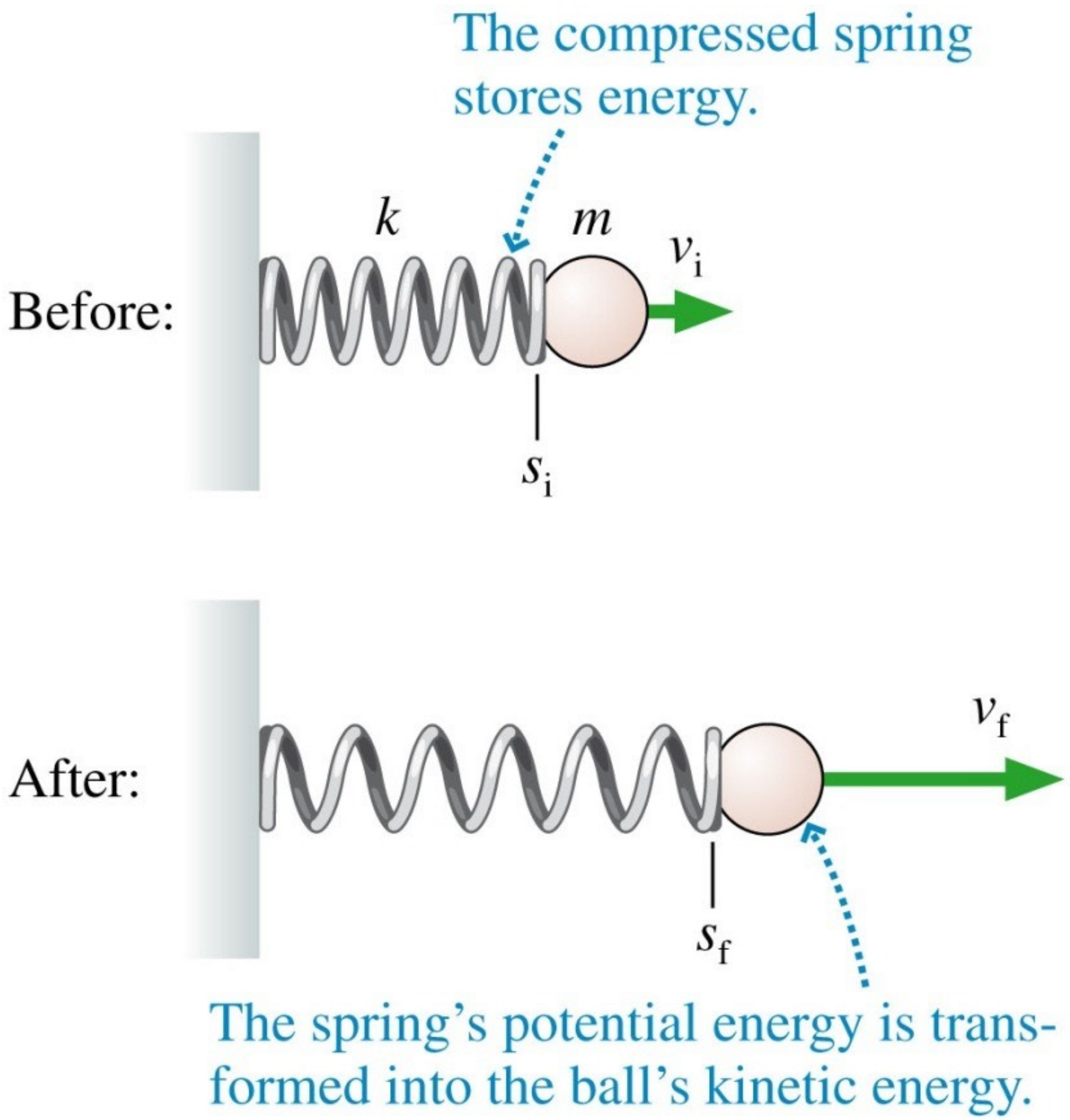
Work done by spring

$$F_{\text{sp}} = -k\Delta s$$



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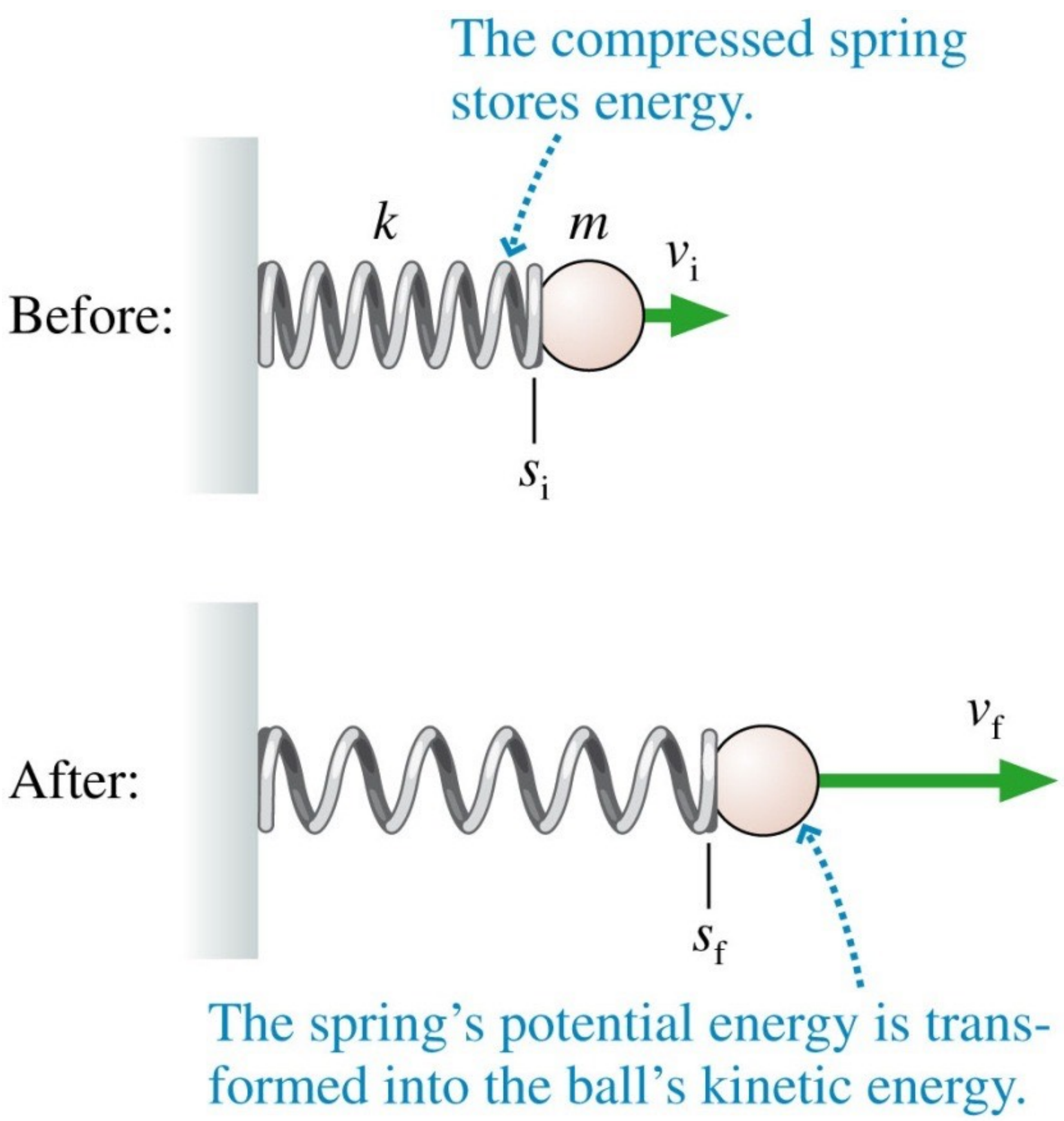
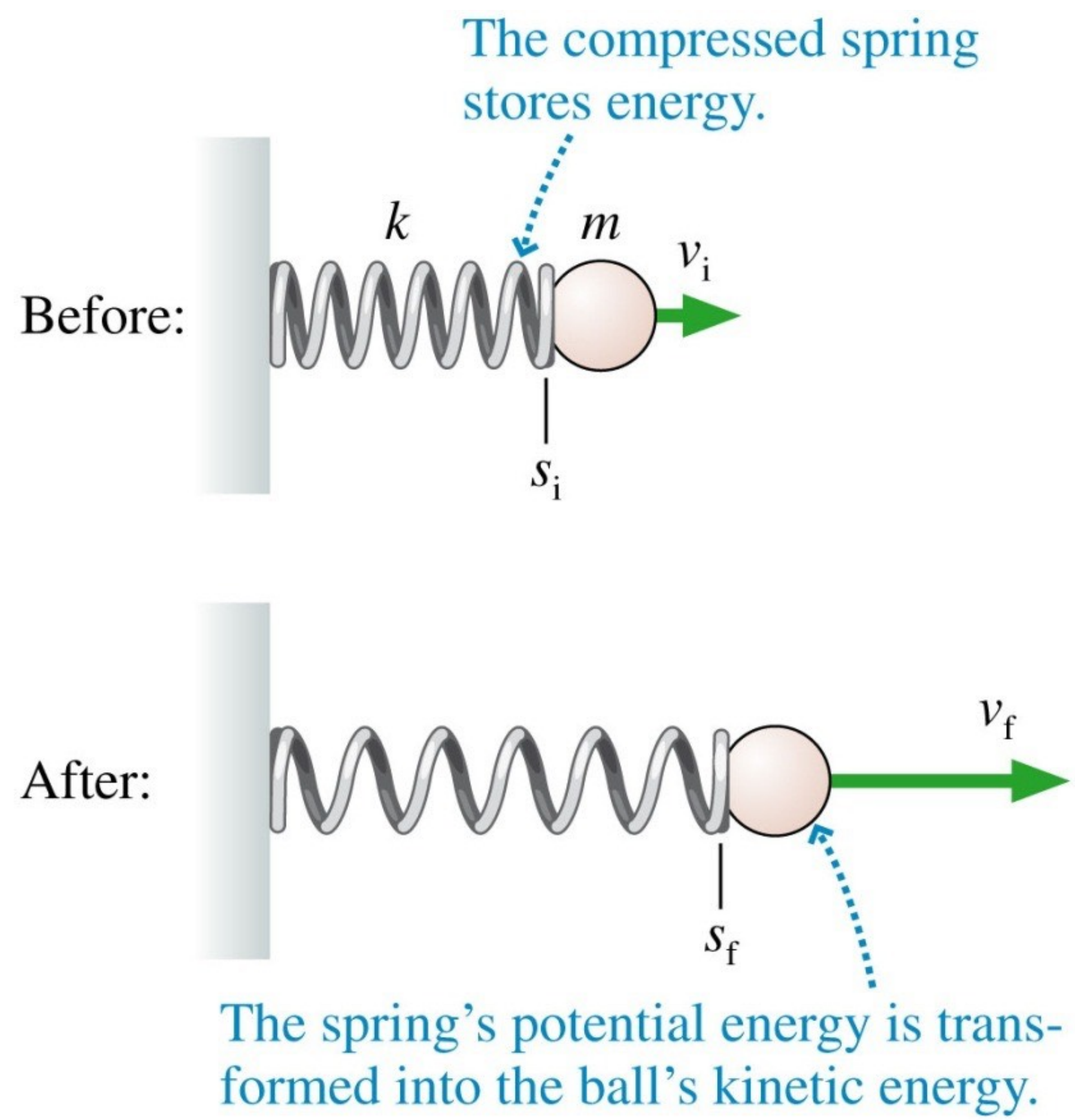


$$W = -\left(\frac{1}{2}k\Delta x_f^2 - \frac{1}{2}k\Delta x_i^2\right)$$

Work done by spring

