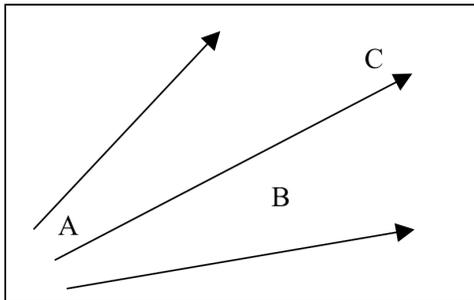


## Physics

# Electrostatic Homework

1. What is the basic law describing the interaction between positive and negative electrical charges?
2. What subatomic particles carry electrical charges?
3. If you scuff electrons onto your feet while walking across a rug, are you positively or negatively charged? How about the rug?
4. We do not feel the gravitational forces between ourselves and the objects around us because these forces are extremely small. Electrical forces, in comparison, are extremely huge. Since we and the objects around us are composed of electric charges, why don't we usually feel any electrical forces?
5. Is it necessary for a charged object to actually touch the ball of an electroscope for the leaves to diverge? Why or why not?
6. How can you charge an object negatively using only your body and a positively charged object?
7. Faraday field lines originate from what kind of charge? What kind of charges are found where these field lines terminate?
8. In which direction would a negative test charge move if released in a location where the Faraday field lines are roughly parallel and point downward? Describe an object (or set of objects) that might produce such an  $\vec{E}$  field.
9. Where is an  $\vec{E}$  field in the following diagram strongest (A, B, or C), or is the field strength the same in all three locations?



10. It is relatively easy to strip the outer electrons from a heavy atom like that of uranium (making a uranium ion), but it's much more difficult to remove its inner electrons. Why is this so?
11. Two equal charges (A and B) will exert equal forces on each other. Now consider a second pair of objects (C and D), where object C has twice the charge of object D. How does the force on object C compare with the force on object D?
12. Two point charges are separated by 6 cm. The attractive force between them is 20 newtons. Find the force between them when they are separated by 12 cm.
13. Measurements show that there is an electric field surrounding the earth. Its strength is about 100 newtons/coulomb at the earth's surface and directed inward toward its center. From this information, can you state whether the earth is negatively or positively charged?
14. Suppose a positive charge A is located at the origin of an x-y graph, a negative charge B is located at the point (0,4) and another negative charge C is located at the point (8,0). Assume all charges have the same magnitude. Draw (an approximation of) the two electrical force vectors operating on each charge. Draw the resultant force vector on each charge, labeling it  $F_R$ .
15. Suppose the potential difference between a storm cloud and the ground is 100 megavolts. If a charge of 2 coulombs flashes in a bolt from cloud to earth, what is the change of potential energy of the charge?
16. Complete the **Electric Potential** worksheet (the one with the spring on it).

17. Suppose that a metal file cabinet is positively charged. How will the charge concentration at the corners of the cabinet compare with the concentration on the flat parts?
18. Suppose that you have a large test container rigged to measure the electric flux through every location on the container walls, floor, and ceiling. When the same file cabinet in **Question #17** is placed inside this test container, you are surprised to find that the device reads zero flux everywhere! Explain how this could be possible given the information given in **Question #17**. How might this new information change your expectations about the charge on the **outside** of the file cabinet?
19. If you bring a strong positive charge near the **top** of a neutral conductor, what charge will appear on the **bottom** of the conductor? Is it correct to say that objects carrying this charge have moved toward the bottom of the conductor? If not, what happened instead?
20. Which direction do the Faraday field lines point between a thundercloud and the ground beneath it? In which direction would any free electrons move in this field? How about ionized air molecules? When an ionized air molecule captures a free electron, what happens to the electric potential energy between them?
21. As the thundercloud moves **away** from a house, describe the charge flow through the wire connected between the house's lightning rod and a metal pipe stuck in the ground.