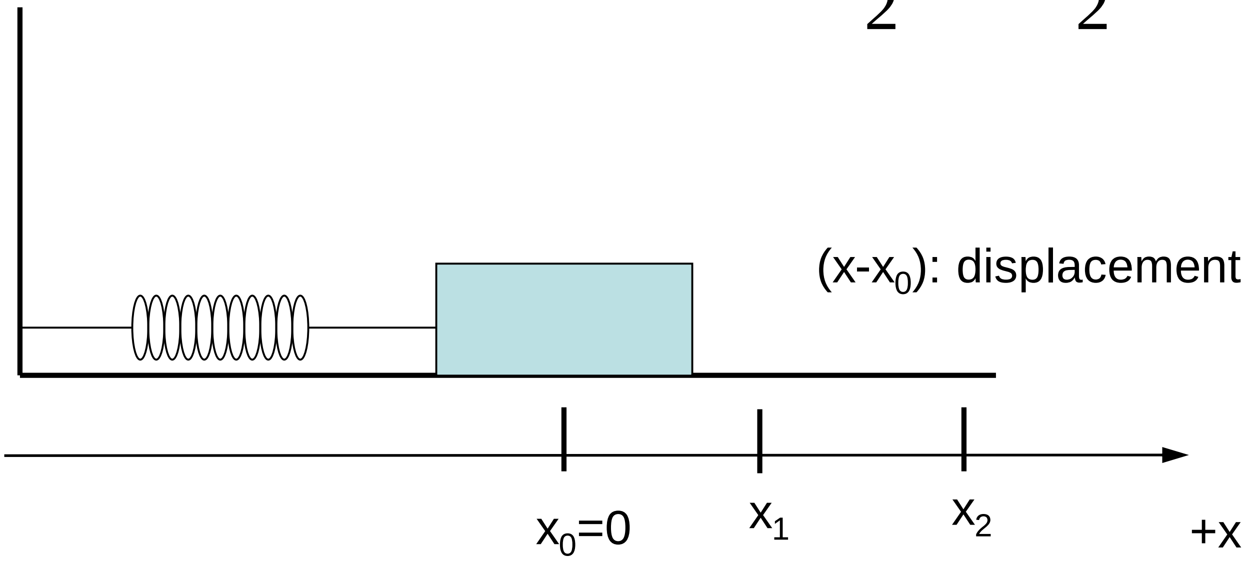
Spring Potential Energy

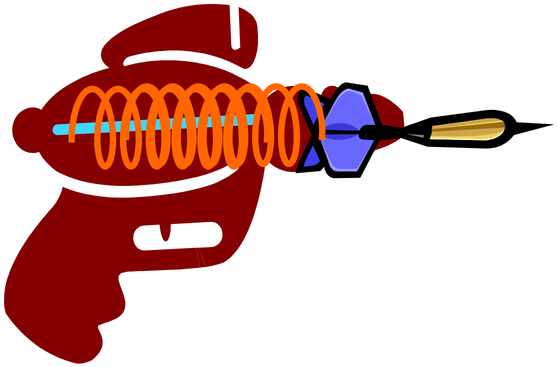
$$U_s = \frac{1}{2}kx^2 \qquad \text{or} \qquad U_s = \frac{1}{2}k(x - x_0)^2$$

$$U_2 - U_1 = \Delta U_{12} = -W_{12} = \frac{1}{2}kx_2^2 - \frac{1}{2}kx_1^2$$



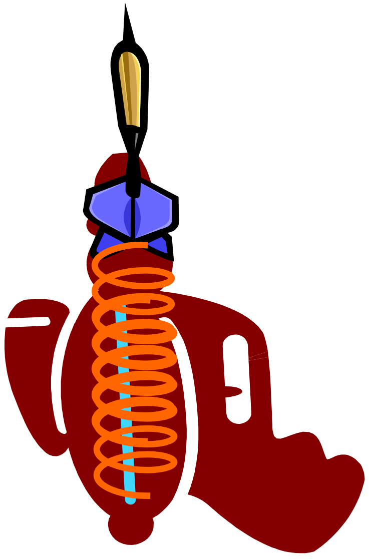
A spring-loaded gun shoots a plastic ball with a speed of 4 m/s. If the spring is compressed twice as far, the ball's speed will be

1. 16 m/s.
2. 8 m/s.
3. 4 m/s.
4. 2 m/s.
5. 1 m/s.



A spring-loaded toy dart gun shoots a dart to a maximum height of 24 meters. The same dart is again shot upward, but this time the spring is compressed only half as far before firing. Neglecting friction and assuming an ideal spring, how far up does the dart go this time? Assume that the compression of the spring is negligible compared to the travel of the dart.

