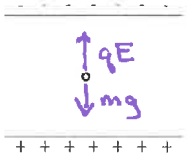
$v^2 = \frac{2eEx}{m}$

$= \frac{2(1.6\times10^{-19})(4\times10^4)(4\times10^{-3})}{9.11\times10^{-31}}$

$= 5.62\times10^{13}$ m²/s²

$v = 7.5\times10^6$ m/s

Bonus: A 0.25 g charged ball is suspended in equilibrium in an electric field between two horizontal, parallel plates. If the magnitude of the electric field is 1500 N/C, and the upper plate is negative, what are the sign and magnitude of the charge?



$qE = mg$

$q = \frac{mg}{E} = \frac{(2.5\times10^{-4})(9.8)}{1500}$

sign = positive magnitude = 1.6×10^{-6} C