# Lecture

2/22/05

# ENERGY, WORK, & POTENTIAL

Recall that for a "field force" like gravity it is useful to define a <u>potential</u> energy $U$ by

$$W = \vec{F} \cdot \Delta\vec{r} = -\Delta U$$

where

$W$ is the work done on an object (think "test mass" $m$) as the object undergoes a displacement $\Delta\vec{r}$.

THINK ABOUT:

- W and hence $\Delta U$ (and U) is a scalar. That's handy!
- The <u>dot product</u> $\vec{F} \cdot \Delta\vec{r}$
- The minus sign.

  Why?

  The "field force" is "conservative", i.e. energy is conserved in the process in which the force does work on the object, thus influencing its motion and changing its kinetic energy.

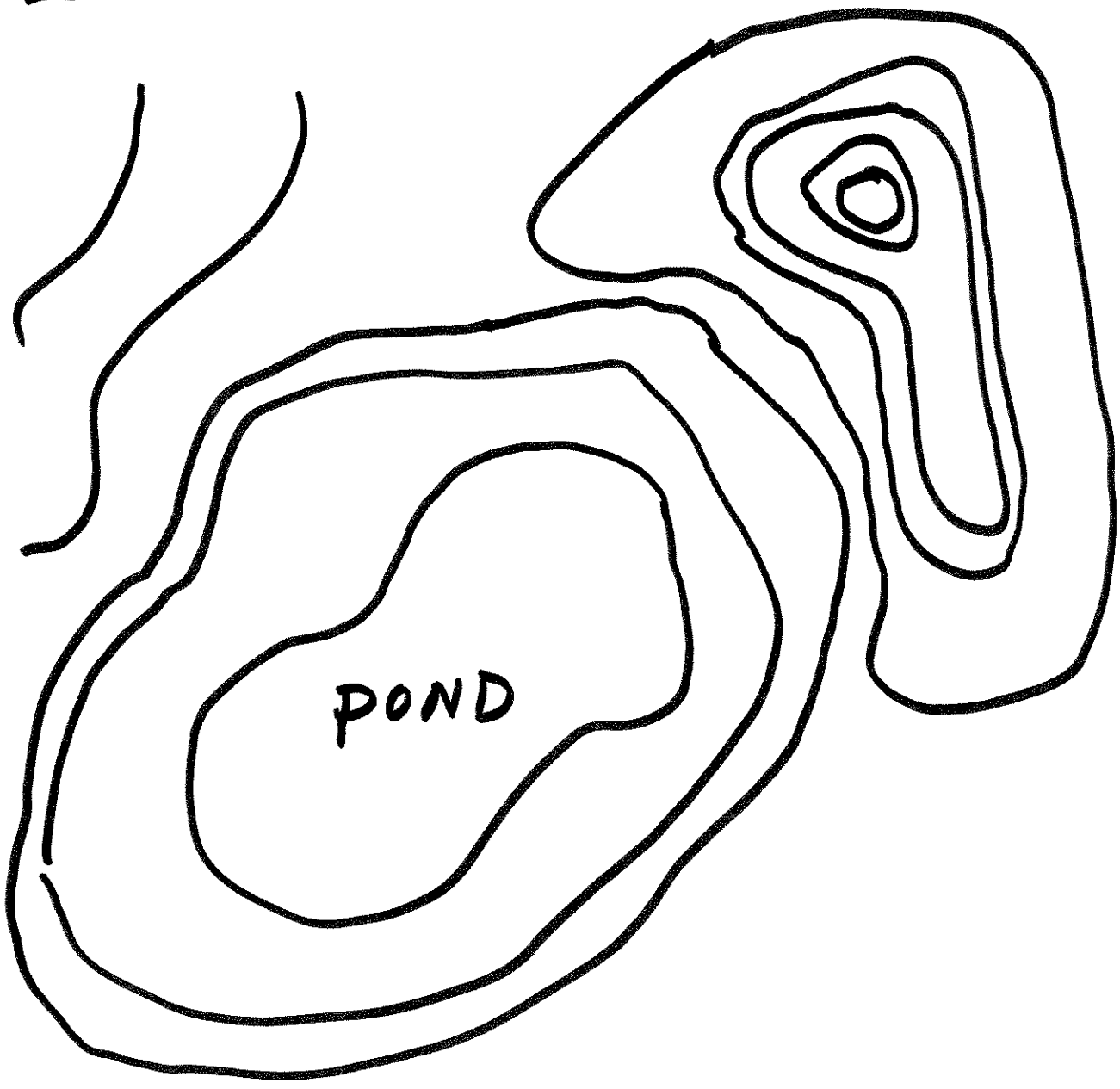
In order to focus on the field force and its origin(s), it is useful to remove the property of the test object, in the gravitational case, its mass; by dividing out the mass:

$$\frac{U}{m} = \text{gravitational potential (NOT potential energy)}$$

LET'S EXPLORE ANALOGIES BETWEEN TWO KINDS OF "FIELD FORCE", gravity and electrical forces

FIRST, GRAVITY

THINK ABOUT A TOPOGRAPHICAL MAP LIKE THIS:



# WHAT DOES THIS MEAN?

- Lines are lines of constant height (altitude)
- This is a way of depicting height (altitude or the vertical dimension) on a horizontal map (a 2-dimensional map)

# WHICH WAY IS UP?

CLICKER

The highest point depicted on the map is:

1. Somewhere above the top.
2. The pond.
3. The little circle at top right. (Are you sure?)
4. None of the above.

A TOPOGRAPHICAL MAP IS ALSO A 2-DIMENSIONAL MAP OF GRAVITATIONAL POTENTIAL AND POTENTIAL ENERGY!

RECALL

$$U_g = mgh$$ ← altitude

$$\frac{U_g}{m} = gh$$

WHY MIGHT YOU THINK THAT THE POND IS THE LOWEST POINT?

WHY IS THE POND SURFACE FLAT?

LOOK AT IT FROM THE SIDE: