Physics 112
Exam #1
September 17, 1999
Name: _____

YOU MUST RECORD ALL ANSWERS ON THE ANSWER SHEETS!! NOTHING WRITTEN ON THE QUESTION SHEETS WILL BE GRADED!!

#1-5 and #7-9 are multiple choice;
For #6, you must write a short explanation.
#10 (A) requires a diagram, and (B) is multiple choice.
#11 and #12 require you to draw diagrams.
 # 11 is 6 points; all others are 4 points each. Total: 50 points.

The following situation applies to problems #1 and #2: A +2-C charge is located at (–1 m, 0 m) and two +2-C charges are located at (+2 m, 0 m). An electron is located at the origin.

1. What is the magnitude of the net electric ***field*** experienced by the electron at the origin, produced by the three 2-C charges described above?

   A. 9.0×10^{9} N/C
   B. 1.8×10^{10} N/C
   C. 2.7×10^{10} N/C
   D. 3.6×10^{10} N/C
   E. 5.4×10^{10} N/C
   F. 1.44×10^{-9} N/C
   G. 2.88×10^{-9} N/C
   H. 4.32×10^{-9} N/C
   I. 5.76×10^{-9} N/C
   J. 8.64×10^{-9} N/C

2. Suppose the electron in problem #1 were replaced with a proton. Then the net ***field*** experienced by the proton, compared to the net field experienced by the electron, would be:

   A. larger in magnitude, but in the same direction
   B. larger in magnitude, and in the opposite direction
   C. equal in magnitude, and in the same direction
   D. equal in magnitude, but in the opposite direction
   E. smaller in magnitude, but in the same direction
   F. smaller in magnitude, and in the opposite direction

3. A 8-kg object with a charge of 18 C is released from rest in a region where an electric field is present. Its potential energy at the location where it was released was 38 J. How fast will it be going when it reaches a location where its potential energy is 2 J?

   A. 1 m/s
   B. 2 m/s
   C. 3 m/s
   D. 4 m/s
   E. 6 m/s
   F. 9 m/s
   G. 12 m/s

4. If an electron is placed at the position (0m, +1m) and a proton is placed at (0m, –1m), is there a net electric field at the origin? Select the best answer:

A. No, there is no net electric field at the origin because the total charge in the system is zero.
B. No, there is no net electric field at the origin because the electric field from the proton points in the opposite direction than the electric field from the electron, so the electric fields cancel.
C. No, there is no net electric field at the origin because the electric field is zero everywhere.
D. Yes, there is a net electric field at the origin because the electric field from the proton points in the same direction as the electric field from the electron, so the electric fields add.
E. Yes, there is a net electric field at the origin because the electric field from the electron does not completely cancel the electric field of the proton.
F. Yes, there is a net electric field at the origin because the electric field is uniform.

5. You are told to measure the electric field in an empty room where the electric field is known to be uniform throughout. You find that a particle with a 4-C charge, placed 3 m from the center of the room, experiences a force of 36 N in the direction of south. After you leave, taking your particle with you, someone else enters the room and makes force measurements on a particle with a charge of –8 C. If they place their particle at a point exactly at the center of the room, they should report that the electric field in the room is:

A. 1.5 N/C pointing north
B. 1.5 N/C pointing south
C. 3.0 N/C pointing north
D. 3.0 N/C pointing south
E. 6.0 N/C pointing north
F. 6.0 N/C pointing south
G. 9.0 N/C pointing north
H. 9.0 N/C pointing south
I. 12.0 N/C pointing north
J. 12.0 N/C pointing south

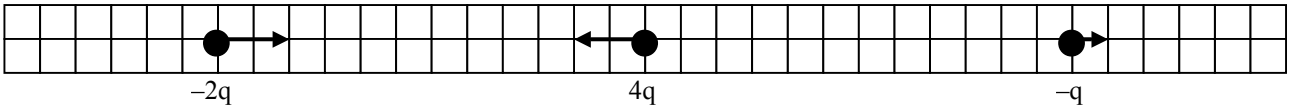
6. Explain the difference between (A) a ***test charge*** and a ***source charge***, and (B) a ***uniform*** and a ***non-uniform*** electric field.

7. At a certain moment, four charges of equal magnitude are located as shown, all on the same line and separated by equal distances. There is ***no*** external electric field. Three of the charges are positive, and one is negative, as shown. Which of the charges experiences the largest magnitude of ***net electrical force*** at the moment shown?

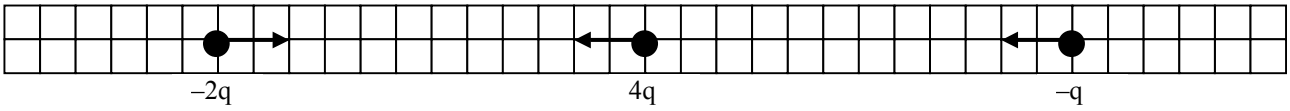
A. Charge A.
B. Charge B.
C. Charge C.
D. Charge D.
E. All four charges experience the same magnitude of force.
F. Charge A and Charge B, which experience equal magnitudes of force.
G. Charge A and Charge C, which experience equal magnitudes of force.
H. Charge A and Charge D, which experience equal magnitudes of force.
I. Charge C and Charge B, which experience equal magnitudes of force.
J. Charge C and Charge D, which experience equal magnitudes of force.