$$F_{\text{sp}} = -k\Delta s$$



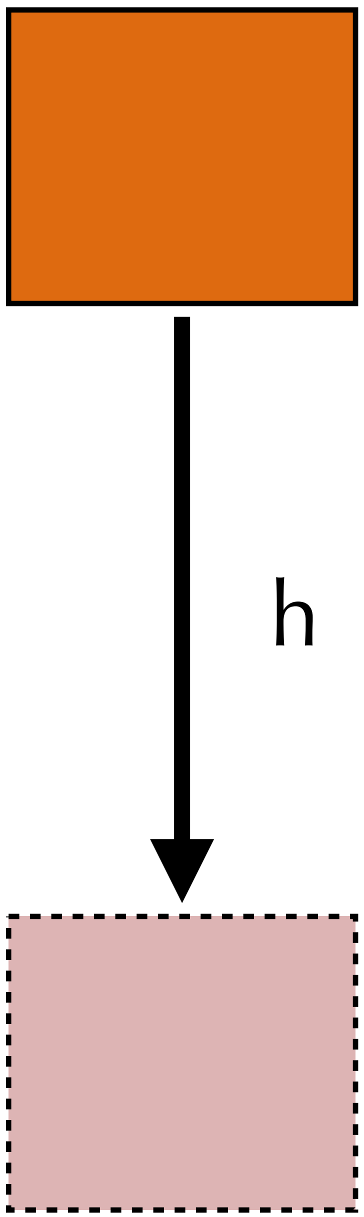
$$W = -\left(\boxed{\frac{1}{2}k\Delta x_f^2} - \frac{1}{2}k\Delta x_i^2\right)$$

Question #3

A $W = -mgh$

B $W = -\frac{mgh}{2}$

C



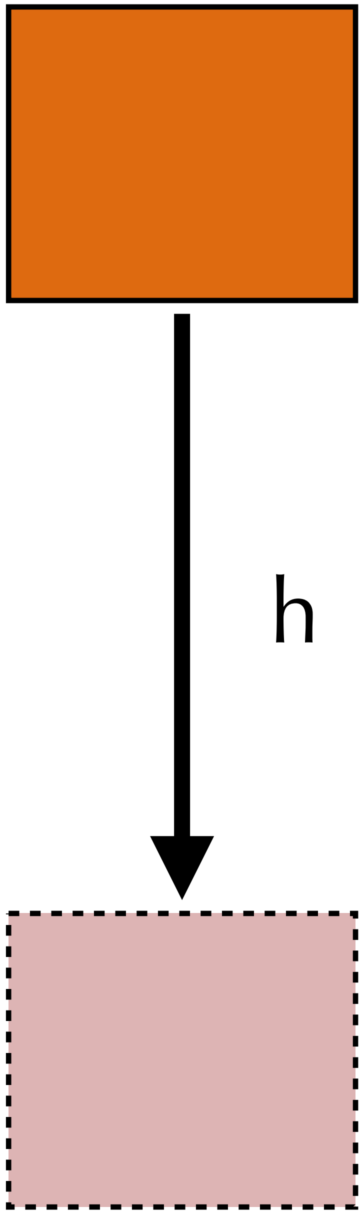
Question #3

How much work does gravity do as this box falls vertically a distance h?

