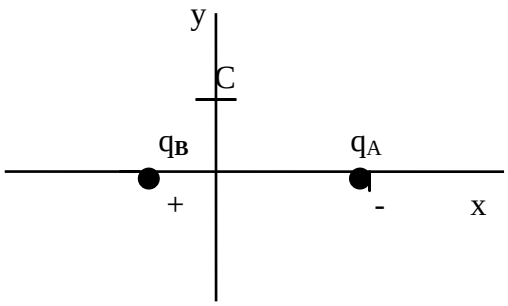
RH = /22 CH1 = /50

PHYS 251 TEST #1 9/7/18 Dr. Holmes NAME **Key**

DO ALL EIGHT PROBLEMS. EACH PROBLEM IS WORTH 12 POINTS EXCEPT #8 WHICH IS WORTH 16 POINTS. SHOW YOUR WORK FOR PARTIAL CREDIT.

For problems 1 through 4, consider the following situation: point C located at (0 m, +5 m);

q_A = -6 μC located at (+6 m, 0 m); q_B = +2 μC located at (-2 m, 0 m).



1) a) What is the magnitude and direction of the **electric force** on q_B due to the presence of q_A ?

magnitude: direction:

[4] **1.69×10^{-3} Nt**, [4] **0^o (+x or right)**.

b) Is the magnitude of the force on q_A due to the presence of q_B [smaller than, the same as, or larger than] the magnitude of the force on q_B due to the presence of q_A ?

[2] **same**.

c) Is the direction of the force on q_A due to the presence of q_B [the same as, opposite to, or other than] the direction of the force on q_B due to the presence of q_A ?

[2] **opposite**.

2) a) What is the magnitude and direction of the **electric field** at point C due to q_A ONLY ?

magnitude: direction:

[3] **885 Nt/C**, [3] **-39.8^o**.

b) What is the magnitude and direction of the **electric field** at point C due to q_B ONLY?

magnitude: direction:

[3] **621 Nt/C**, [3] **68.2^o** .

3) What is the magnitude and direction of the total **electric field** at point C due to BOTH q_A and q_B? magnitude: direction:

[6] **910.6 Nt/C**, [6] **0.6^o**.

4) a) If an electron were placed at point C, what would the magnitude and direction of the **electric force** on the electron be? magnitude: direction:

[4] __**1.46 x 10^{-16} Nt**___, [4] __**180.6^{o}**_____ .

b) What would be the magnitude and direction of the **acceleration** of the electron due to this electric force (that is, assume this is the only force on the electron)?

magnitude: direction:

[2] ___**1.60 x 10^{14} m/s^{2}**___, [2] __**180.6^{o}**_____ .

5) Consider a straight wire of length 48 cm with a uniform charge density of +9 μC/m.

a) What is the magnitude and direction of the electric field 3 cm above the middle of the wire?

magnitude: **≈ 5.36 x 10^{6} Nt/C** direction:

[3] __**= 4.40 x 10^{6} Nt/C**___, [3] __**90^{o} (+y or up)**_____.

b) Did you assume that you had a long wire, or did you use the more exact formula to calculate your answer?

[1] _____.

c) How far off is the long wire result from the more exact result: [<1%, 1-10%, 10-50%, >50%] ?

[3] ___**<1% (0.8%)**_____.

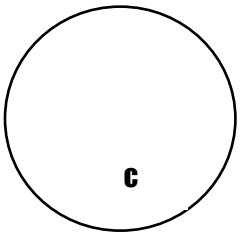
d) If you move twice as close to the wire (move from the 3 cm above the middle of the wire to 1.5 cm above the middle of the wire), does the electric field [get approximately 4 x as big, get exactly 4 x as big, get approximately 2 x as big, get exactly 2 x as big, stay approximately the same, or stay exactly the same] ?

[2] ___**≈ 2x**_____ .

6) A charge of +3 μCoul is placed on the surface of a sphere of radius 14 cm.

a) What is the electric field at a point located 17 cm above the center of the sphere (point a, which is outside the sphere)?

magnitude: [2] **9.34 x 10^5 Nt/C** direction: [2] **90^o (+y or up)**.



b) What is the electric field at a point located 8 cm to the left of the left surface of the sphere (point b, which is outside the sphere and which is 25 cm to the left of the center of the sphere)?

magnitude: [2] **4.32 x 10^5 Nt/C** direction: [2] **180^o (-x or left)** .

c) What is the electric field at a point located 7 cm below the center of the sphere (point c, which is inside the sphere) magnitude: [2] **0 Nt/C** direction: [2] **none**.

7) Consider a **long** coaxial cable: at the center of this cable is a wire of radius 2 mm, and around this wire is insulation and then another conductor (cylinder) at a radius of 14 mm. The wire has a charge density of +200 nC/m and the cylindrical conductor has a charge density of -200 nC/m.

a) What will the magnitude and direction of the electric field be 7 mm above the axis (between the cylinder and the wire) ? magnitude: [3] **5.14 x 10^5 Nt/C** , direction: [2] **90^o (+y or up)** .

b) Will the electric field get [stronger, weaker, or stay the same in magnitude] as you approach the wire (go from 7 mm above the wire which is 7 mm below the cylinder to less than 7 mm above the wire which is more than 7 mm below the cylinder)?

[2] **stronger**. c) What is the magnitude and direction of the electric field at a distance of 18 mm above the axis (4 mm above the surface of the cylinder)? magnitude [3] **0 Nt/C**, direction: [2] **none**.

8) Two parallel plates are separated by 20 mm and are each 60 cm by 60 cm in size. An electron is to be released from the bottom plate so as to accelerate up to the top plate. When it reaches the top plate a final speed of 2×10^6 m/s is desired. *{In the following, if you cannot get an answer to any part, guess an answer for that part, and then use your guess as the basis for the next part. You will be graded on your consistency for each part.}*

a) What acceleration does the electron have to have in order to go from zero to 2×10^6 m/s in a distance of 20×10^{-3} m assuming the acceleration is constant?

[2] __**1.0×10^{14} m/s^2**_____.

b) What force must be on the electron in order to cause this acceleration?

magnitude: direction:

[2] __**9.10×10^{-17} Nt**____ [2] __**90^o (+y or up)**_____.

c) What electric field must be between the plates in order for the electron to have this electric force on it? magnitude: direction:

[3] __**569 Nt/C**_____ [2] __**270^o (-y or down)**___.

d) If the two plates have equal (but opposite sign) charge density, what is the magnitude of that charge density for each plate to provide ½ the electric field between the plates?

[3] __**5.03 nC/m^2**__.

e) Which plate should have the positive charge on it [the top or the bottom]?

[2] __**top**_____.