8. In each of the boxes below there is a uniform electric field, and three particles with charges of –2q, 4q, and –q as shown. Which of the diagrams correctly shows the electric force ***due to the uniform field*** that acts on each of the particles?

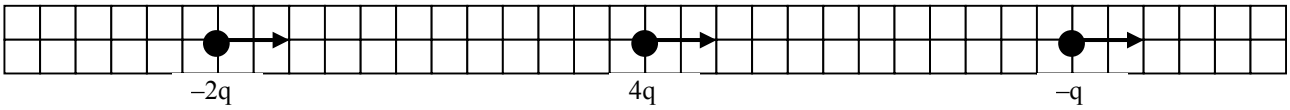
A



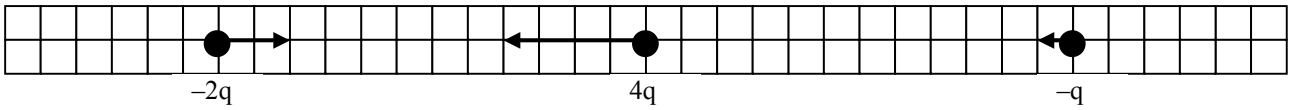
B



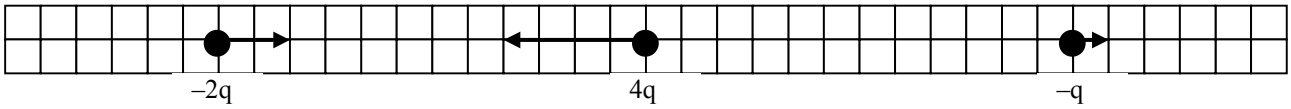
C



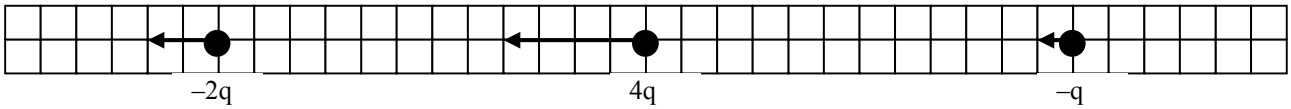
D



E

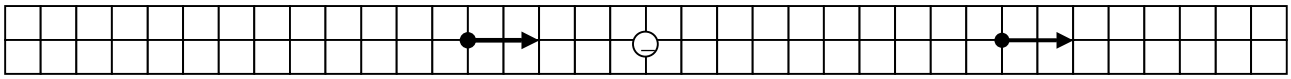


F

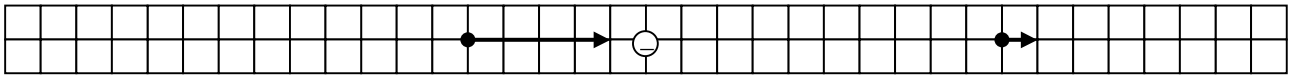


9. The arrows below represent electric field vectors in the neighborhood of the ***negative*** source charge at the center. Which of the diagrams correctly represents the magnitude and direction of these vectors?

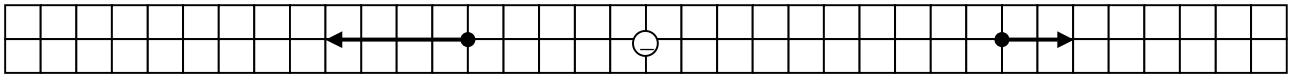
A



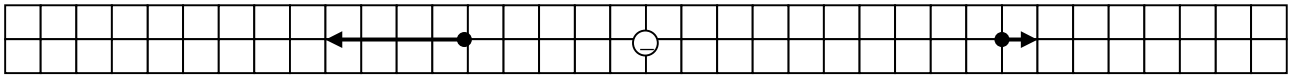
B



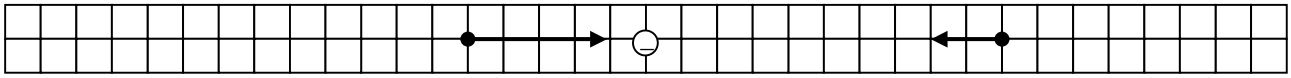
C



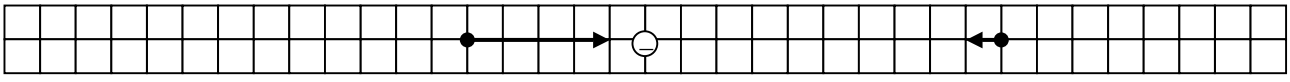
D



E



F



10. Given a +1 μC charge at (0m, 2m), a +1 μC charge at (0m, –2m) and a –1 μC charge at (2m, 0m) as shown in the diagram, answer the following questions.