A $W = -mgh$

B $W = -\frac{mgh}{2}$

C



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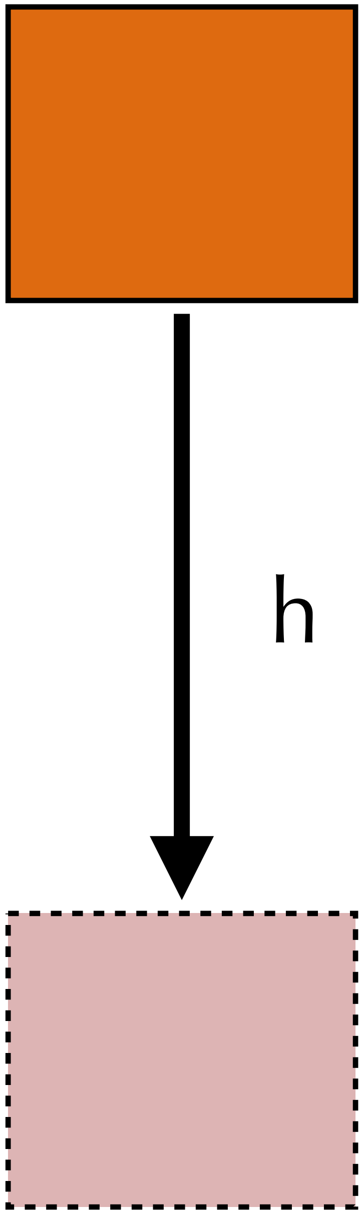
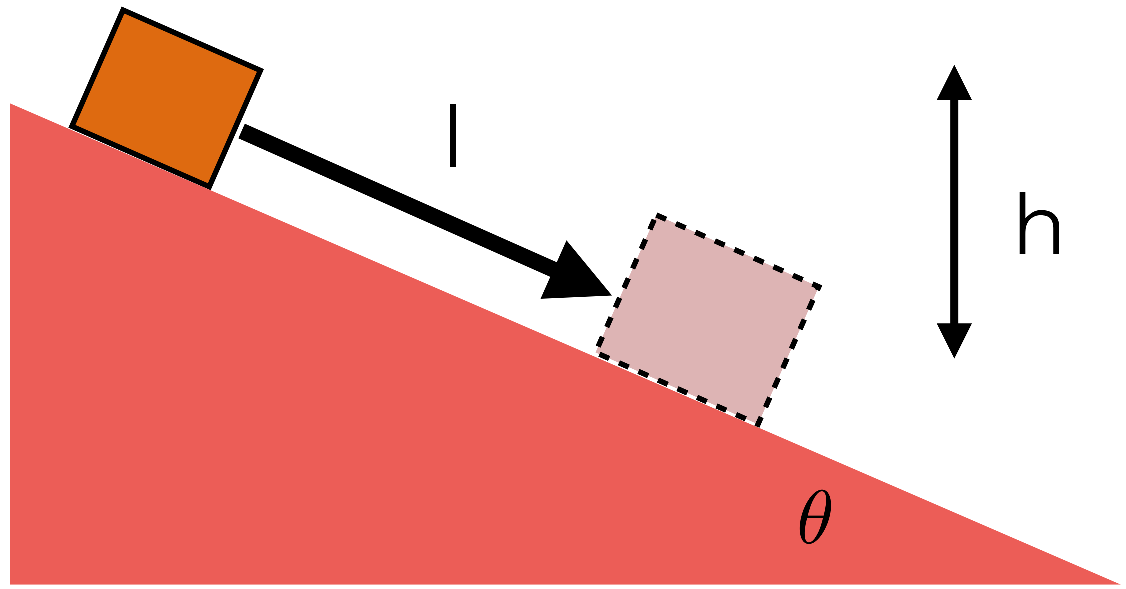


Question #4



A $W = -mgh$

B

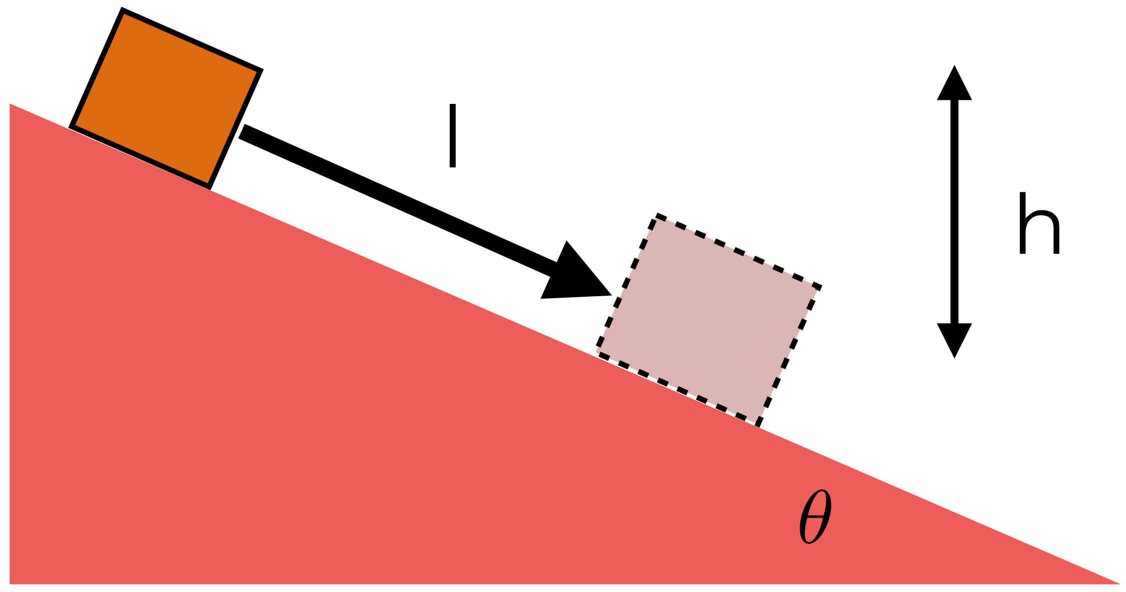
C $W = -mgl\sin\theta$

D. Both b) and e) are correct.

E $W = mgl\sin\theta$

Question #4

How much work does gravity do as the box slides down the incline?



