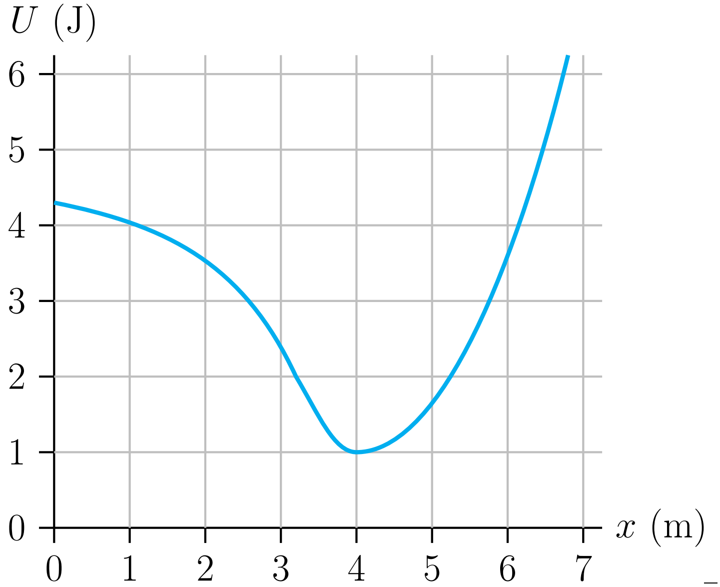
Lecture 18: Potential Energy Diagrams

Warm-Up Activity

A potential energy diagram for some system is shown at right. At what position(s) is the magnitude of the force at a maximum?



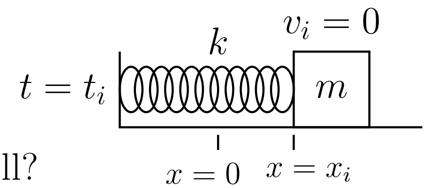
A Deeper Model for Interactions

- Quantities
  - Energy E
  - Work $W = \int_{r_i}^{r_f} \vec{F} \cdot d\vec{r}$
  - Kinetic Energy $K = \frac{1}{2}mv^2$
  - Potential Energy $U =$ depends on interaction
    You have to tell everyone where zero PE is!
    * Gravity $U_g = mgy$
    * Spring $U_{sp} = \frac{1}{2}kx^2$
- Laws
  - Work-energy theorem $W_{\text{net,ext}} = \Delta E_{\text{total}}$

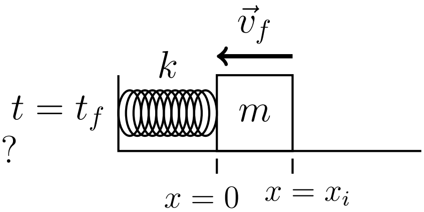
L18-1: Potential Energy Diagrams

The potential energy of the spring is given by $U_{sp} = \frac{1}{2}kx^2$.

- Sketch a potential energy diagram (a graph of U_{sp} vs. x).



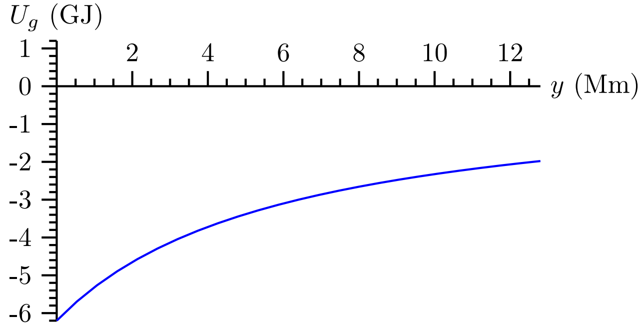
- Where is the potential energy largest? Smallest? How can you tell?
- How does the total energy change? How can you tell?



- Where is the kinetic energy largest? Smallest? How can you tell?
- Where is the spring force largest? Smallest? How can you tell?

L18-2: Astronaut Energy I

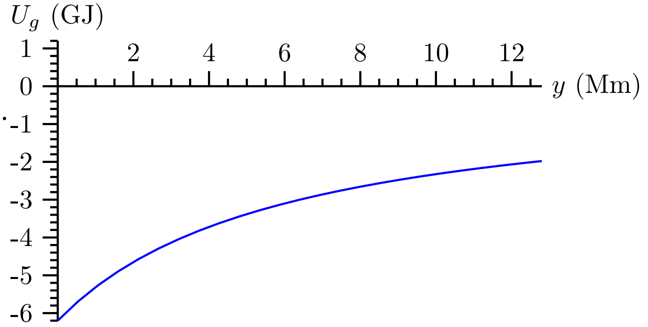
We send an astronaut into space, creating the following graph of potential energy U_g vs. distance from the surface of the Earth y.



- Describe how the potential energy of the system changes as y increases. Do you think this behavior makes sense?
- Describe how the gravitational force changes as y increases. Do you think this behavior makes sense? (**Hint:** What feature of the graph tells you about the force?)

L18-3: Astronaut Energy II

We send an astronaut into space, creating the following graph of potential energy U_g vs. distance from the surface of the Earth y.



Assume the total energy of the Astronaut-Earth system is -4 GJ.

- How high above the surface of the Earth does the astronaut go?
- What is the astronaut's largest kinetic energy? Where does this happen?

Main Ideas

- The work-energy theorem can be used to solve a broad array of problems.
- A variety of representations can be helpful in solving problems using work and energy.