1. A point is 3 mm from a $-1.5\mu C$ charge.
   A. Calculate the electric potential at the point.
   $V = k\frac{q}{r} = -4.5\times10^{6}V$
   B. To increase the magnitude of the potential should the distance be increased or decreased? closer $r\downarrow$ $V\uparrow$

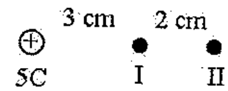
2. A 5 C charge is at a point that has a potential of 8V.
   A. A volt breaks down into what units? J/C
   B. Calculate the potential energy of the charge.
   $\frac{8J}{1C}\cdot\frac{5C}{1} = 40J$
   C. How much work was necessary to move this charge to this point? 40 J

3. Where is zero volts defined for point charges?
   ∞ why? $\frac{kq}{r}$ as $r\uparrow$ $V\downarrow$

4. A car battery provides 12V. All electrical components are grounded to the car. How can the car be grounded?
   We define 0volts as the car's metal. 12V is +12V above the car. "Ground" means lowest voltage.

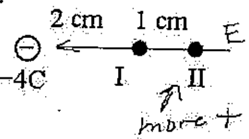
5. 12 J of energy is gained by a charge as it moves thru a potential difference of 24V. Calculate the magnitude of the charge.
   $V = \frac{J}{C}$, $C = \frac{J}{V}$, $\frac{12J}{24V} = 0.5$ coulombs

6. A 5C charge is in a region of space.



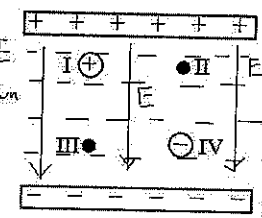
   A. Calculate V at position I.
   $V_I = \frac{k5}{.03} = 1.5\times10^{12}V$
   B. Calculate the electric potential at II.
   $\frac{k5}{.05} = 9\times10^{11}V$
   C. Where is V greater: near or far from a + charge?
   V is defined by a + charge.
   D. Calculate the potential difference between the two points. $V_I - V_{II} = 6\times10^{11}V$

7. A $-4C$ charge is in a region of space.



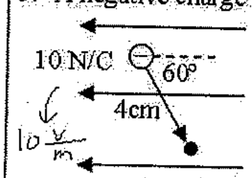
   A. Calculate V at position I.
   $V_I = \frac{k(-4)}{.02} = -1.8\times10^{12}V$ (J/C)
   B. Calculate the potential at II.
   $V_{II} = \frac{k(-4)}{.03} = -1.2\times10^{12}V$
   C. Where is V greater (more +): near or far from a −?
   where a + charge could have more PE
   D. Draw the direction of E on the left side of the charge.
   E. Does E point toward higher or lower V? always

8. A positive charge is within a charged capacitor.



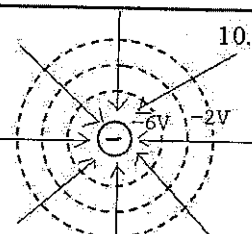
   A. Is V greater at point I or III?
   where a ⊕ could have more PE
   B. Draw E between the plates? down
   C. Does the + want to move to a point of higher or lower V?
   D. Which way will the − move naturally? up
   E. Will the − move to a point of higher or lower V?
   V higher for + charge at + plate (and for neg too)
   F. Draw dashed equipotential lines between the plates.

9. A negative charge is moved 4cm at 60° to a constant E.



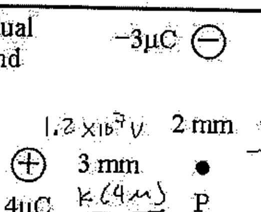
   A. What is the distance the charge moves parallel to the field?
   $d = .04\cos 60° = .04(\frac{1}{2}) = .02m$
   B. Calculate the change of potential of the charge.
   $\Delta V = -E\Delta d$ *a − charge naturally moves toward higher V*
   $= -(-10\frac{V}{m})(.02m) = .2$ volts

10. The inner dashed circle is −6V and the outer is −2V.



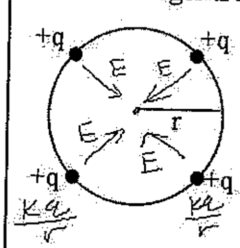
   A. Does potential become more positive near a + or − charge? see Q6
   B. Label the charge as + or −
   C. Draw the electric field lines around the charge.

11. A. Calculate the individual voltages at point P and then the net voltage.



   $\frac{k(-3\mu)}{2mm} = -1.35\times10^{7}V$
   $\frac{k(4\mu)}{3mm} = 1.2\times10^{7}V$
   $V_{net} = 1.2\times10^{7} - 1.35\times10^{7} = -1.5\times10^{6}V$ (J/C)
   B. If a 2μC charge is put at P, calculate net PE.
   $-1.5\times10^{6}\frac{J}{C}(2\times10^{-6}C) = -3J$

12. Four charges are equidistance from the center of a circle.



   $\frac{kq}{r}$ $\frac{kq}{r}$
   A. By symmetry, what is the electric field at the center of the circle?
   0 N/C (all balance)
   B. Give an expression for V_{net} at the center.
   $4\frac{kq}{r}$
   C. How can the center have energy, but no field?
   Like pushing a ball up a hill. Takes Work to get it there, but it has no F at the top (balanced)