Review

Kinetic Energy $= \frac{1}{2} m v^2$

$W_{net} = F_{net\parallel} \, d$

$W_{net} = \Delta K = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

Potential Energy

Gravity $\quad P.E = mgh$

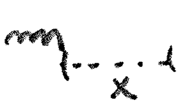
...... h $\quad P.E = mgh$

—— Ground
$h = 0$
$P.E = 0$

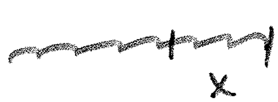
Spring $\quad P.E = \frac{1}{2} k x^2$

K = spring constant
x = distance from springs natural length

 $x = 0 \quad P.E = 0$



$P.E = \frac{1}{2} k x^2$



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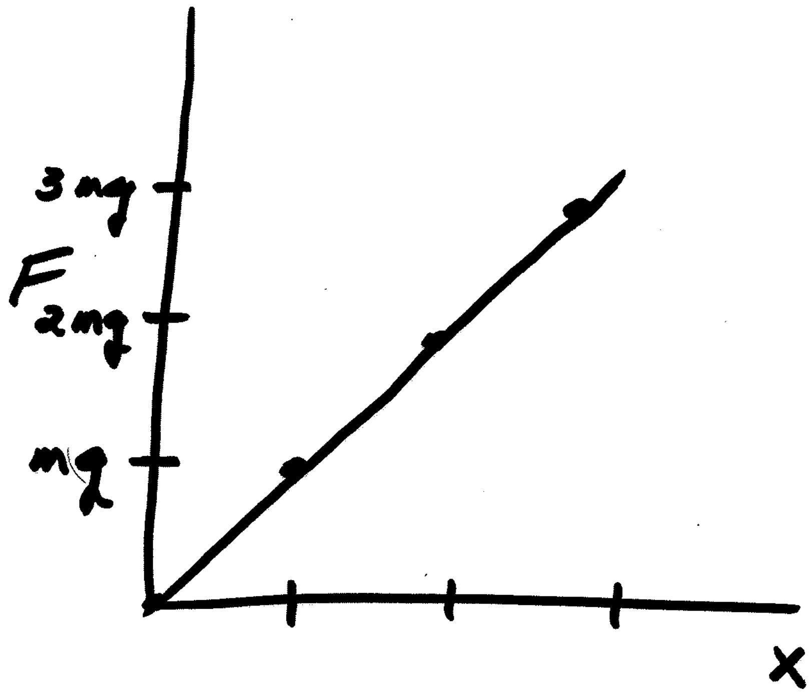
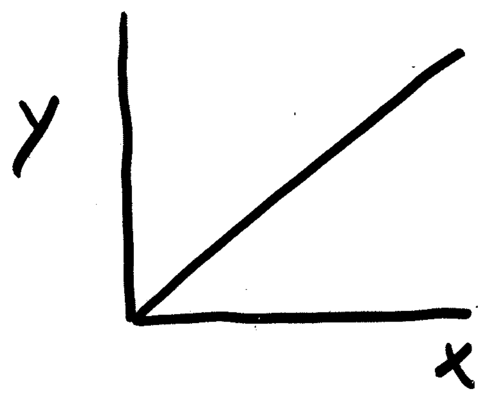


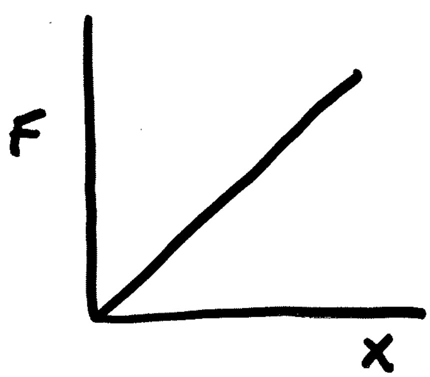


$y = mx + b$

m = slope

b = y-intercept

$b = 0$



$F = kx$

k = slope

= spring constant

B

Interactive Question

In which system is there a decrease in potential energy?

