Name: _____

Charged Sphere

Your group has a plastic surface and a contour map that represent the electric potential due to a charged sphere as a function of position. The electric potential is zero infinitely far away from the sphere. Solve the following problems together and discuss the results.

You are employed by an electronics company called Crabapple Technologies. Crabapple wants to put a small charged nanoprobe at the blue circle.

(1) If the nanoprobe moves further away from the sphere, how will the electric potential change? What if the nanoprobe moves closer to the sphere?

(2) Identify other points on the surface where the electric potential is the same as the potential at the blue circle and draw a line to connect them. Do the same for the orange star and the green square.
   (a) Align your surface with the contour map. How are you making your alignment?
   (b) How could the nanoprobe move so that the electric potential remains constant?

(3) Sketch a graph of the potential (V) vs. distance from the center of the sphere (r). Remember to label your axes.
   (a) Does your graph match your answers to (1)? If not, reconcile any differences.
   (b) Why is it reasonable to represent the information from the surface in a graph with only 2 axes?

(4) Indicate the direction of the field at the blue circle on the contour map. Explain your reasoning.

(5) Locate a point where you would expect the electric field to be larger. How do you know it's larger?

(6) Is the rate of change of electric potential with respect to $\boldsymbol{r}$ positive, negative, or zero?

(7) Compare $\frac{dV}{dr}$ at the two points from (4) and (5). Which one has a larger magnitude?

(8) Sketch a graph of the electric field vs. distance from the center of the charged sphere. Remember to label your axes.

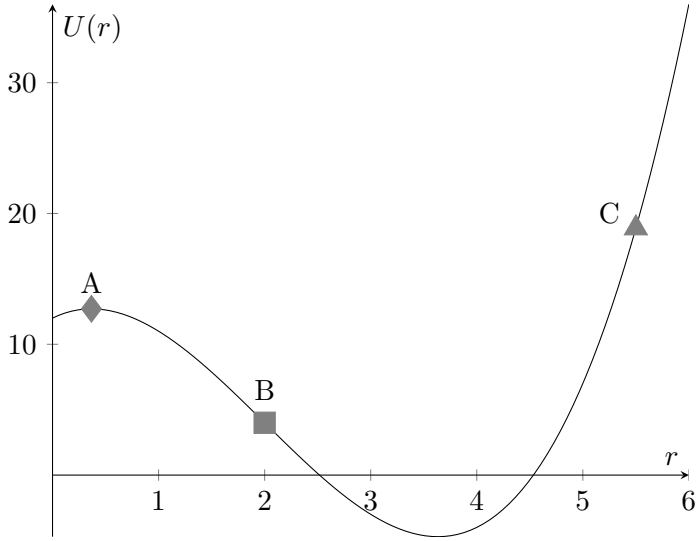
(9) The Crabapple employee handbook states:

> There is a relationship between electric potential and electric field; field is the negative gradient of potential. $\vec{E}(\vec{r}) = -\vec{\nabla}V(\vec{r})$

Do you agree? Support your answer with evidence from this activity.

Pre-Activity
Write down things you know about electric potential.

This is a graph of potential energy as a function of distance with appropriate units. Rank the magnitude of the force at the following points (diamond, square, and triangle) on the graph from greatest to least.



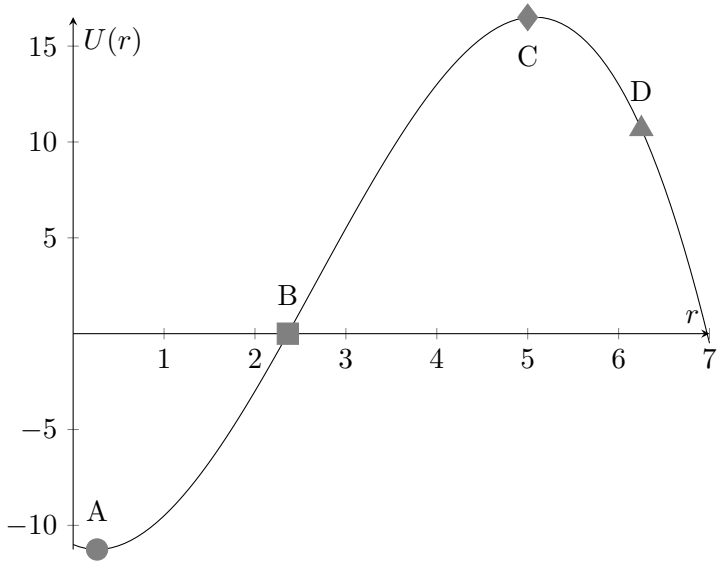
Write at least one question you have about electric potential.

Name: _____

Activity Evaluation

Write something specific you learned from today's activity.

This is a graph of potential energy as a function of distance. Rank the force at the following points (circle, square, diamond, and triangle) on the graph from greatest to least.



What questions do you still have? What new questions came up?