A $W = -mgh$

B

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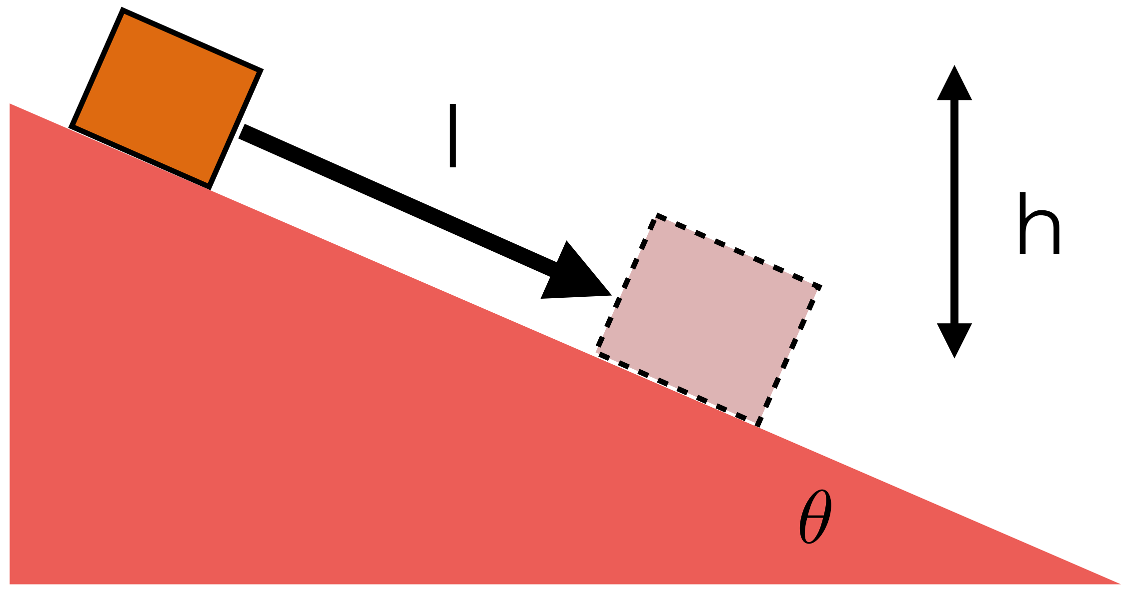

A $W = -mgh$

B $W = mgh$

C $W = -mgl\sin\theta$

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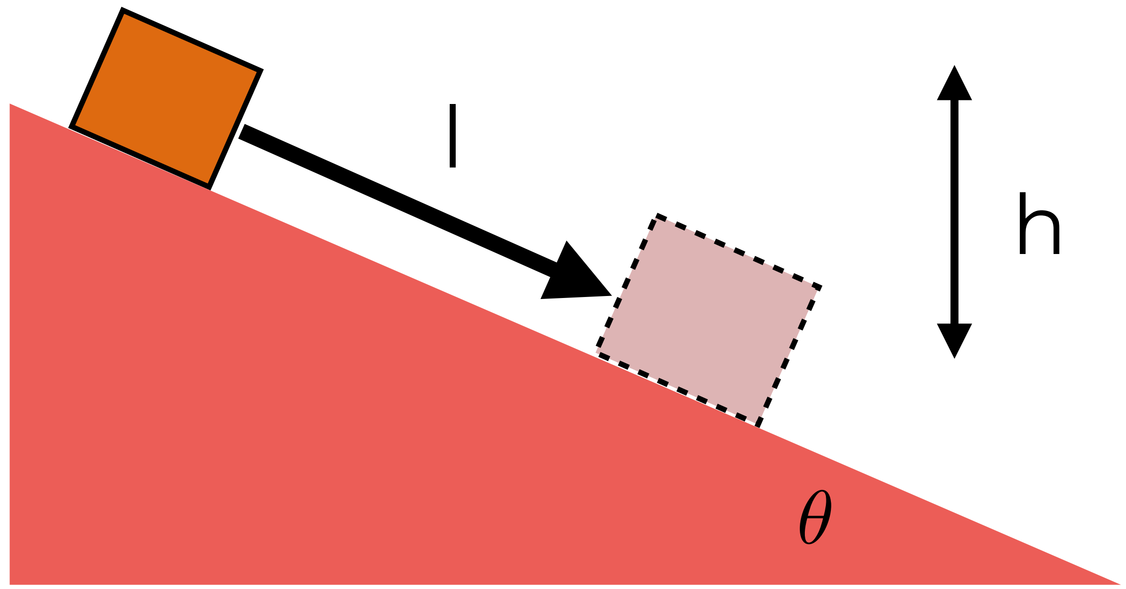


$$W = -\Delta U$$

A $W = -mgh$

B $W = mgh$

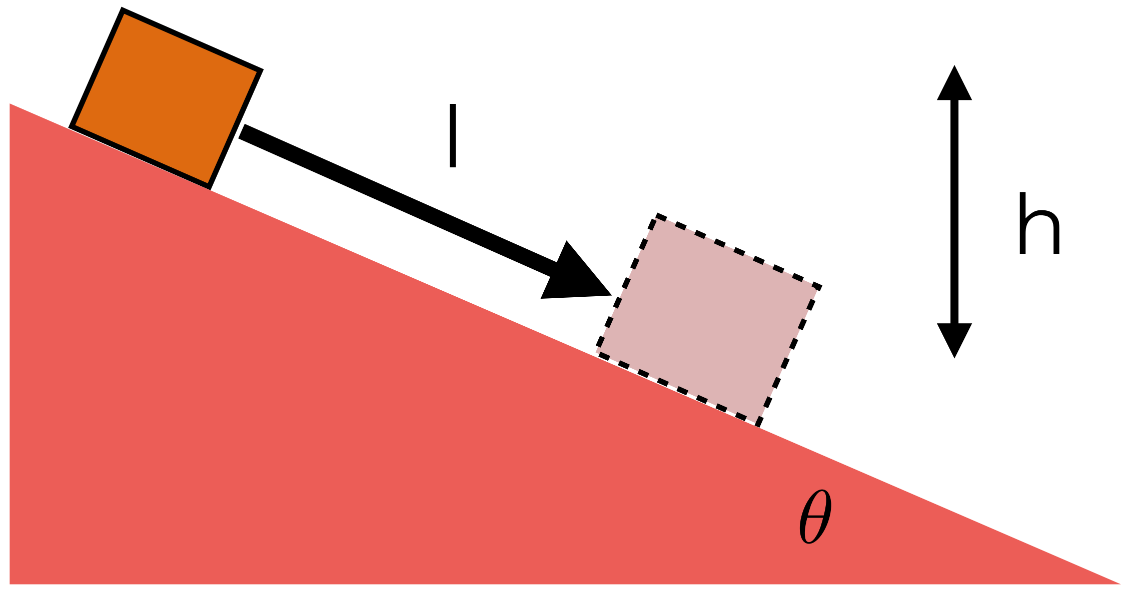
C $W = -mgl\sin\theta$

D. Both b) and e) are correct.

E $W = mgl\sin\theta$

Question #4

How much work does gravity do as the box slides down the incline?