A) A boy stretches a spring.
B) A child slides down a sliding board.
C) A crate rests at the bottom of an inclined plane.
D) A car ascends up a steep hill.
E) More than one of the above

B

Interactive Question

If the height of an object above a reference level is quadrupled its gravitational potential energy is multiplied by

$P.E = mgh$

A) 16
B) 4
C) 2
D) 1/4
E) 1/16

Interactive Question

E

If the distance a spring is stretched from its equilibrium position is halved the potential energy of the spring is multiplied by

$P.E = \frac{1}{2} k x^2$

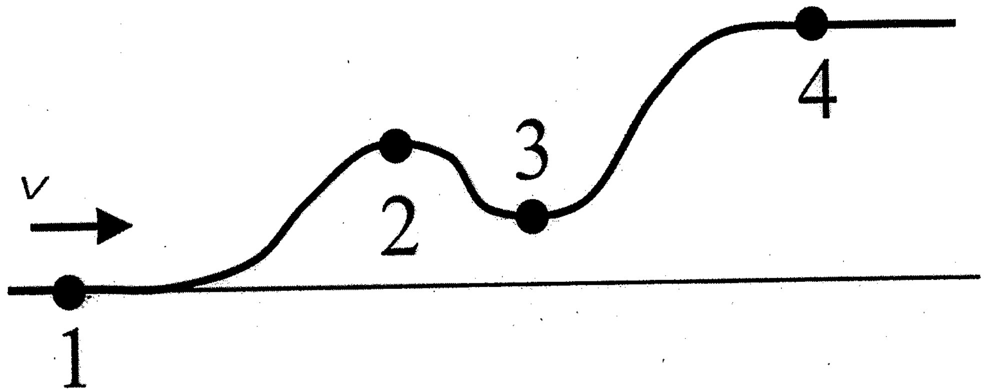
$x \rightarrow \frac{x}{2}$

A) 4
B) 2
C) 1
D) 1/2
E) 1/4

A

Interactive Question

A cart starts with velocity v and rolls up the frictionless path shown. Which of the following is *not* true?



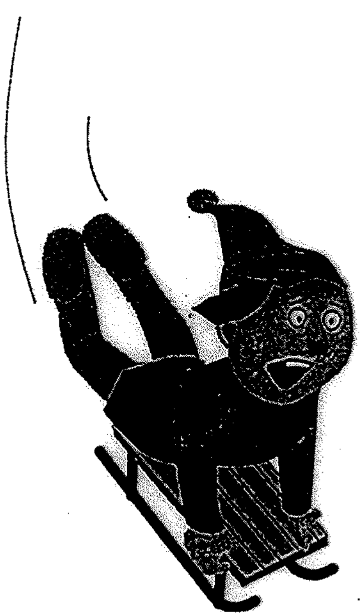
A) The potential energy at point 3 is greater than the potential energy at point 2
B) The potential energy is greatest at point 4.
C) The kinetic energy is greatest at point 1.
D) The mechanical energy does not change.
E) The cart has kinetic and potential energy at point 2.

<u>Problem:</u> A child and sled with mass of 50 kg start from rest at the top of a 1.8 m high frictionless hill.

a) What is the potential energy at the top of the hill?

b) What is the kinetic energy at the bottom of the hill?

c) How fast is the child and sled going at the bottom?



