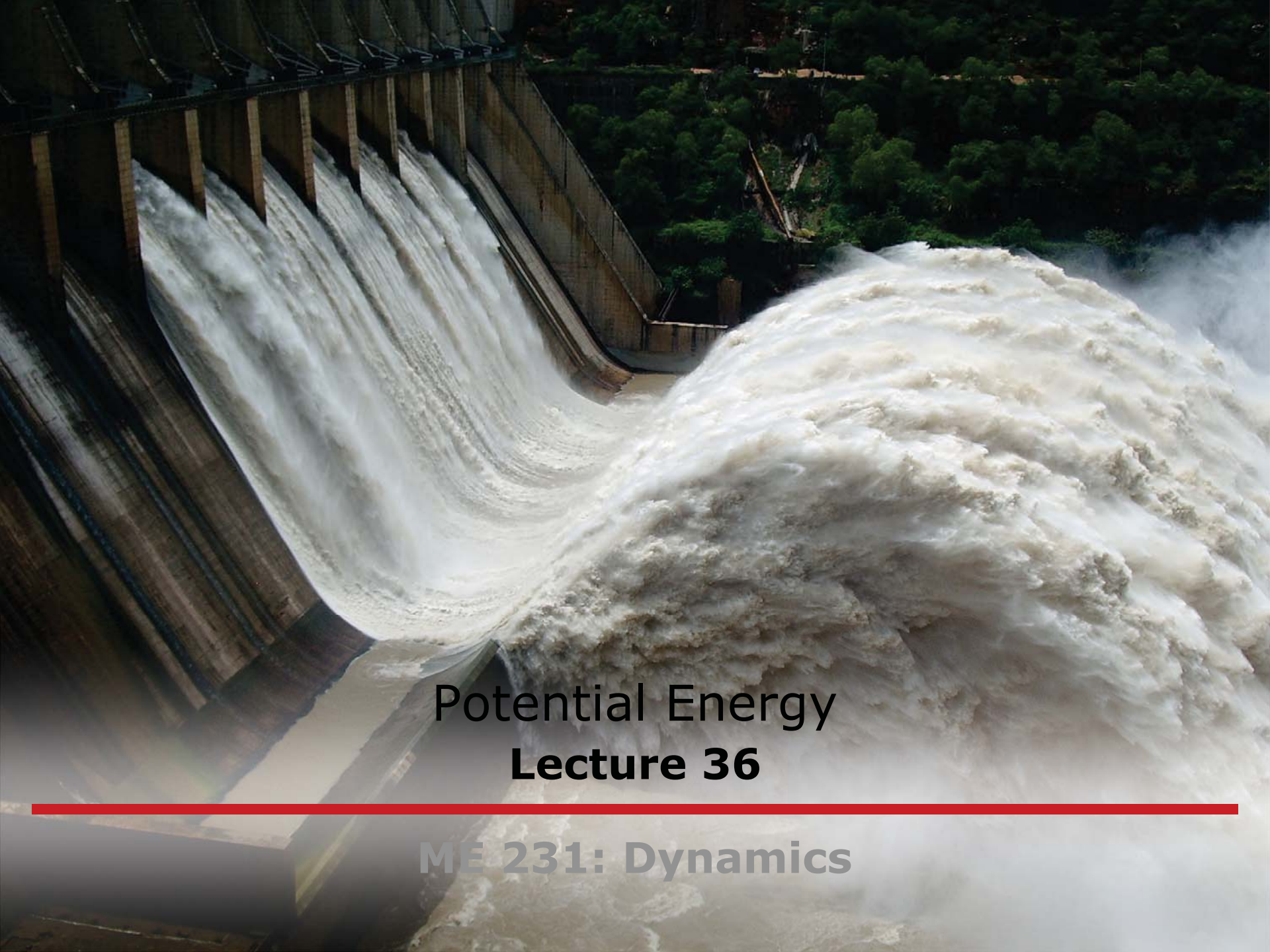


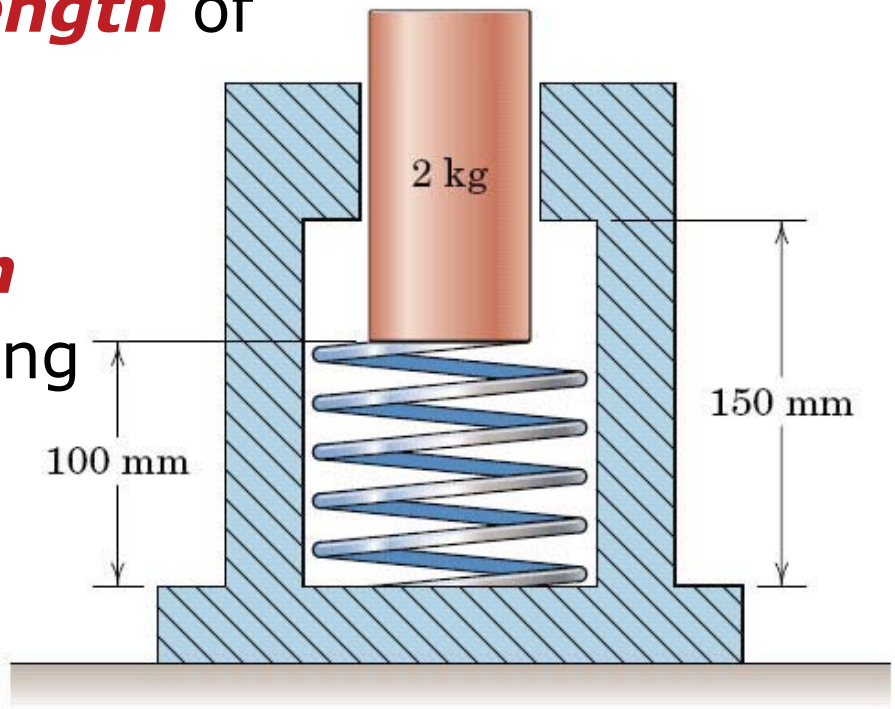
Potential Energy
Lecture 36

ME 231: Dynamics

Question of the Day

The ***2-kg*** plunger is released from rest in the position shown. The spring has a ***stiffness*** of ***500 N/m*** and ***resting length*** of ***200 mm***.