$$W = -\Delta U$$

$$U_g = mgy$$

A $W = -mgh$

B $W = mgh$

C $W = -mgl\sin\theta$

D. Both b) and e) are correct.

E $W = mgl\sin\theta$

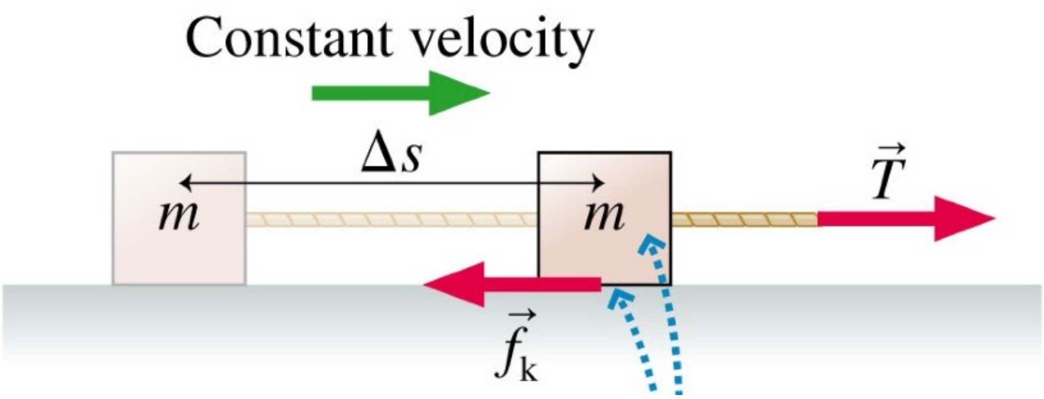
$$\Delta K = W_{\text{net}}$$

but if there are ever springs in the system and/or the vertical position of the object changes, I can just use.

$$\Delta K + \Delta U_s + \Delta U_g = W_{\text{net}}$$

Dissipative Forces

$$\Delta K + \Delta U_s + \Delta U_g = W_{\text{net}}$$



$$\Delta K + \Delta U_s + \Delta U_g + \Delta E_{\text{th}} = W_{\text{net}}$$

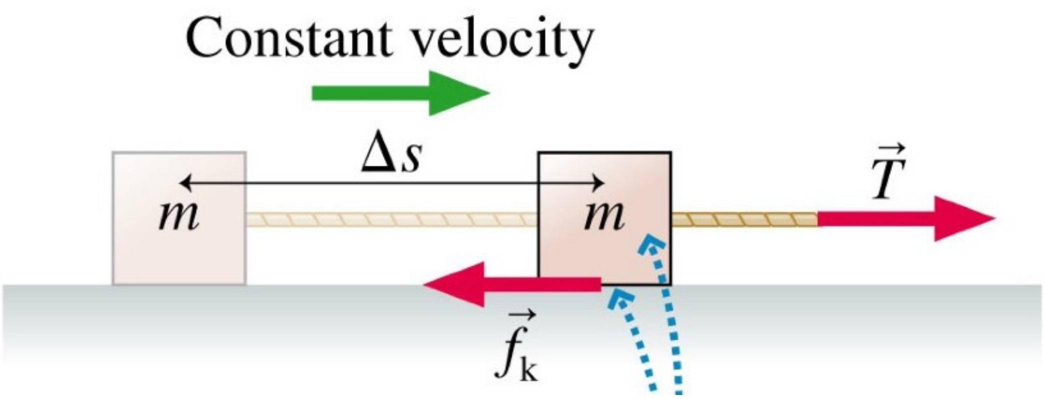
$$\boxed{U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}}$$

Dissipative Forces

$$\Delta K + \Delta U_s + \Delta U_g = W_{\text{net}}$$

$$\Delta E_{\text{th}} = f_{\text{k}} \Delta s$$

But if friction is present, let's use:

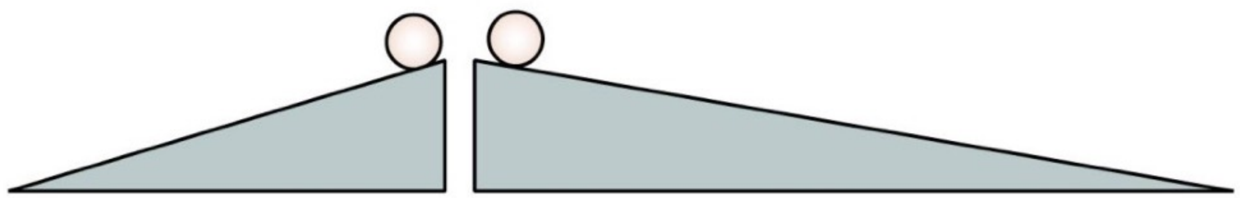


$$\Delta K + \Delta U_s + \Delta U_g + \Delta E_{\text{th}} = W_{\text{net}}$$

$$\boxed{U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}}$$

Question #5

Starting from rest, a marble first rolls down a steeper hill, then down a less steep hill of the same height. For which is it going faster at the bottom?



a. Same speed at the bottom of both hills.

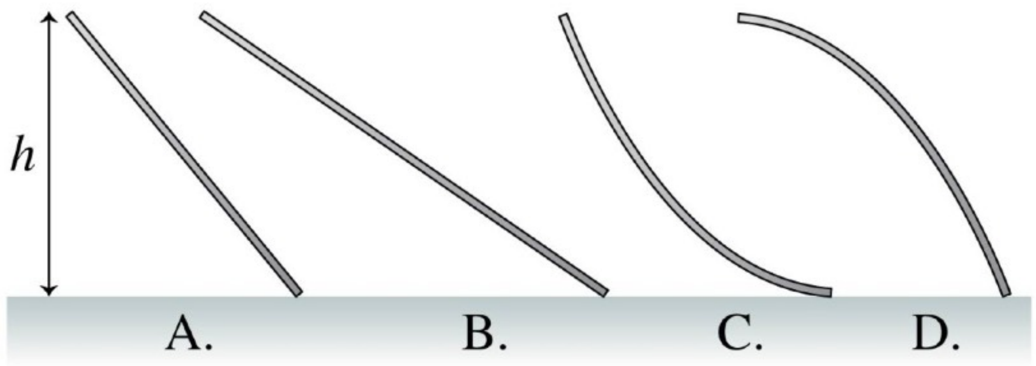
b. Faster at the bottom of the steeper hill.

c. Faster at the bottom of the less steep hill.

d. Can't say without knowing the mass of the marble.