A. Draw the individual electrical field vectors at the point (–2m, 0) due to each charge in the system. Make sure the arrows correctly represent the relative magnitudes of the electric field vectors (not ***exactly,*** but enough to see which is larger than which).

B. The **net** electric field vector at the ***origin*** (0m, 0m) [***not*** at (–2m, 0)] is in the following direction:

a. The positive x direction.
b. The positive y direction.
c. Some combination not along any of the axes.
d. The negative x direction.
e. The negative y direction.

11. *(six points)* Two source charges of equal magnitude are shown; the one on the left is positive and the one on the right is negative. Draw arrows on the figure to represent the ***net*** electric field at points A, B, C, and D. (There are no charges at these points, just empty space.) Make sure the arrows correctly represent the relative magnitudes of the four electric field vectors (not ***exactly,*** but enough to see which is larger than which). If the electric field at a point is zero, write "***zero***" at that point. ***IMPORTANT: ONLY*** DRAW ARROWS REPRESENTING THE ***NET*** ELECTRIC FIELD AT THOSE POINTS!!

12. The top diagram shows the forces between a +2C charge and a –2C charge. In the second diagram, the –2C charge is replaced by a +4C charge. In the third diagram, the charges are moved closer together. In ***both*** the second and third diagrams, draw the following arrows ***(Here, you should draw your arrow lengths exactly to scale!)***:

i) an arrow to represent the force exerted ***by*** the +2C charge ***on*** the +4C charge. Label these arrows (A).
ii) an arrow to represent the force exerted ***by*** the +4C charge ***on*** the +2C charge. Label these arrows (B).

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Name: _____

1. _____

2. _____

3. _____

4. _____

5. _____

6. (A)_____

_____

_____

_____

(B)_____

_____

_____

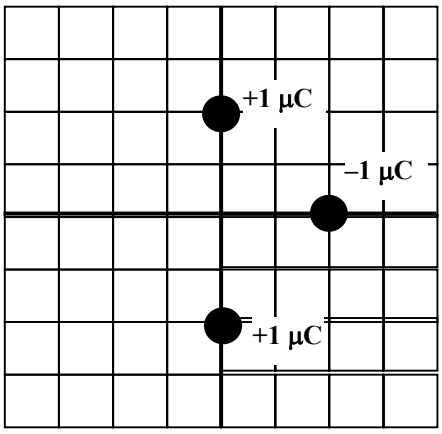
_____

7. _____

8. _____

9. _____

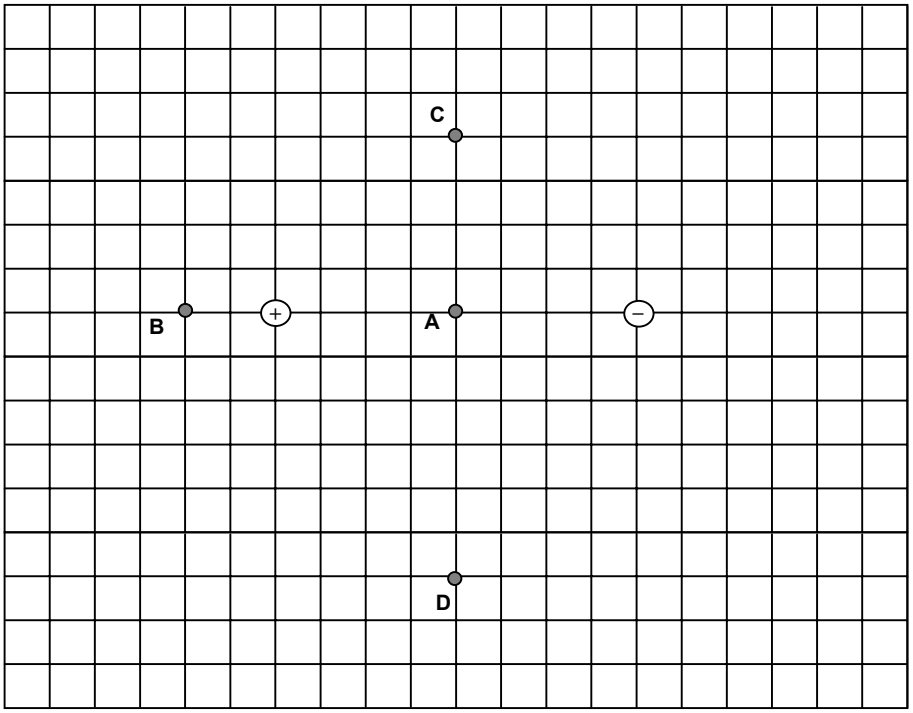
10. (A)



(B) _____

Name _____

11.



12.