Introduction

This is a card-sorting review activity for NYB, focusing on field, energy, and potential. Students analyze different situations (source charge + test charge) by grouping the appropriate representations (graphs, words, diagrams, etc). You can expect the activity to take about 45 minutes.

There are a lot of cards here, so some organization and clear instructions will help the activity run smoothly. My instructions for the students are in the file **reviewInstructions.pdf**

Before Class:

There are 6 situations (and distractors), but that might be too much.
I've used the following set of 4 for each group:
1. Parallel-plate: proton
2. Parallel-plate: electron
3. Positive spherical charge: proton
4. Positive spherical charge: electron

Before the class, cut out a set of cards for each group (this takes a while!). Organize each into 2 subsets:
　　　1 (the setup): Charge setup, initial velocity, and speeding up/slowing down.
　　　2 (the analysis): All of the other cards.

The Activity (In Class)

1. Organize the students in groups of ~4.

2. **(~5-10 minutes)**

    Before giving the students any cards, take them through an example of how to set up the situations using subset 1 (see reviewInstructions.pdf for visuals).

    For **each** charge setup, the students will:
    a. Choose **one** initial velocity card.
    b. Answer: Is the test charge speeding up/slowing down?
    c. Describe the motion in words

    Once you've gone through one example, pass subset 1 out to the students and have them set up each situation.

3. **(~20 minutes)**
    Give the students the remaining cards. Have them
    a. Choose the appropriate cards for each charge setup.
    b. Optional: **sketch** $s(t)$ for the motion.

    As the students work on this, circulate around to see how they are doing & to answer questions.

4. **(~10 minutes)**
   Have the students switch (exchange) places with another table.
   a. Have them come up with 3 questions for the other group.
   b. Have them discuss.

5. **(~5 minutes)**
   Wrap-up with the whole class. A few ideas:
   a. Ask the students about questions that came up.
   b. Ask them which cards depend on
      i. Only the source charge.
      ii. The test charge.
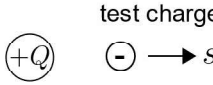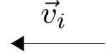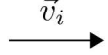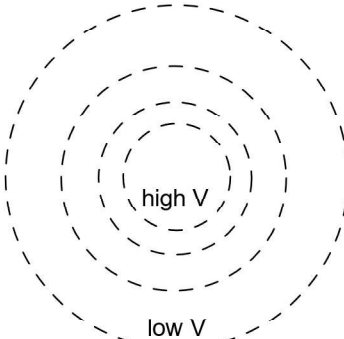   iii. The test charge's initial velocity.

Parallel-plate: proton

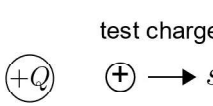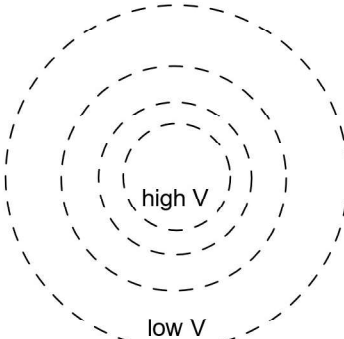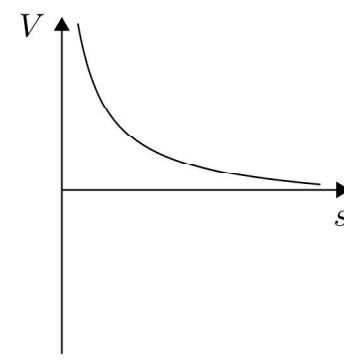|			
+ + + + + + + + test charge $\oplus$ $\longrightarrow s$ (- - - - - - - - plates)		$\overleftarrow{\vec{v}_i}$	speeds up
	$\overrightarrow{\vec{v}_i}$	$\vec{v}_i = 0$	slows down
(field lines) 60 V 0 V	$V \uparrow \quad U \uparrow \quad K \downarrow$		$W_{\text{field}} > 0$
	$V \downarrow \quad U \downarrow \quad K \uparrow$		$W_{\text{field}} < 0$

V vs s (decreasing line)

E vs s (horizontal line)

