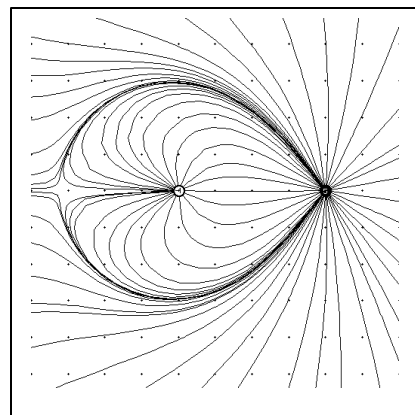
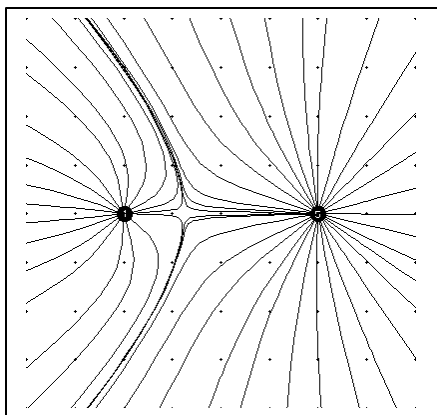
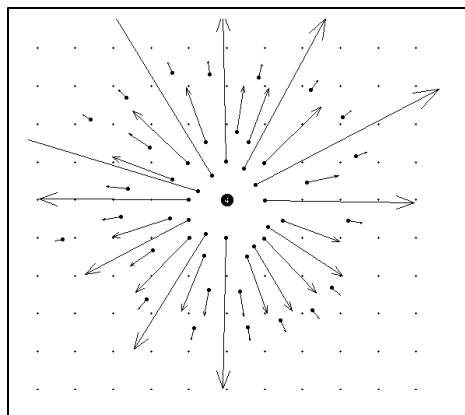


Name, period _____



Part A: Looking at Electric Field vectors

1. Open the program on the desktop **EMField** and click on the maximize box. Under **Display** turn on **Show Grid** and **Constrain to grid**.
2. Click on **Sources, 3D point charges**, and click and drag one positive charge to the center of the screen. For example, +4. Click on **Field and Potential** and then **Field vectors**. Click at various places: left, right, top, bottom, near the charge, away from the charge. (If the display ever gets too messy, click on **Display** and **Clean up Screen**.) What does the length of the vector indicate? What does the direction of the vector indicate?
3. Click on **Sources, 3D point charges**, and set up one negative charge, centered on the screen. For example, -4. Click on **Field and Potential** and then **Field vectors**. Click at various places: near the charge, away from charge. What does the direction of the vector indicate? Compare to results in step 2.
4. Click on **Sources, 3D point charges**, and set up two equal opposite charges about 4 blocks apart, centered on the screen. For example, +4 and -4. Click on **Field and Potential** and then **Field vectors**. Starting at the top, click on each black grid dot in the column halfway between the charges. Why do the field vectors point horizontally at each point?

Part B: Looking at Electric Field lines

5. Click on **Sources, 3D point charges**, and click and drag one positive charge to the center of the screen. For example, +4. Click on **Field and Potential** and then **Field lines**. Click at various places: left, right, top, bottom, near the charge, away from the charge. (If the display ever gets too messy, click on **Display** and **Clean up Screen**.) What does red mean? What does blue mean? Make a small sketch. Use arrows.
6. Do the same as step 5 for a negative charge of the same magnitude. How does this compare to step 5? Make a small sketch. Use arrows.

7. Now drag two equal positive charges about 4 blocks apart, centered on the screen. For example, +4 and +4. Click on **Field and Potential**, then **Field lines**. Click in various locations. Make a small sketch. Use arrows.
8. What is the “hole” halfway between the charges?
9. Click on **Sources, 3D point charges**, and set up two equal negative charges about 4 blocks apart, centered on the screen. For example, -4 and -4. Click on **Field and Potential**, then **Field lines**. Click in various locations. Where is the hole and what does it mean? Make a small sketch. Use arrows.
10. Click on **Field and Potential**, then **Field lines**. Set up two unequal positive charges about 4 blocks apart, centered on the screen. For example, +2 and +7. Click at various locations. What is different about this diagram? Where is the hole and what does it mean? Make a sketch. Use arrows.
11. Now put up two unequal negative charges about 4 cm apart. For example, -2 and -7. Again plot some electric field lines. Where is the hole and what does it mean? Make a sketch. Use arrows.
12. Now put up two unequal opposite charges about 4 cm apart. For example, -2 and +7. Again plot some electric field lines. Where is the hole and what does it mean? Make a sketch. Use arrows.
13. Now put in one positive charge centered. Click in some **equipotential lines**. Describe them. You will learn more about equipotential lines or surfaces soon. How are they related? Make a sketch.
14. Now put in two positive charges centered. Click in some **equipotential lines**. Describe them. Now click in 3 or 4 **field lines**. How are they related? Make a sketch.
15. Now put in two opposite charges centered. Click in some **equipotential lines**. Describe them. Now click in 3 or 4 **field lines**. How are they related? Make a sketch.