Determine the ***maximum height h*** above the starting position reached by the plunger.



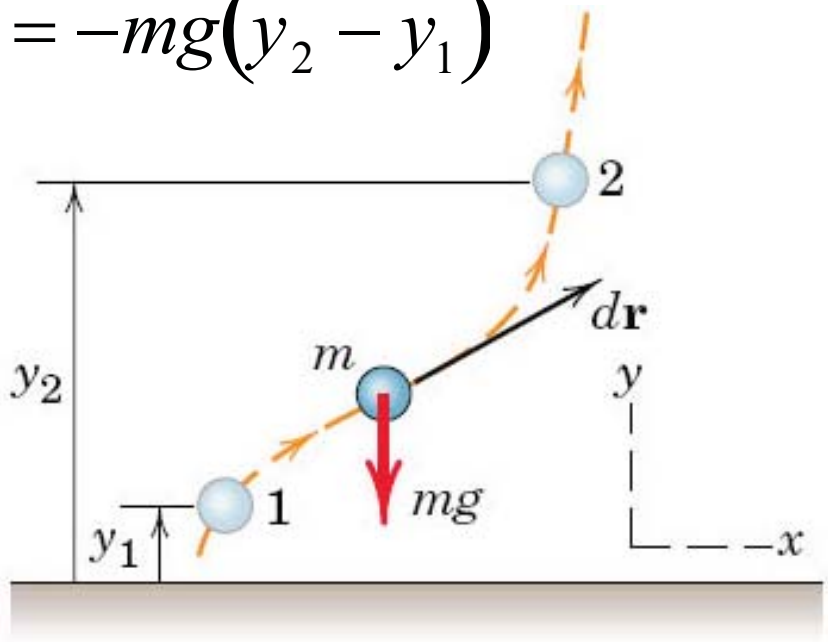
Outline for Today

- Question of the day
- Work vs. potential energy
- Gravitational potential energy
- Elastic potential energy
- Work-energy equation
- Answer your questions!