$h_i = 1.8\,m$

$v_i = 0$

$m = 50\,kg$

$h_f = 0$

$P.E = mgh = (50\,kg)(9.8\,m/s^2)(1.8\,m) = 880\,J$

$K.E = 0 \quad (v=0)$

$P.E = 880\,J$

$P.E = 0 \quad (h=0)$

$K.E = 880\,J$

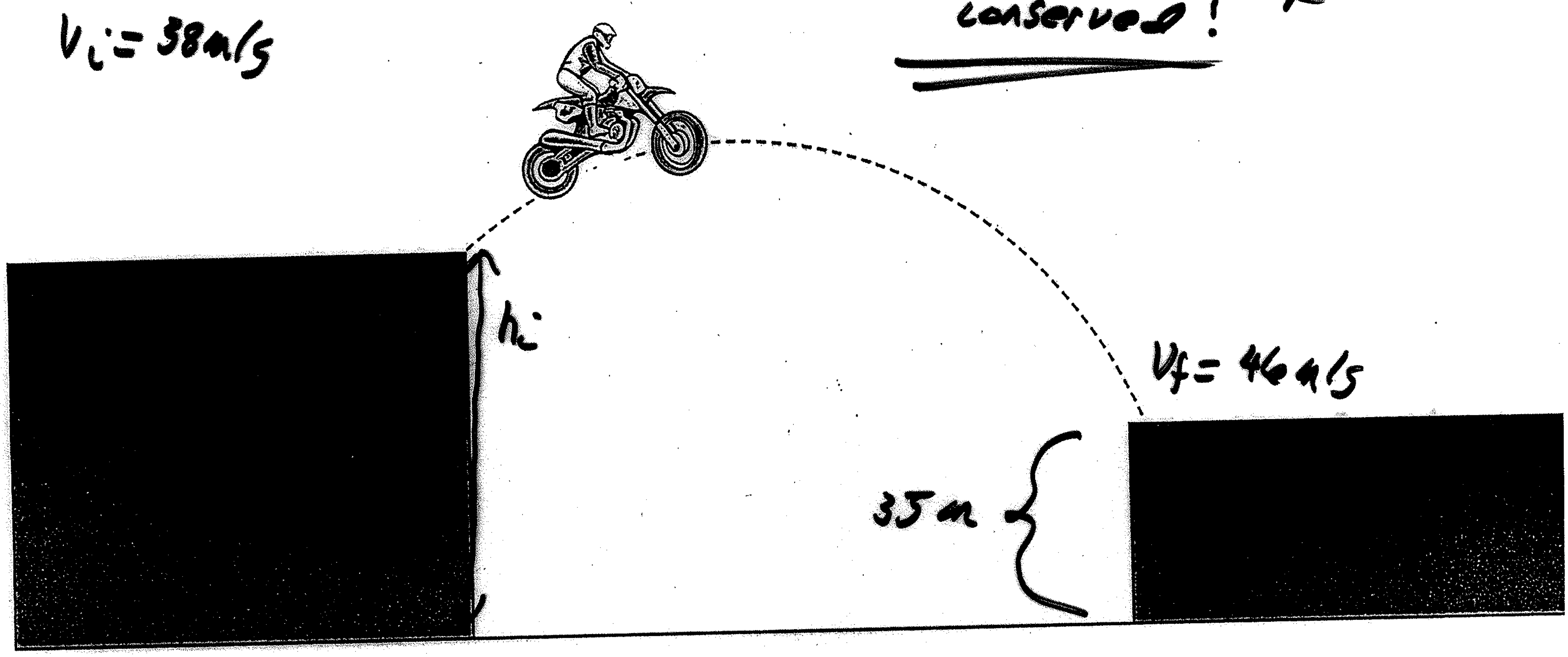
c) $K.E_f = \frac{1}{2}mv_f^2 \qquad v_f^2 = \frac{2\,K.E_f}{m} \qquad v = \sqrt{\frac{2 \cdot 880\,J}{50\,kg}}$

$\boxed{5.9\,m/s}$

Problem: A motorcycle rider leaps across a canyon with an initial speed of 38.0 m/s He lands at a height of 35.0 m with a speed of 46 m/s. How high above the canyon was his starting point?

Frictionless

Mechanical Energy conserved!



$$K.E_i + P.E_i = K.E_f + P.E_f$$

$$\frac{1}{2}\cancel{m}v_i^2 + \cancel{m}gh_i = \frac{1}{2}\cancel{m}v_f^2 + \cancel{m}gh_f$$

$$gh_i = \frac{1}{2}v_f^2 + gh_f - \frac{1}{2}v_i^2$$

$$h_i = \frac{v_f^2}{2g} + h_f - \frac{v_i^2}{2g} = \frac{v_f^2 - v_i^2}{2g} + h_f$$

$$h_i = \frac{(46\,m/s)^2 - (38\,m/s)^2}{2 \cdot 9.8\,m/s^2} + 35\,m = \boxed{69\,m}$$

Interactive Question

C

Suppose you wanted to ride your mountain bike down a steep hill. Two paths lead from the top to the base, one twice as long as the other. Neglect friction and air resistance. Compared to the maximum speed you would reach if you took the short path, the maximum speed you will reach along the longer path is

A) one quarter as fast.
B) twice as fast.
C) the same speed.
D) half as fast.
E) four times as fast.