Question #6

A small child slides down the four frictionless slides A–D. Rank in order, from largest to smallest, her speeds at the bottom.



a. $v_D > v_A > v_B > v_C$

b. $v_A = v_B = v_C = v_D$

c. $v_D > v_A = v_B > v_C$

d. $v_C > v_A > v_B > v_D$

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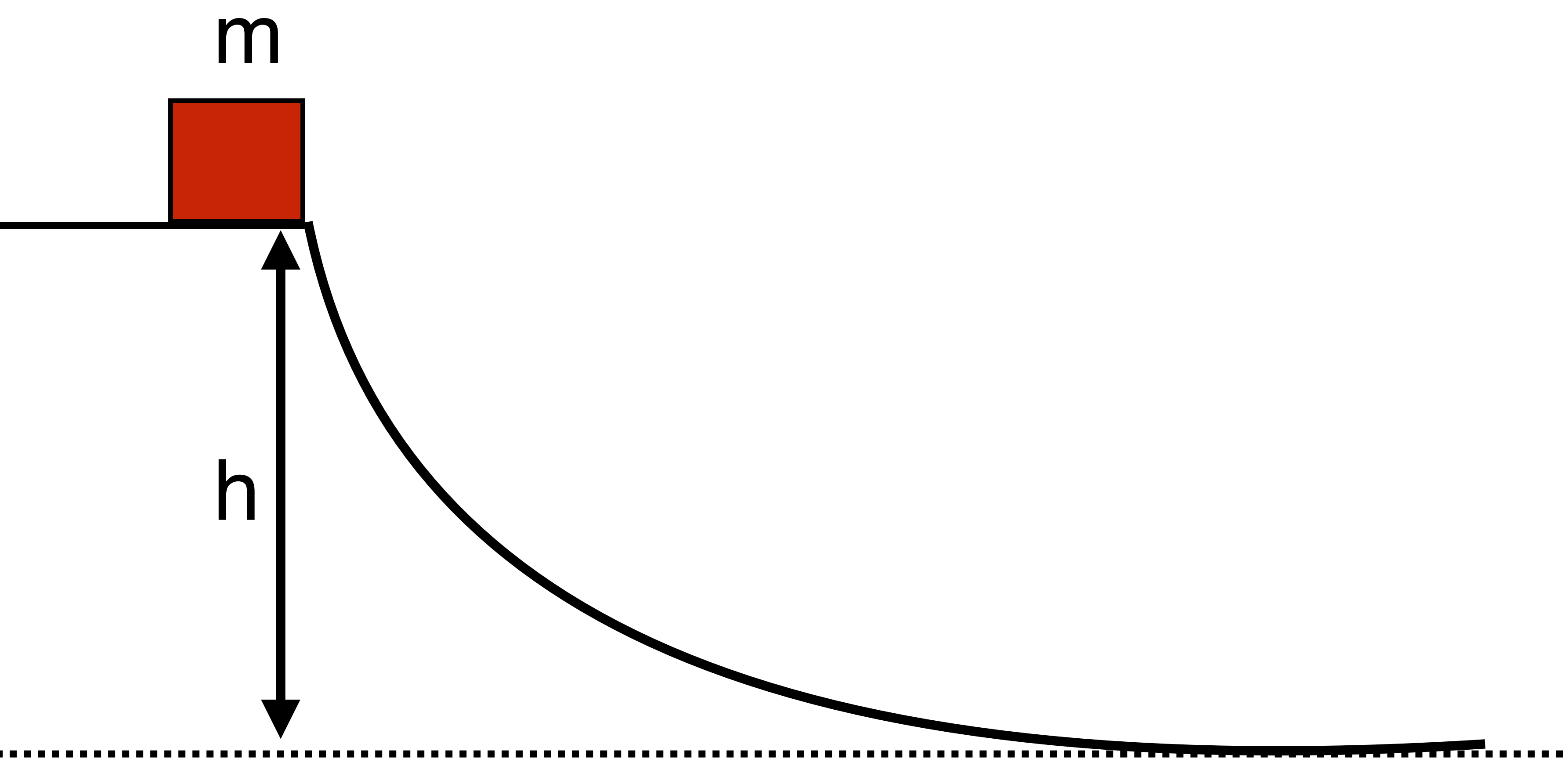
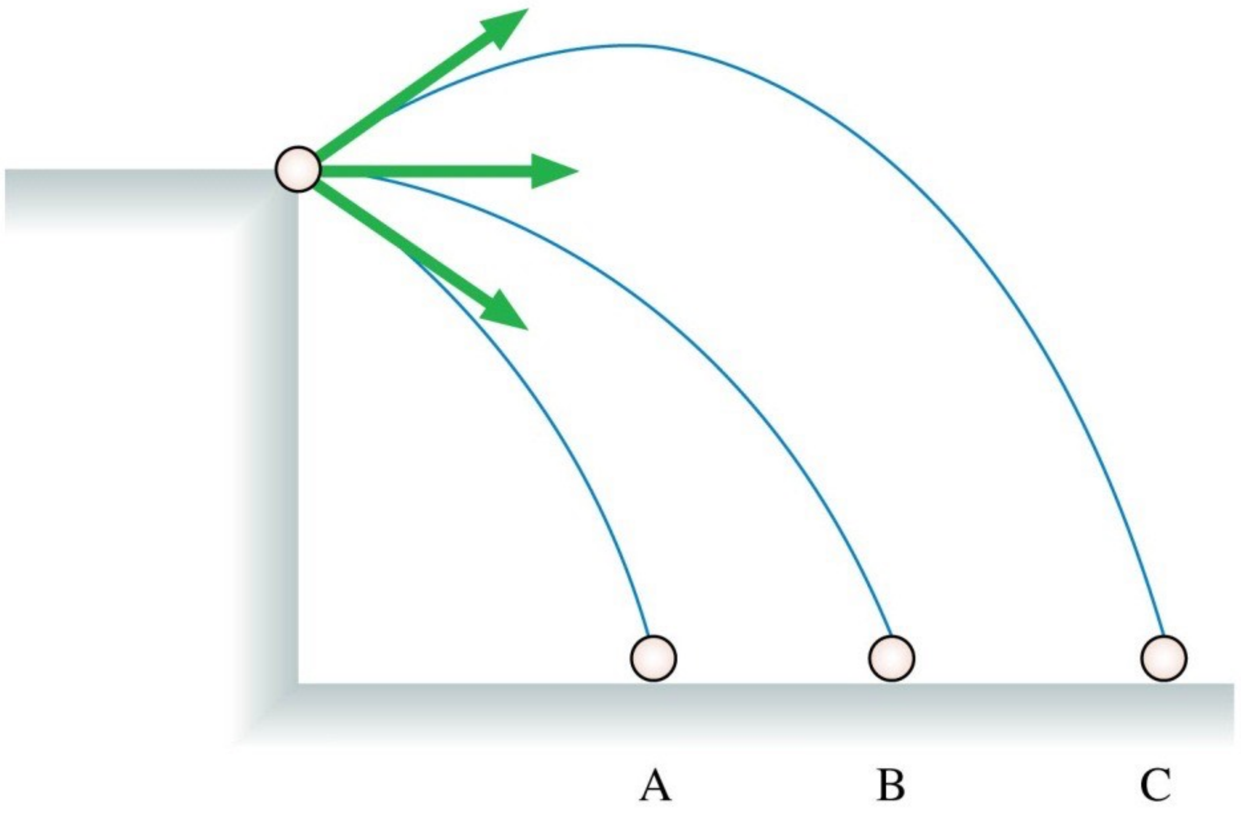
How fast is the block moving at the bottom of the hill?



