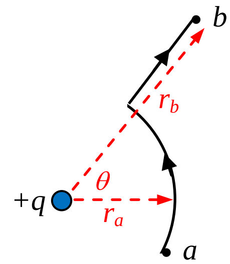
Lesson #8: Curl of E; Electric Potential　　　　Name: ______________________________

1. A positive point charge $+q$ is located at the origin. Calculate the path integral $\int_a^b \vec{E} \cdot d\vec{L}$ along the path (shown as the solid black line) between the points a and b. The path consists of a circular arc of radius r_a and a straight line section between $r = r_a$ and $r = r_b$. You will want to do this in spherical coordinates. (If you need a refresher on path integrals, check out example 1.6; although that example is in Cartesian coordinates, the general procedure is the same).



a. Sketch a representative electric field vector on each part of the path.

b. How do you write the element of length $d\vec{L}$ along each part of the path? Remember, it's a vector!

Along the curved part: $d\vec{L} =$

Along the straight part: $d\vec{L} =$

c. What is the value of $\int \vec{E} \cdot d\vec{L}$ along the curved part of the path? Explain how you know.

d. Evaluate the integral $\int \vec{E} \cdot d\vec{L}$ for the straight part of the path (show your work!). Your final answer should be only in terms of given parameters and constants.

2. The height of a hill is given by $h(x, y) = 2xy - 3x^2 - 4y^2 - 18x + 28y + 12$.

Here, x is the distance east and y is the distance north of the origin. A function like this is often used to produce topographic maps.

Where is the top of the hill and how high is it?　　　　(*you saw this in Calc class …*)

3. In your own words, how is the preceding question related to electric fields and electric potential? (Your answer should not be surface level – try to provide some real insight in 3-4 sentences.)