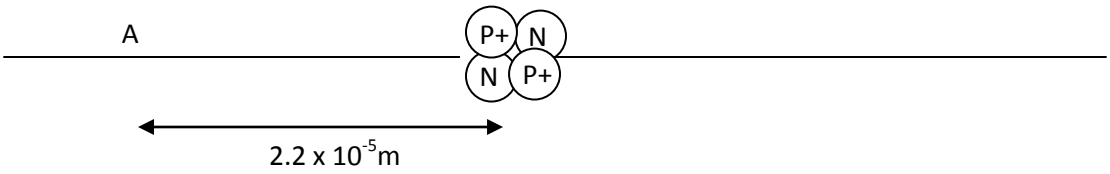
1. A helium nucleus, which contains two protons and two neutrons, is stripped off its orbiting electrons and is suspended in space as shown below.



a. Determine the strength and direction of the electric field generated by the helium nucleus at point A. (indicate direction with "Left" or "Right") [1cp] **6.0 N/C to the left**

b. What force (magnitude and direction) would act on a +2.0 coulomb charge placed at point A? [1 cp] **12 N to the left**

c. A proton has a mass of 1.67×10^{-27} kg, determine the initial acceleration of a proton placed at point A [2cp] **5.7×10^{8} m/s^2 to the left**

d. If the helium nucleus were replaced by an oxygen nucleus (#8 on the periodic table) what would be the strength of the field at point A? [2 cp] **24 N/C to the left**

2. A charge generates an electric field of +2.0 N/C at some distance, r, away.

   a. Is this a positive or negative charge? [1 cp] **a positive charge**

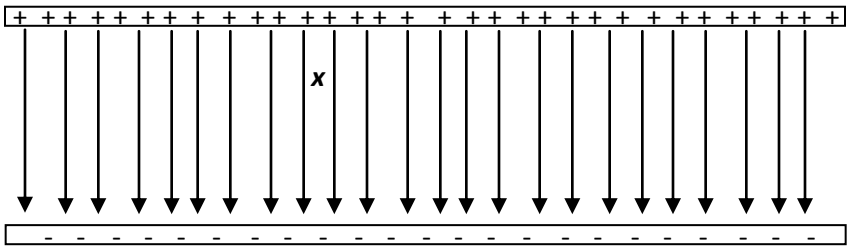
   b. Determine the new field if: [2 cp each]

      i. the charge was quadrupled and the radius was doubled **+2.0 N/C**

      ii. the charge was doubled, and the radius was cut in half **+16 N/C**

      iii. the charge changed sign and the radius was doubled **-0.50 N/C**

3. Consider the vertical, uniform electric field drawn below. The field is positioned on the surface of the Earth and the strength of the field is -5.57 x 10^{-11} N/C.



a. An apple is placed at point x and experiences a force of 1.0 N down. What must be the charge on the apple? [2 cp]

+1.8 x 10^{10} C

b. An electron is placed at point x and is suspended perfectly in place. What must be the mass of the electron? [4 cp]

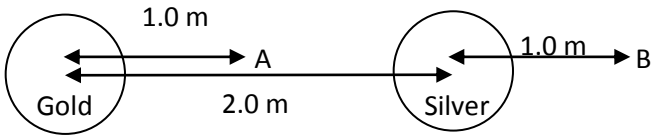
8.91 x 10^{-31} kg

4. A gold bar is given a charge of -4.0 mC. It touches a silver bar and ***half*** of the excess charge is transferred from the gold to the silver.

   a. How many electrons pass from the gold bar to the silver bar? [1 cp]

      1.3 x 10^{16} e- are transferred

   b. The gold and silver bars are arranged as shown in the diagram below.



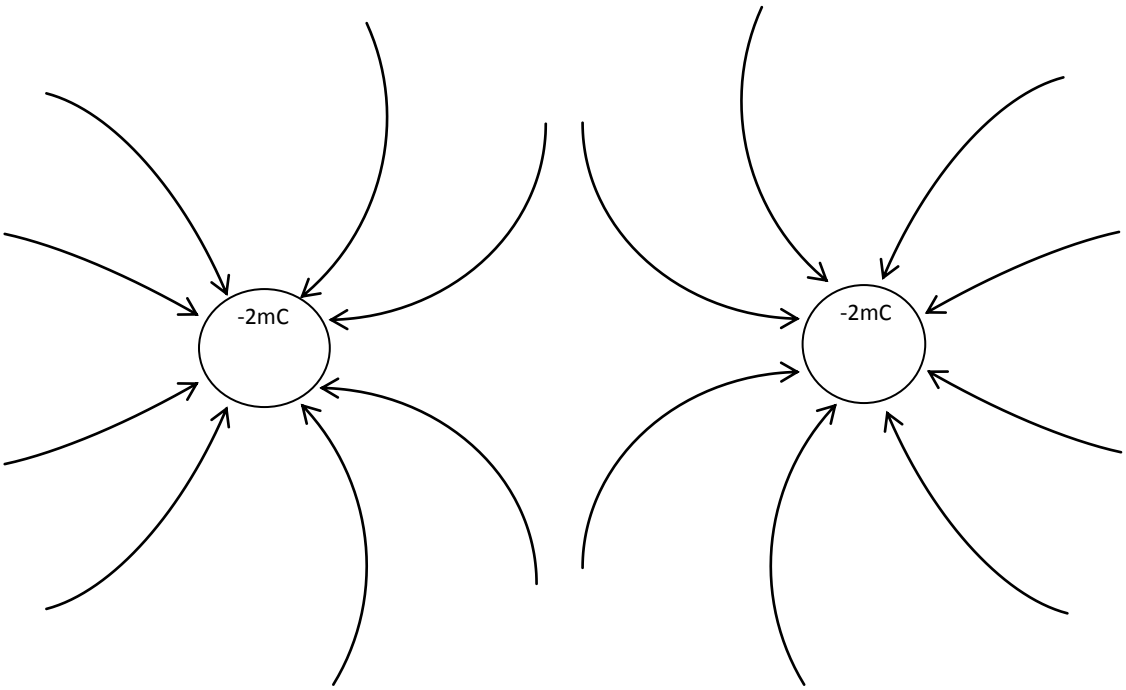
      i. Add the correct charges to the diagram above and draw the proper field lines [2 cp]

         See below

      j. Determine the field strength and direction at the points A and B. [2 cp each]

         A: 0 N/C

         B: 2.0 x 10^{7} N/C to the left



5. Draw the field lines for the following cases: [2 cp each]

a. 

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b. 

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c. 

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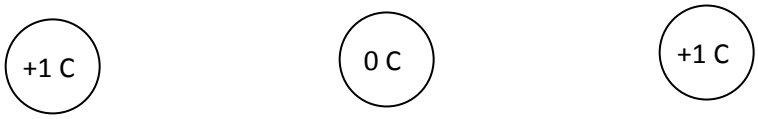
d. 

6. Determine the error(s) in each of the following diagrams. (2 cp each. Must find all errors to earn points)

a.

i. **Too few lines to show what's happening in the field**
ii. **Bad symmetry**
iii. **Wrong arrow direction**

b.

i. **Lines cross**
ii. **+4 should have 4x the # of lines**
iii. **The asymptote should be much closer to the +1**
iv. **Lines should bend AWAY from opposing charges**

c.

i. **Not enough lines to show what's happening in the field**
ii. **Not the same # of lines for each unit of charge**

d.

i. **Wrong arrow direction**
ii. **+1 is weaker, not stronger than +2**
    1. **Asymptote is on the wrong side**
    2. **The lines coming from the +2 should bend LESS than those from the +1**