Question #7

Three balls are thrown from a cliff with the same speed but at different angles. Which ball has the greatest speed just before it hits the ground?



A. Ball A
B. Ball B
C. All balls have the same speed.
D. Ball C

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Question #8

A hockey puck sliding on smooth ice at 4 m/s comes to a 1-m-high hill. Will it make it to the top of the hill?

A. Yes
B. No
C. Can't answer without knowing the mass of the puck.
D. Can't say without knowing the angle of the hill.

Question #9

A spring-loaded gun shoots a plastic ball with a launch speed of 2.0 m/s. If the spring is compressed twice as far, the ball's launch speed will be

a. 1.0 m/s.
b. 2.0 m/s.
c. 4.0 m/s
d. 2.8 m/s.
e. 16.0 m/s.

Quiz

A spring-loaded gun shoots a plastic ball with a launch speed of 2.0 m/s. If the spring is compressed twice as far, the ball's launch speed will be

a. 1.0 m/s.
b. 2.0 m/s.
c. 2.8 m/s
d. 4.0 m/s.
e. 16.0 m/s.

Conservation of energy: $\frac{1}{2}mv^2 = \frac{1}{2}k(\Delta x)^2$

Double $\Delta x \Rightarrow$ double v

Using Work and Potential Energy

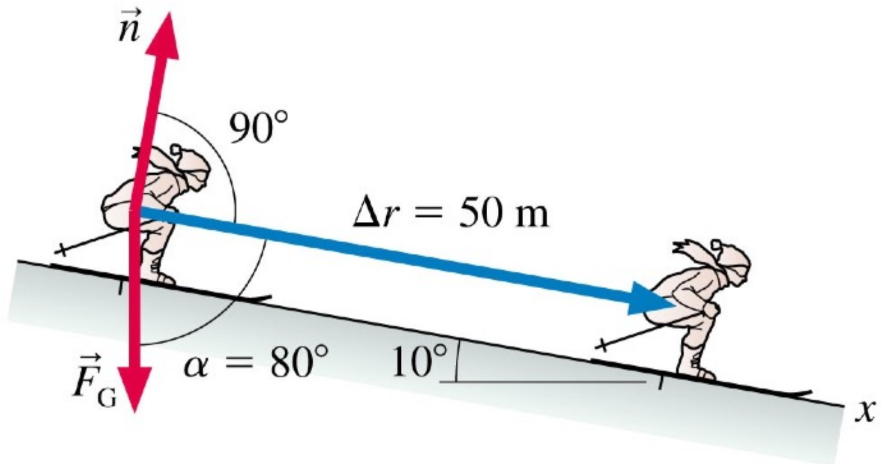
Question #10

A 70-kg skier is gliding at 2.0 m/s when he starts down a very slippery 50-m long, 10 degree slope. What is his speed at the bottom if the wind exerts a steady 50 N retarding force opposite his motion?

Which equation is a correct statement of conservation of energy for this problem?

E $mg\Delta r \sin\theta + \frac{1}{2}mv_i^2 - F_W \Delta r \cos\theta = \frac{1}{2}mv^2 + \Delta E_{th}$

D $mg\Delta r \cos\theta + \frac{1}{2}mv_i^2 + F_W \Delta r \cos\theta = \frac{1}{2}mv^2 + \Delta E_{th}$



C $mg\Delta r \sin\theta + \frac{1}{2}mv_i^2 + F_W \Delta r \cos\theta = \frac{1}{2}mv^2 + \Delta E_{th}$

B. $mg\Delta r \sin\theta + \frac{1}{2}mv_i^2 - F_W \Delta r \sin\theta = \frac{1}{2}mv^2 + \Delta E_{th}$

E

$$U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}$$

A problem

Question #11

A 20-kg person slides down a rough 3.0-m-high playground slide. She starts from rest, and her speed at the bottom is 2.0 m/s.

Which is a correct statement of conservation of energy for this situation?

E $mgh - mgl\sin\theta = \frac{1}{2}mv_f^2 + \Delta E_{\mathrm{th}}$

D $mgh = \frac{1}{2}mv_f^2 + \Delta E_{\mathrm{th}}$

C $mgh + \frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2 + \Delta E_{\mathrm{th}}$

B. $mgh\cos\theta = \frac{1}{2}mv_f^2 + \Delta E_{\mathrm{th}}$

$$U_i + K_i + W_{\mathrm{ext}} = U_f + K_f + \Delta E_{\mathrm{th}}$$

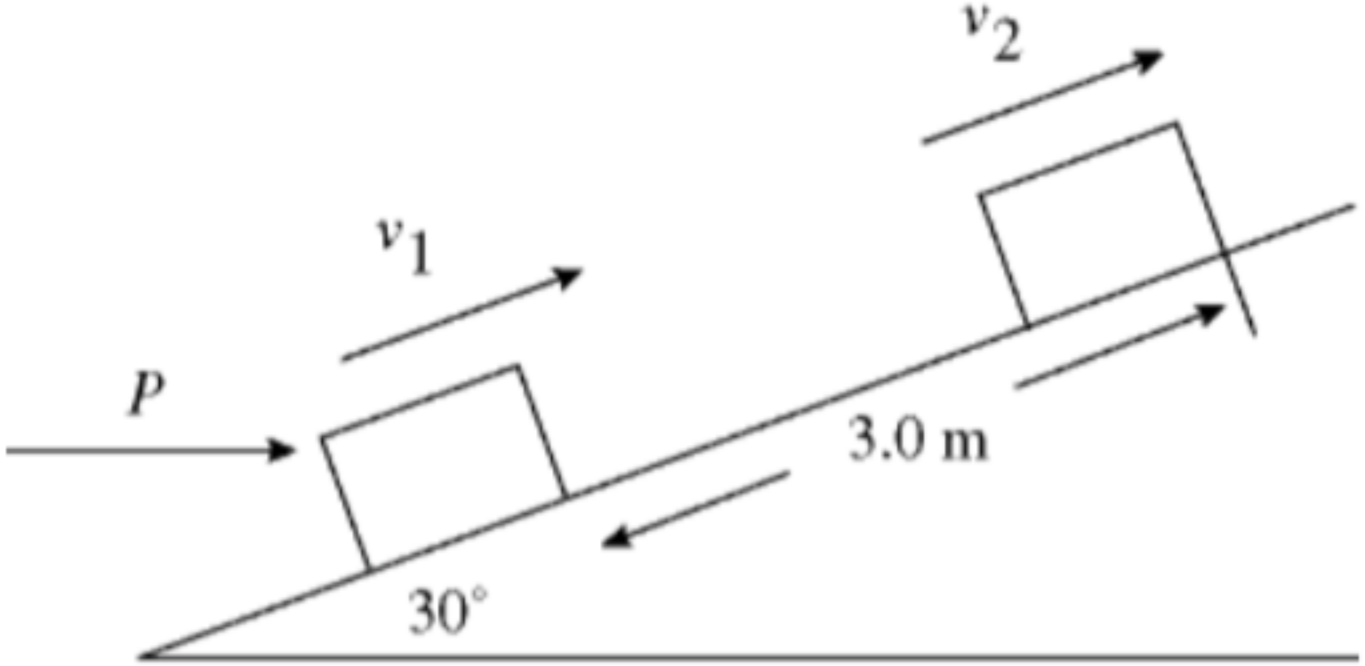
Another Problem

A horizontal spring with a spring constant of 100 N/m is compressed 20 cm and used to launch a 2.5 kg box across a frictionless, horizontal surface. After the box travels some distance the surface becomes rough. The coefficient of kinetic friction of the box on the surface is 0.15. Use work and energy to find how far the box slides across the rough surface before stopping.

