AP Physics 2: Electrostatics

1. A parallel plate capacitor stores 6.0µC of charge when a potential difference of 120V exists between its plates. How much charge will be stored by the same capacitor with the same ΔV, if the separation between the plates is doubled?

2. Consider the following charge distribution:

N

1.1mm

2.8 C

-1.6 C

4.6mm

A

B

W

E

S

 a. What is VA?

 b. What is VB?

 c. How much work would it take to move a proton from A to B?

 d. How much work would it take to move an electron from A to B?

 e. What is the electric field at A?

 f. What is the electric field at B?

 g. What would be the force on a +2.0x10-12C charge at A?

 h. What would be the force on a -4.0x10-12C charge at A?

 i. How much work would it take to move a proton from A to infinity?

 j. How much work would it take to move a proton from infinity to A?

3. How much time would it take for a proton to accelerate from rest to 3.0x107m/s (10% the speed of light) in a region where the potential changes by 120V for every 1.00cm of motion?

4. An electron is orbiting the nucleus in a hydrogen atom. The approximate radius of the orbit is 5.0x10-11m. What is the speed of the electron?

5. A proton at rest is 10.0cm from a fixed -6.0x10-8C charge. The proton is released. What is its speed when it is 2.00cm from the charge?

6. The energy of two point charges is -3.00x10-16J. What is the **change in energy** of these two point charges if the distance between is quadrupled?

7. The energy of two point charges is -3.00x10-16J. When released will the charges naturally move towards each-other or away from each other?

8. Two point charges have an energy of 5.6x10-12J when separated by d, both at rest. The charges are released. Find their kinetic energy when separated by 3d.

9. The force between two point charges, separated by D, is 3.00x10-14N. What is the force if the separation is ***increased by*** 3D?

10. Imagine two identical conducting spheres. Got it? Ok. Now imagine that a charge of +2Q is placed on one and a charge of -4Q is placed on the other. When separated by D the spheres feel an attractive force of 24N.

Now imagine the two spheres are brought into contact and allowed to reach equilibrium. The separated by D again. What is the new force between the spheres?

11. An electron is accelerated through a potential difference of 2400V. Assuming it begins at rest what is its final speed?

12. A proton is fired at 2.00x106m/s into the region between two parallel plates as shown:

L

The plates are separated by 6.00mm and the potential difference across them is 750V. The proton exits the plates with a final velocity directed 82o above –x. Find the length of the plates, L.

13. How much work must be done to move an electron 42.0cm in a region of uniform field, at constant speed, from a point A (VA=12V) to a point B (VB=97V)?

14. How much work must be done to move a proton 42.0cm in a region of uniform field, at constant speed, from a point A (VA=12V) to a point B (VB=97V)?

15. How much work must be done to move an electron 42.0cm in a region of non-uniform field, at constant speed, from a point A (VA=12V) to a point B (VB=97V)?

16. A parallel plate capacitor has plate separation of 0.00900m and stores 68μJ of energy. The charge on the plates is held constant and the separation is decreased to 0.00700m. How much energy is now stored on the plates?

17. What is the potential at the surface of a conducting sphere with a radius of 16cm carrying 2.4x1012 excess electrons?

18. A proton is released from rest 14.0cm from a fixed +16nC charge. How far from the charge will it be when it is moving at 4.2x105m/s?

19. A proton is released from rest 14.0cm from a fixed -16nC charge. How far from the charge will it be when it is moving at 4.2x105m/s?

20. A parallel plate capacitor is charged by moving 83 million electrons from one plate to the other. The plates measure 2.00mm by 5.00mm and are separated by an empty gap of 0.800mm. What is the potential difference between the plates?

21. Find the speed of an electron with 1250eV of kinetic energy.

22. A -14nC charge is fixed at 0m $\hat{x}$. A +32nC charge is fixed at 1.2m $\hat{x}$.

 A. Find all points on the x-axis where the potential due to these charges is zero.

 B. Find all points on the x-axis where the field due to these charges is zero.

 C. Sketch a graph of the potential along the x-axis from -10m to +10m.