Homework 4: Energy

1. **(10 points)** Problem 4.3 from the book, calculating the line integral for a given force. Set expectations: Will the work on each path be positive, negative, or zero? Also, it turns out you do need to figure out the parametrization for part c; use $x = \cos\phi$; $y = \sin\phi$; $0 \leq \phi \leq \pi/2$.

2. **(5 points)** Summarize in your own words what we learned about gradient, line integrals, curl, force, and potential energy.

3. **(10 poins)** View Khan Academy on Divergence and Curl and answer the standard reading questions.

   `https://www.khanacademy.org/math/multivariable-calculus/multivariable-derivatives/partial-derivative-and-gradient-articles/a/the-gradient`

   `https://www.khanacademy.org/math/multivariable-calculus/multivariable-derivatives/divergence-and-curl-articles/a/curl`

4. **(5 points)** Problem 4.22 in the book; show that the Coulomb force is conservative by evaluation the curl in spherical coordinates

5. **(5 points)** Show that $\vec{\nabla} \times (\vec{\nabla} U) = 0$ in all three coordinate systems (Cartesian, cylindrical, spherical). This means that if $\vec{F} = -\vec{\nabla} U$ then we are guaranteed that the curl of $\vec{F}$ is zero. This says that our condition on the curl of the force of a conservative field is consistent with force being the gradient of a scalar field.

6. **(10 points)** Problem 4.24

7. **(10 points)** *(Computer)* Problem 4.29

8. **(10 points)** Problem 4.35

9. **(10 points)** Problem 4.43

10. **(10 points)** Problem 4.48