Work vs. Potential Energy

$$U = -mg\int_{y_1}^{y_2} dy = -mg\left(y_2 - y_1\right)$$

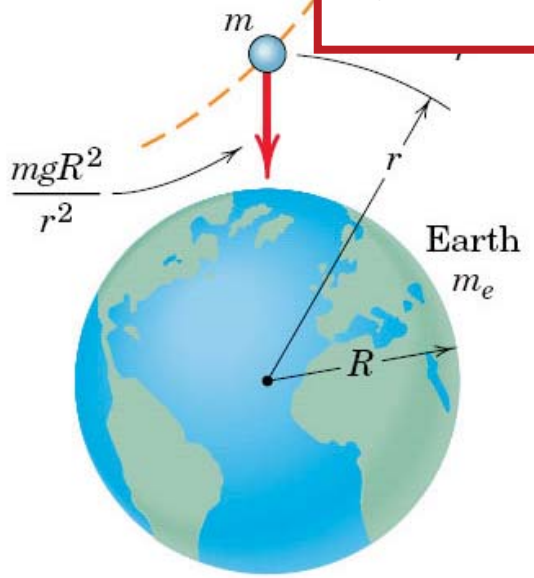
- Recall: ***Work*** is done by the ***weight mg*** over an ***altitude change (y_2-y_1)***



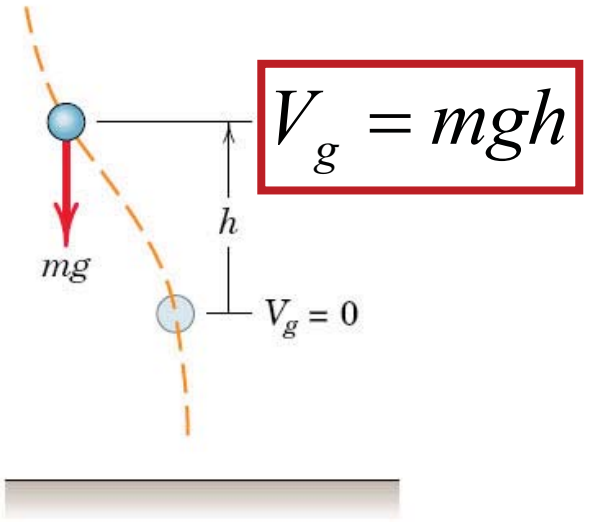
- ***Potential energy*** is simply the ***opposite sign (-work)*** because of its ***potential*** to be converted into ***energy***

Gravitational Potential Energy

$$V_g = \frac{mgR^2}{r}$$



- Particle of ***mass m*** with large changes in altitude
- ***Gravitational force*** mgR^2/r^2 is not constant



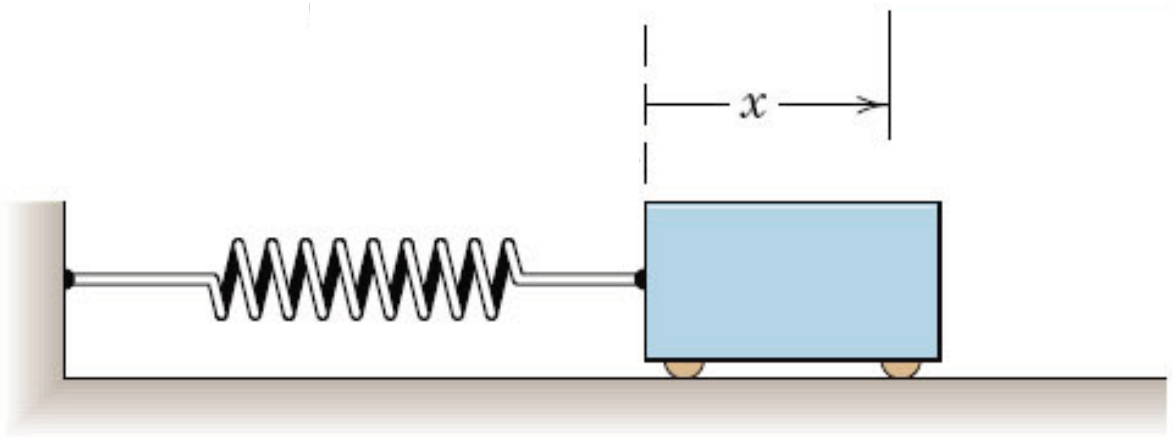
$$V_g = mgh$$

- Particle of ***mass m*** in close proximity to Earth
- ***Weight mg*** is constant
- ***Work*** is change in ***potential energy*** $mg\Delta h$

