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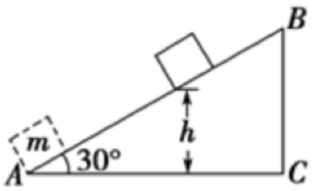
Lesson 2.3: Elastic potential energy and conservation of energy

Warmer question: (more than 1 correct answer…)

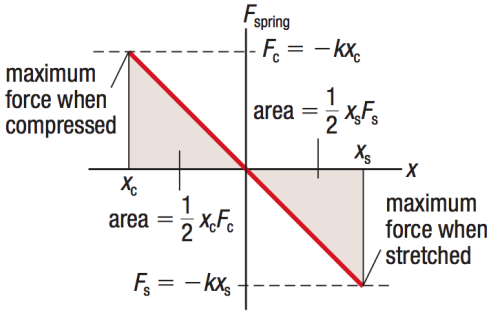
As shown in the diagram, the block with a mass of m sliding up from point A with initial velocity at uniform deceleration of $\frac{3}{4}g$ to reach the maximum height of h. The ramp is inclined at 30°and friction between ramp and block is NOT negligible. Then which option is correct:



a) Gravitational potential energy increases by $\frac{3}{4}mgh$
b) Gravitational potential energy increases by mgh
c) Kinetic energy decreases by mgh
d) Mechanical energy decreases by $\frac{1}{2}mgh$

Elastic potential energy: is the potential energy due to the stretching or compressing of an elastic material, such as spring.

Jumping on a trampoline, the stretch and restore of trampoline fabric and springs can cause the jumper encounters energy conversion from one form to another. As the trampoline is stretching, she (the jumper) transfers her kinetic energy into elastic potential energy stores in the trampoline. Later, the stored elastic potential energy can be transferred back to kinetic energy that she needs for her upward jump.



Mathematically, Elastic potential energy can be calculated by: $\boldsymbol{E_e = \frac{1}{2}k(\Delta x)^2}$.

Example 1: A 42 kg teenager balances briefly on a pogo stick, causing the spring in the stick to compress downward by 0.18 m. Determine the elastic potential energy of the teenager.

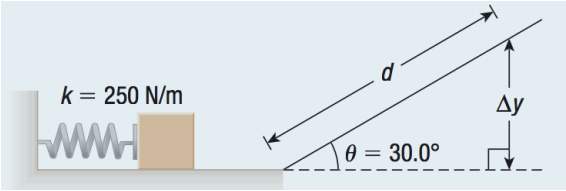
Practice: Textbook pg196. #1, 2

Example 2: Analyzing Energy transformations

A model car of mass 5.0 kg slides down a frictionless ramp into a spring with spring constant $k = 4.9kN/m$.

a) The spring experiences a maximum compression of 22 cm. Determine the height of the initial release point.
b) Calculate the speed of the model car when the spring has been compressed 15 cm.
c) Determine the maximum acceleration of the car after it hits the spring.

Example 3: A block with a mass of 2.0 kg is held against a spring with spring constant 250 N/m. The block compresses the spring 22 cm from its equilibrium position. After the block is released, it travels along a frictionless surface and then up a frictionless ramp. The ramp's angle of inclination is 30 degrees. Determine how far along the ramp the block will travel before it stops.



What if the surface has friction and the block takes 0.55 m to become completely stopped. What is the coefficient of kinetic friction?

If we refined the Law of conservation of Energy by taking both mechanical energy and non-mechanical energy, then:

$$E_{ei} + E_{gi} + E_{ki} + E_{lost} = E_{ef} + E_{gf} + E_{kf}$$

↓

Negative in magnitude, due to friction…

Textbook pg208. #2 – 9