PHYS 3320 **Name:_____**

Test Work Energy and Stuff

Show ALL STEPS. Your score will be based on your presentation of your solution, not just your final answer.

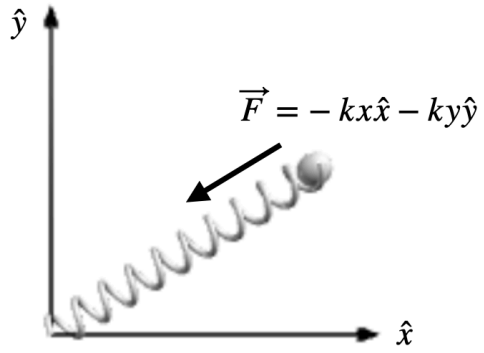
1. Given a force of $\vec{F} = xy\hat{x} - y^2\hat{y}$, find the work done going from the point (0,0) to the point (2,1) along a parabolic path ($y = \frac{1}{4}x^2$).

2. An object is near the Earth (with a mass M_E) a distance r_1 from the center with a mass m. The gravitational force on the mass is $\vec{F} = -G\frac{M_E m}{|\vec{r}|^2}\hat{r}$. The object then moves to a further distance of r_2. Show that the work done by gravity is equal to negative the change in gravitational potential energy where:

   $U(r) = -G\frac{M_E m}{r}$

   Hint: you can use $\vec{dr} = dr\hat{r}$

3. Below is a 2D spring with an unstretched length at the origin. Is this force conservative (hint: yes)? Create a potential energy for this force in the form of $U(x, y)$. A ball of mass m starts at position (x_1, y_1) with a velocity v_1. What is its speed when it reaches the origin?



4. Consider the following 2D potential:
   $U(x, y) = 2x^2 - y^2 - xy$

   a) Compare the magnitude of the force at point 1 (0,0) and point 2 (1,2).
   b) Is this a conservative force? Justify your answer.
   c) Calculate the change in kinetic energy of the particle as it moves from point 1 to 2 under the influence of this force.