Elastic Potential Energy

- ***Stiffness*** of ***k***
- ***Displacement*** of ***x***

$$V_e = \int_0^x kx\,dx = \frac{1}{2}kx^2$$



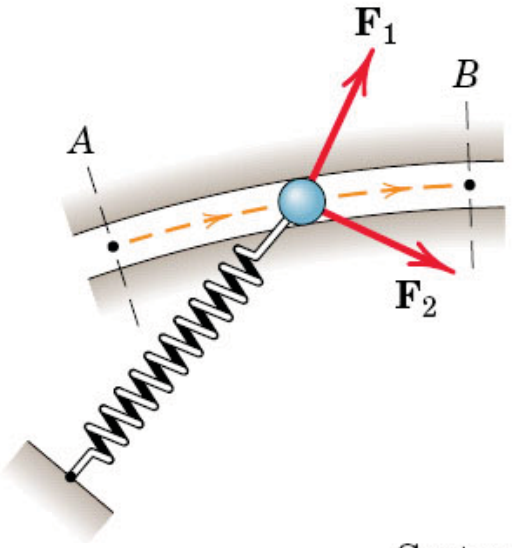
Work-Energy Equation

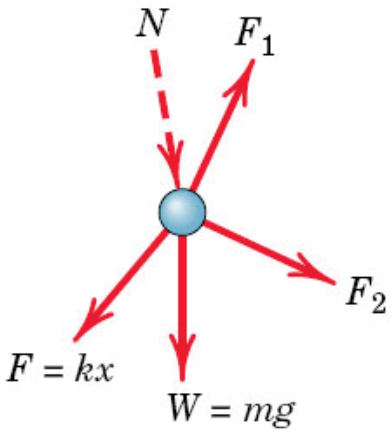
- The ***work*** of all external forces *other than* gravitational and spring forces is $\boxed{U'_{1-2}}$

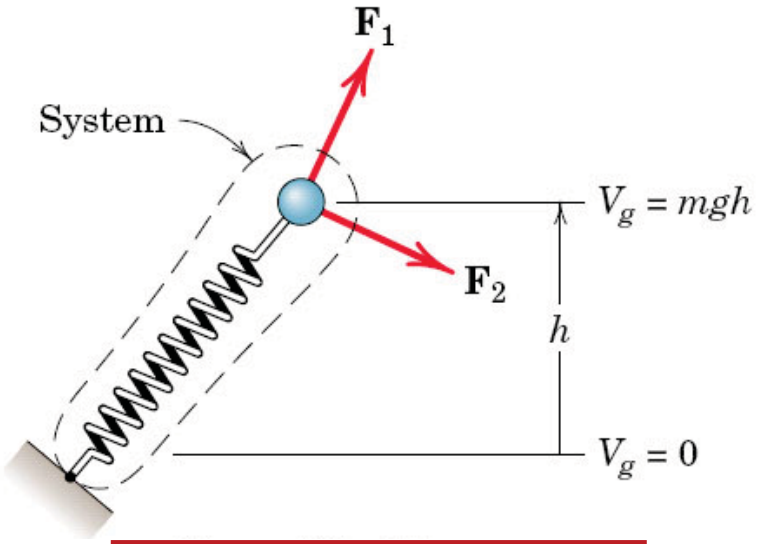
$$\boxed{U'_{1-2} = \Delta T + \Delta V} \quad \textbf{\textit{(work-energy eq.)}}$$

