Problem Set 13 – electrostatics & electric fields

1. I add 3 X 1016 electrons to a neutral object. What is the resulting charge on the object?

2. How many electrons must I remove from a neutral object to give the object a charge of +0.025 C?

3. Objects A and B are isolated, charged conductors. The charge on object A is +8 C and the charge on object B is -2 C. The two objects touch and charge is allowed to flow between the objects. The objects are then separated. What is the charge on object A and the charge on object B after they are separated?

4. A hydrogen atom can be pictured as an electron moving in a circular path around a proton. The radius of the orbit of the electron is 5.3 X 10-11 m. The mass of an electron is 9 X 10 -31 kg.

(a) What is the size of the electric force the proton exerts on the electron?

(b) What is the speed of the electron around the nucleus? (Hint: Use circular motion equations.)

5. Object P has a charge of +3 μC and object U has a charge of –1 mC. Object P is attracted to object U by a force of 153 N. How far apart are P and U?

6. Three particles are placed motionless in a uniform electric field. The three particles are an electron, a proton, and an antielectron (aka *positron*). The antielectron has the same mass as an electron but the same charge as a proton. The electric field strength is 2000 N/C.

 |------------ 0.3 m -----------|

 L R

 (a) On which particle does the electric field exert the larger force?

 (b) After moving 10 cm, which particle has more kinetic energy?

 (c) After moving 10 cm, which particle has the higher speed?

 (d) After moving 10 cm, which particle moved through the

 larger potential difference?

(e) Which plate is positively charged?

(f) If the three particles were placed in the center of the field,

 toward which plate would each particle move?

7. An electron is accelerated from rest through a potential difference

of 5 X 105 volts in a uniform electric field with ***E*** = 1 X 105 N/C.

(a) What is the speed of the electron at this time?

(b) How far did the electron move in the field?

(c) The answer you get for part (*a)* is mathematically correct. The answer is impossible physically. Why?

ANSWERS

1. - 4.8 X 10-3 C or - 0.0048 C 6. (a) same size force for all three particles: 3.2 x 10-16 N

 (b) same KE for all three particles: 3.2 x 10-17 J

2. 1.56 X 1017 electrons (c) same speed for e- & e+ : 8.4 X 106 m/s but

3. object A is +3 C lower speed for p+ : 2.0 X 105 m/s

 object B is +3 C (d) same potential difference for all three particles: 200 volts

 (e) Plate L is positively charged.

4. (a) 8.2 X 10-8 N (f) The electron moves toward plate L.

 (b) 2.2 X 10 6 m/s The proton and antielectron move toward plate R.

 7. (a) 4.2 X 108 m/s

5. 0.42 m 🡪 42 cm (b) 5 m