U vs s (decreasing line)

s vs t **sketch** the motion

Parallel-plate: electron

  + + + + + + + + plates, $\ominus$ test charge, $\longrightarrow s$		$\overleftarrow{\ \vec{v}_i\ }$	speeds up
	$\xrightarrow{\ \vec{v}_i\ }$	$\vec{v}_i = 0$	slows down
  60 V 0 V	$V \uparrow \qquad U \downarrow \qquad K \uparrow$		$W_{\text{field}} > 0$
	$V \downarrow \qquad U \uparrow \qquad K \downarrow$		$W_{\text{field}} < 0$

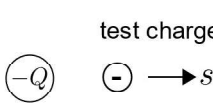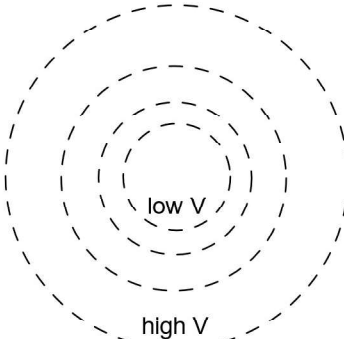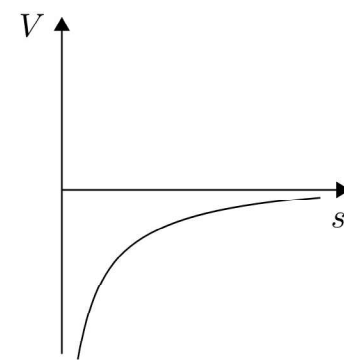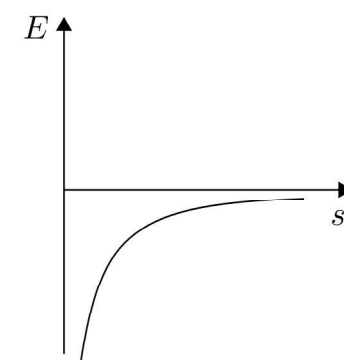

sketch the motion

Spherical charge (+Q): electron
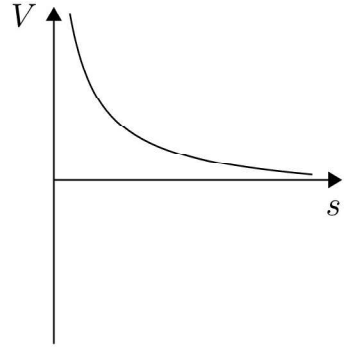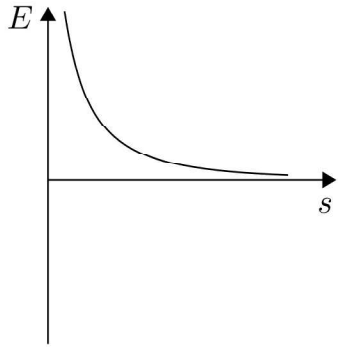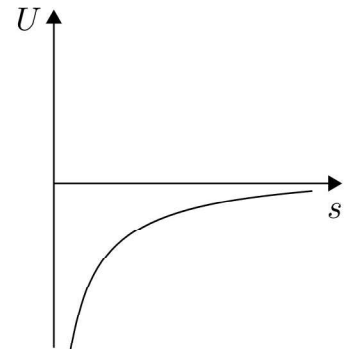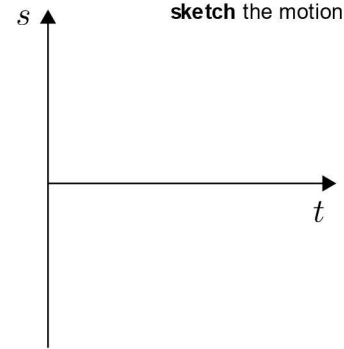
		$\vec{v}_i$ ←	**speeds up**
test charge $(+Q)$ $\ominus$ → s	$\vec{v}_i$ →	$\vec{v}_i = 0$	**slows down**