$$T_1 + V_1 + U'_{1-2} = T_2 + V_2$$

Work-Energy Equation: Usage



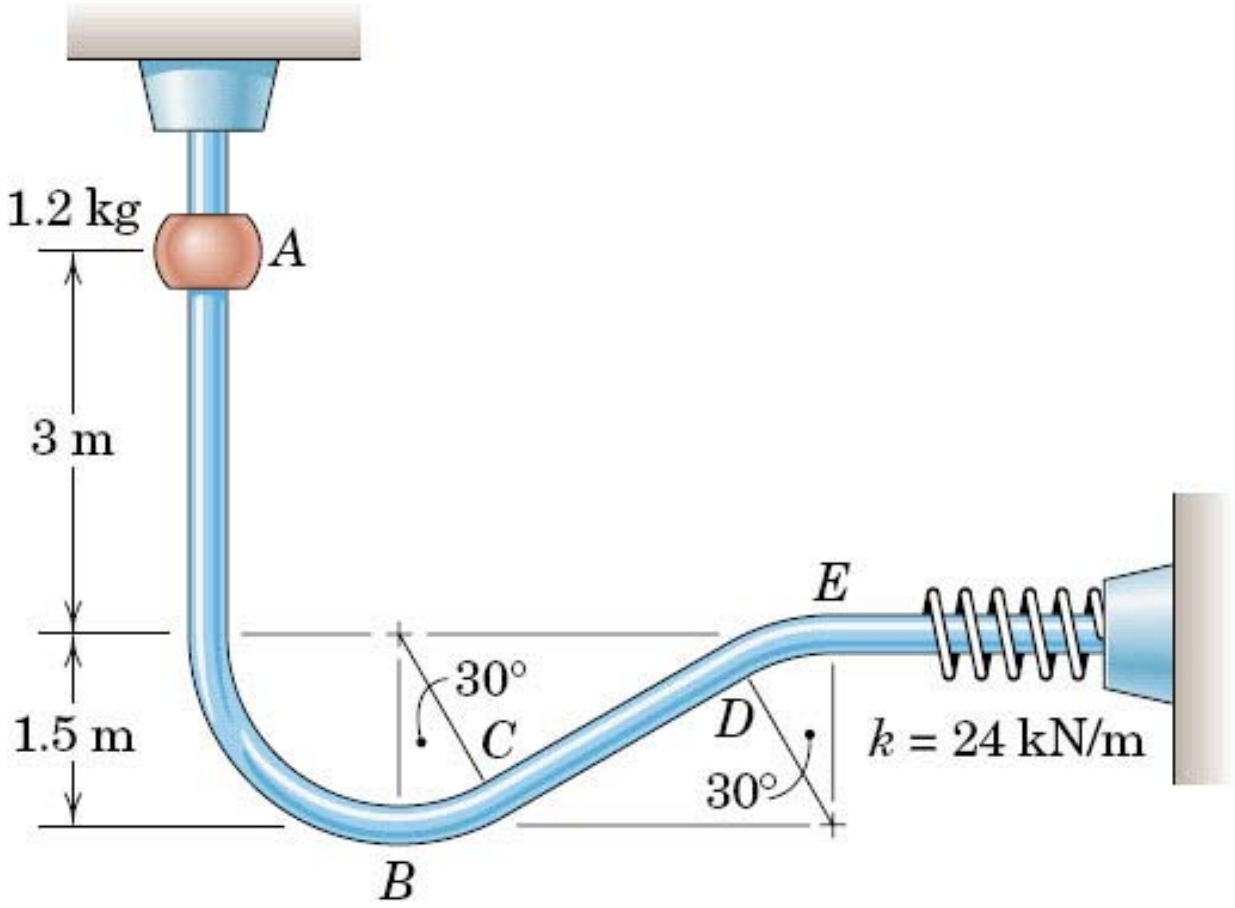




$$U_{1-2} = \Delta T$$

$$U'_{1-2} = \Delta T + \Delta V$$

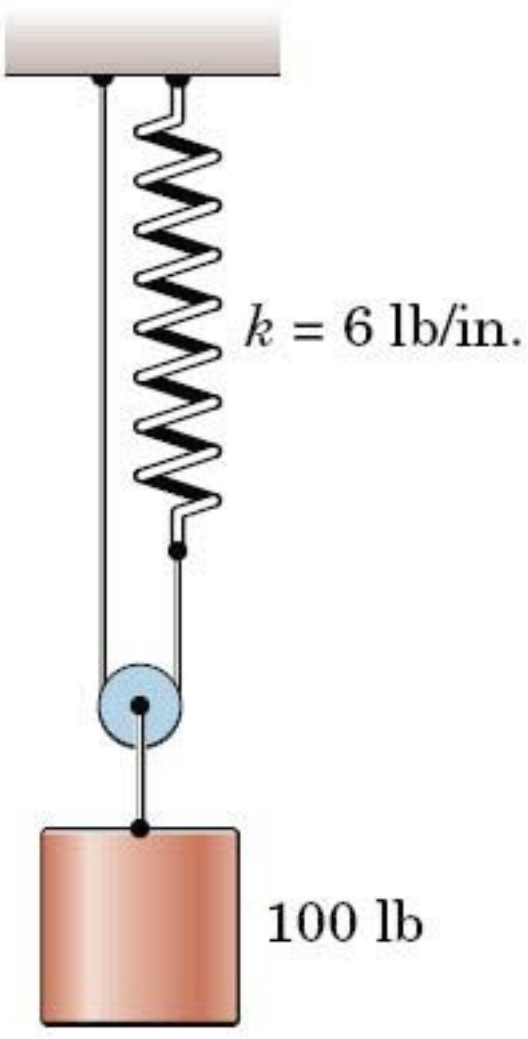
Work-Energy: Exercise 1



The ***1.2-kg*** slider is released from rest at A and slides without friction along the guide.

Determine (a) the ***speed*** v_B of the slider at B and (b) the ***maximum deflection*** δ of the spring.

Work-Energy: Exercise 2

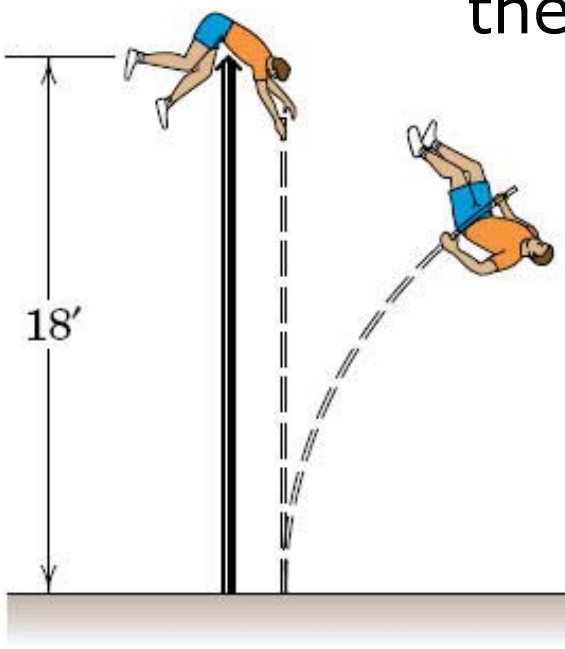


The system is released from rest with the spring initially ***stretched 3 in***.

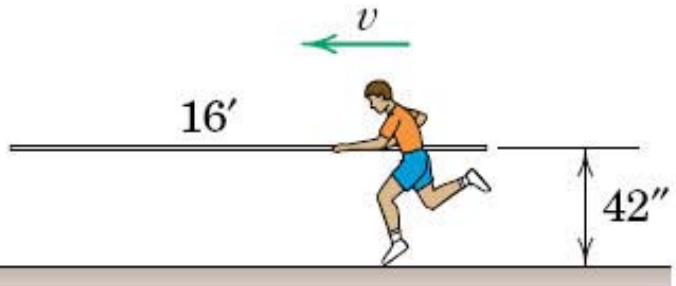
Determine the ***velocity v*** of the cylinder after it has ***dropped 0.5 in***.

Work-Energy: Exercise 3

A ***175-lb*** pole vaulter carrying a uniform ***16-ft***, ***10-lb*** pole approaches the jump with a ***velocity v*** and barely clears the bar ***height*** of ***18 ft*** when he and the pole have essentially ***zero velocity***.



Determine the ***minimum*** value of ***v*** to make the jump.



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For Next Time…

- Finish Homework #12 due on ***Tonight(11/26), note date change***
- Read Chapter 4, Section 4.3