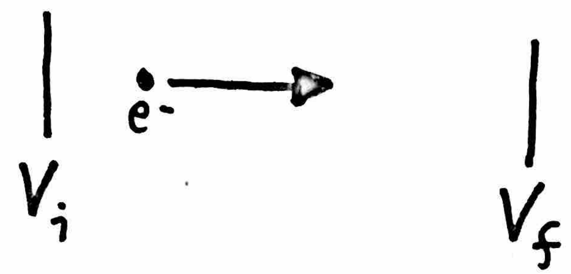
Worksheet 6
Solutions

(1) $U = qV \Rightarrow V = \frac{U}{q} \Rightarrow \left[\frac{J}{C}\right] = [V]$

volts

(2)



(3) $E = K + U$

$\Delta U = \Delta K \rightarrow \Delta U = q\Delta V = e(V_i - V_f)$

(4) $K = \frac{1}{2} m v^2 \rightarrow v = \left(\frac{2K}{m}\right)^{1/2}$

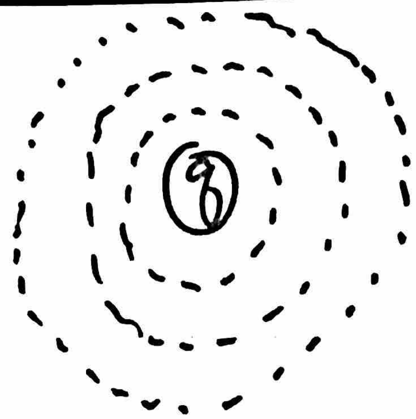
$$v = \sqrt{\frac{2e(V_i - V_f)}{m}}$$

(5) Whichever has the largest $V_i - V_f$, Which is $20 - 5 = 15$ [V], so b, e, h, and k

(6) $F = ma = -\nabla U = -q\nabla V$, here, V is linear, So the one with the highest ΔV over the shortest separation, which is 15 [V] over 0.1 [mm]

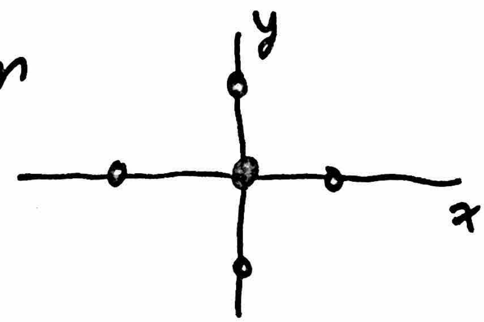
(7) $F = -\nabla U = -q\nabla V = qE \Rightarrow E = -\nabla V$

(8)



(9) $r = a$ for all of them

$$V = \sum \frac{kq}{r} = \frac{4kq}{a}$$



(10) $$U = \frac{k q_1 q_2}{r} = -\frac{ke^2}{r_0}$$

Note, we started with one particle and $U=0$, and then added a second particle.

(11) $$U = -\frac{ke^2}{r} = -\frac{8.988 \times 10^9 \cdot (1.602 \times 10^{-19})^2}{5.292 \times 10^{-11}} = -4.36 \times 10^{-18} [J]$$

(12) $-27.2 [eV] \Rightarrow$ precisely twice!

(13) $E = -\nabla V = -2(x, y, z)^T \Rightarrow E = -(2,4,6)^T$

(14) At short distances, charge separation is very powerful, but at larger distances charges tend to balance out (thunder storms are an exception), while there is only one type of gravitational charge, and it adds.

(15) Angular momentum would probably be lost.