$$U_i + K_i + W_{\text{ext}} = U_f + K_f + \Delta E_{\text{th}}$$

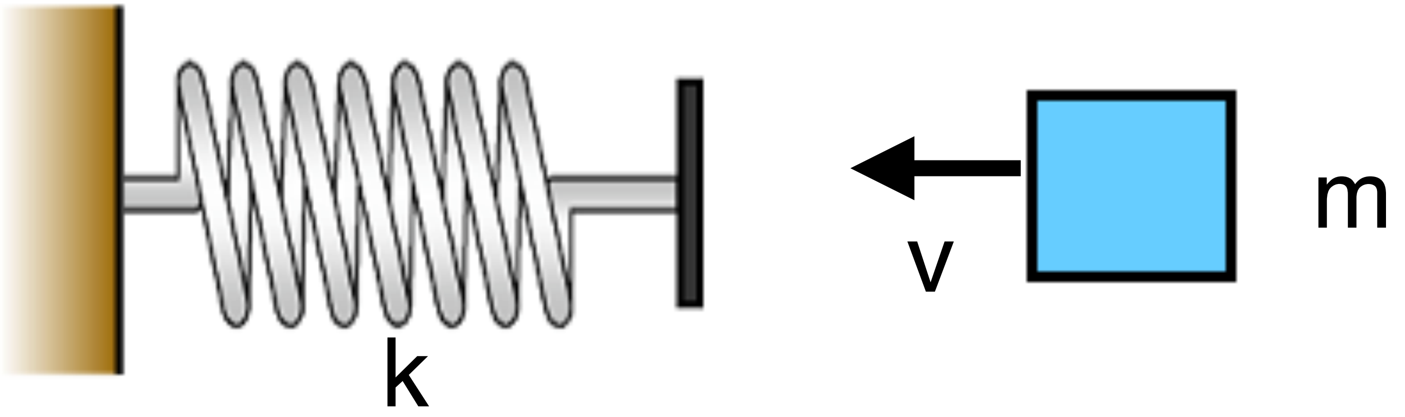
In the figure, a 900-kg crate is on a rough surface inclined at 30º. A constant external force P =7200 N is applied horizontally to the crate. While this forces pushes the crate a distance of 3.0 m up the incline, its velocity changes from 1.2 m/s to 2.3 m/s. How much new thermal energy is generated?

a) 4200 J
b) 7200 J
c) 3700 J
d) 1500 J
e) 5500 J

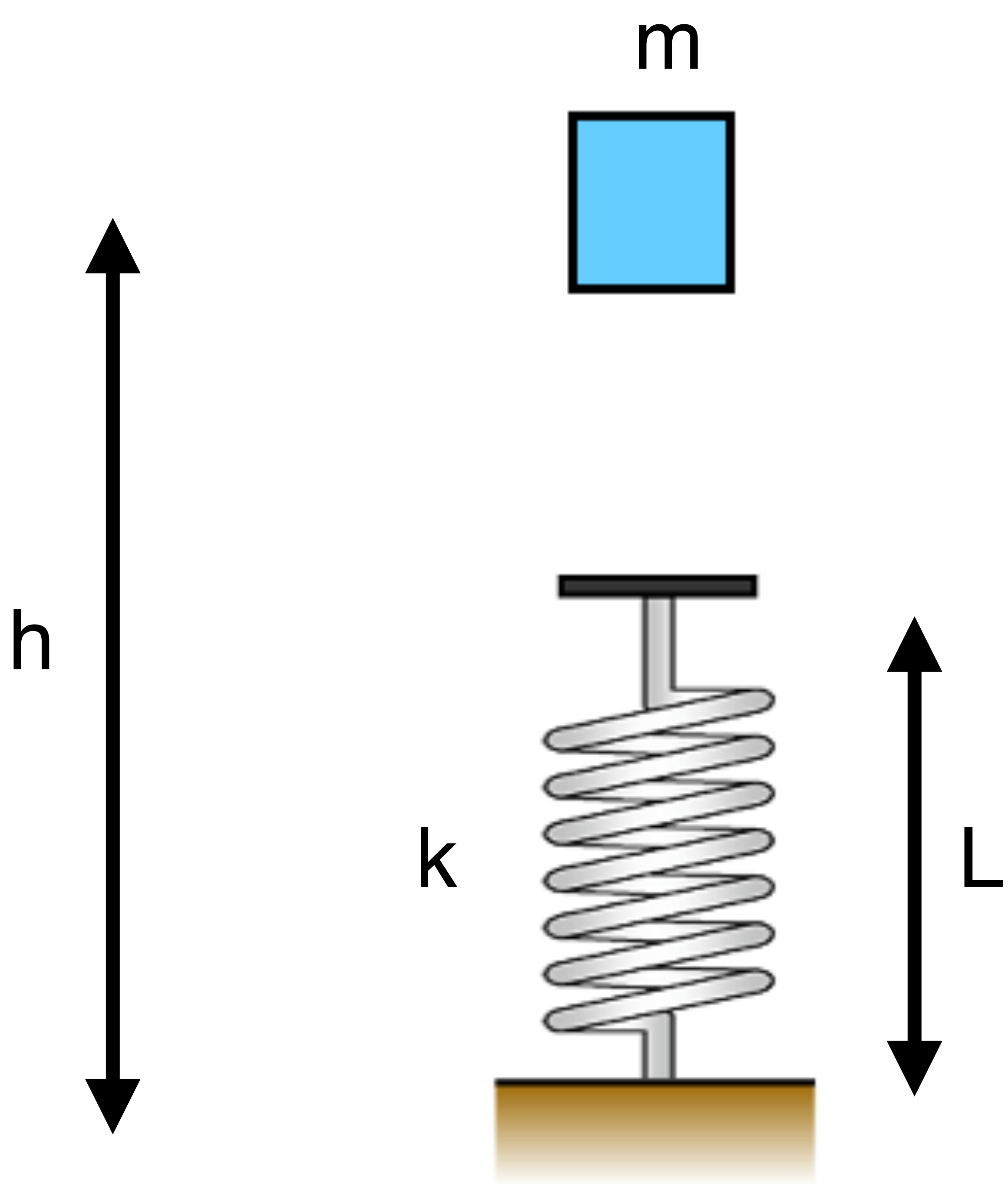


Spring potential energy

By how much does the spring compress?



Spring potential energy



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