	$V \uparrow \qquad U \downarrow \qquad K \uparrow$	$W_{\text{field}} > 0$
high V low V	$V \downarrow \qquad U \uparrow \qquad K \downarrow$	$W_{\text{field}} < 0$

sketch the motion

Spherical charge (+Q): proton

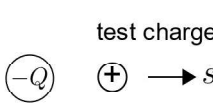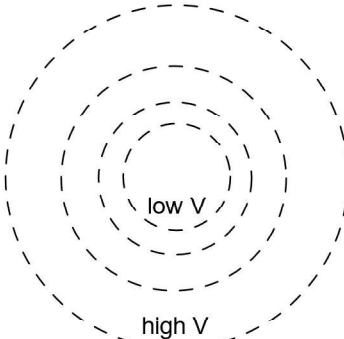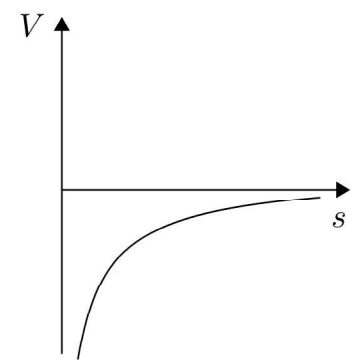|			
test charge $+Q$ $\oplus \longrightarrow s$		$\overleftarrow{\quad} \vec{v}_i$	speeds up
	$\vec{v}_i \longrightarrow$	$\vec{v}_i = 0$	slows down
high V low V	$V\uparrow \qquad U\uparrow \qquad K\downarrow$		$W_{\text{field}} > 0$
	$V\downarrow \qquad U\downarrow \qquad K\uparrow$		$W_{\text{field}} < 0$

V vs s

E vs s

U vs s

s vs t — **sketch** the motion
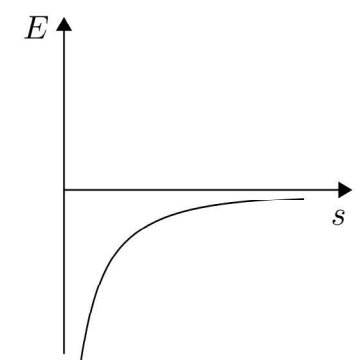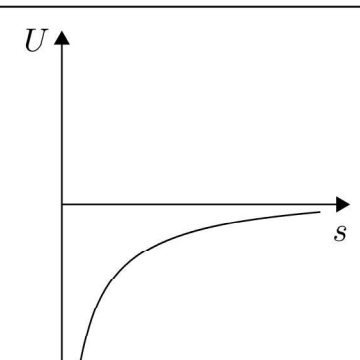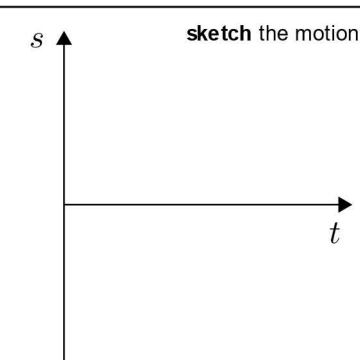
EXTRA

Spherical charge (-Q): electron

test charge $(-Q)$ $(-)$ $\longrightarrow s$		$\overleftarrow{\vec{v}_i}$	speeds up
	$\overrightarrow{\vec{v}_i}$	$\vec{v}_i = 0$	slows down
low V high V	$V \uparrow$ $U \downarrow$ $K \uparrow$		$W_{\text{field}} > 0$
	$V \downarrow$ $U \uparrow$ $K \downarrow$		$W_{\text{field}} < 0$

V vs s

E vs s

U vs s

s vs t **sketch** the motion

Spherical charge (-Q): proton

test charge $(-Q)$ $(+)$ $\longrightarrow s$		$\overleftarrow{\vec{v}_i}$	speeds up
	$\overrightarrow{\vec{v}_i}$	$\vec{v}_i = 0$	slows down
low V high V	$V\uparrow \quad U\uparrow \quad K\downarrow$		$W_{\text{field}} > 0$
	$V\downarrow \quad U\downarrow \quad K\uparrow$		$W_{\text{field}} < 0$

V vs s

E vs s

U vs s

s vs t — **sketch** the motion

Parallel-plate: distractors

60 V   0 V