Name: ______________________________ DISC: ____________ Score: _____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers

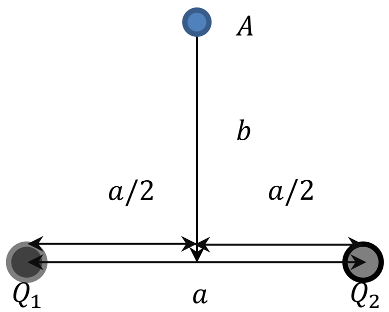
Q1	Q2	Q3	Q4
5	10	5	5

1. How would you explain the difference between the ***electric potential energy*** and the ***electric potential***? Are these quantities vectors or scalars?

Definitions: 3 pts. Vector or Scalar: 2 pts

The *electrical potential* describes the amount of electrical potential energy a charge could have if it were located at a particular point. The *electrical potential energy* is the energy of a charge at a given location.
Both of these quantities are scalars.

2. Consider the following situation (Q_1, Q_2 are fixed):



a	b	Q_1	Q_2	k	ELECTRIC POTENTIAL	WORK
$5\ m$	$3\ m$	$+6.0\ \mu C$	$-3.5\ \mu C$	$9\times10^9 N\ m^2/C^2$	$V(r)=\frac{kq}{r}$	$W = Vq$

a. Using the information in the table, find the electric potential at the point A.

Potential (5 pts):

The electrical potential at point A is the sum of the electrical potentials at point A from each charge:

$$V_A = k\left[\frac{Q_1}{r}+\frac{Q_2}{r}\right] = \frac{k}{r}[6.0-3.5]\mu C = 5761\ V$$

$$r = \sqrt{(2.5)^2+3^2} = 3.905\ m$$

b. How much work do you have to do to bring a charge $q = 1.5\ \mu C$ from far away to the point A?

$$W = qV(A) = (1.5\ \mu C)(5761\ V) = 0.0086\ J = 8.6\times10^{-3}\ J$$

Work (5 pts):

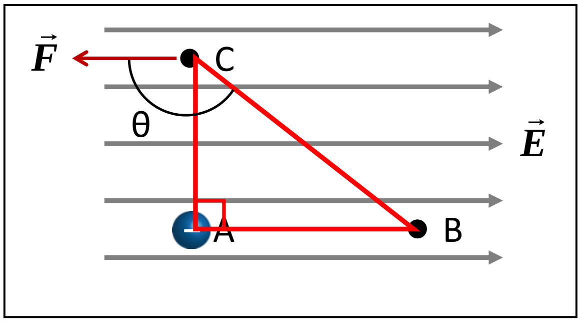
3. Consider the charged particle and uniform electric field shown in the figure. The particle travles from point **A** to point **C** to point **B**. ($W = F\Delta r\cos\theta$)

   a. In which step(s) does the *electric force* do work?

Steps (2 pts):

The electric force will do work when the particle moves from point C to point B.

The electric force will also do work when the particle moves from point A to point B.



   b. How does the work done by the *electric force* change if the particle travels from point **A** to point **B** *without* traveling to point **C**? Explain your reasoning.

In the original diagram, the total work done is:

$$W_{AC} = 0\,J$$
$$W_{CB} = -qEd_{CB}\cos\theta$$
$$W_{ACB} = -qEd_{CB}\cos\theta$$

If the particle travels from point A directly to point B the work is now:

$$W_{AB} = -qEd_{AB}$$

Look carefully now at the distance terms $d_{cb}\cos\theta$ and d_{AB}. What do you notice? Using our trig skills we notice that 1) the triangle is a *right triangle* 2) $d_{AB} = d_{cb}\cos\theta$. Putting this together we realize that the work done in moving the particle from point A to point B *directly* is the <u>*same*</u> as moving the particle from point A to point C to point B:

$$W_{ACB} = -qEd_{CB}\cos\theta = -qEd_{AB} = W_{AB}$$

Change (1 pts):
Explanation (2 pts):

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