1. 96 m
2. 48 m
3. 24 m
4. 12 m
5. 6 m
6. 3 m



Potential Energy

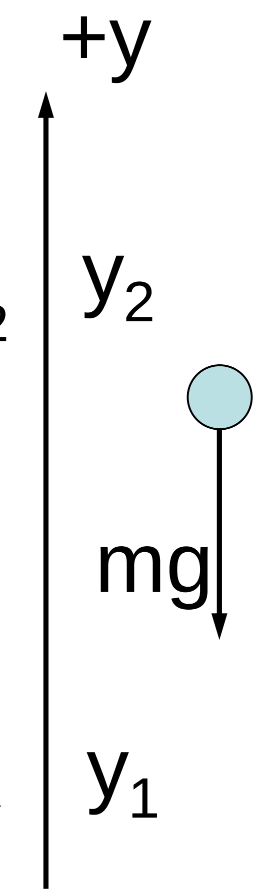
$$W_{12} = -mg(y_2 - y_1)$$
$$= -(U_2 - U_1) = -\Delta U_{12}$$

Gravitational Potential Energy

$$U = mgy$$

$$U_2 = mgy_2$$

$$U_1 = mgy_1$$



$$\Delta U = -W = -\Delta K$$

$$\Delta U + \Delta K = 0$$

$$U_1 + K_1 = U_2 + K_2$$

Conservation of Mechanical Energy

Potential Energy $U_G = mgy$ $U_s = \frac{1}{2}kx^2$

Kinetic Energy $K = \frac{1}{2}mv^2$

Mechanic Energy E=K+U

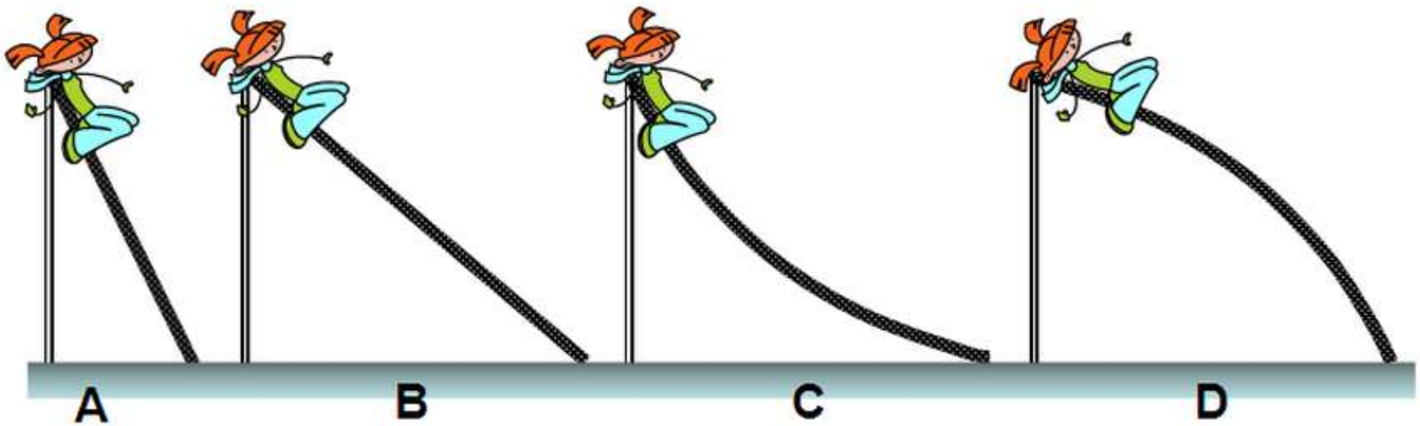
No external force (isolated system)

E is conserved $(E_i = E_f)$

$$U_1 + K_1 = U_2 + K_2$$

$$\Delta U = -\Delta K$$

A child starting from rest slides down each of the four frictionless slides A to D. Each has the same vertical height. Rank in order, from largest to smallest, her speeds v_A to v_D at the bottom.



(1) $v_A = v_B = v_C = v_D$

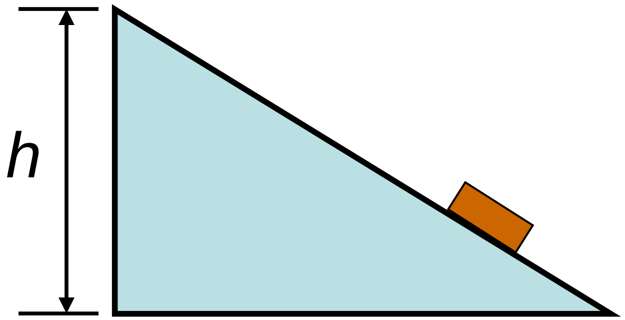
(2) $v_D > v_A = v_B > v_C$

(3) $v_D > v_A > v_B > v_C$

(4) $v_C > v_A = v_B > v_D$

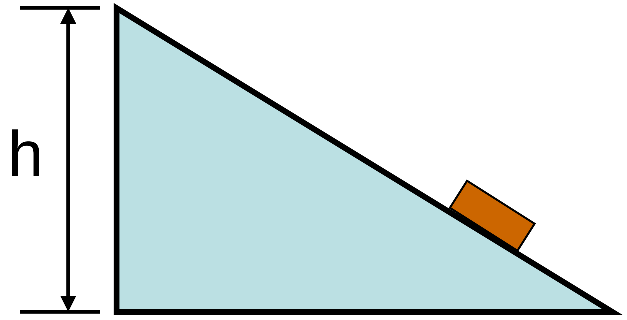
(5) $v_C > v_B > v_A > v_D$

A block of mass *m* is at rest at the top of a ramp of vertical height h. The block starts to slide down the frictionless ramp and reaches a speed *v* at the bottom. If the same block were to reach a **speed 2*v*** at the bottom, it would need to slide down a frictionless ramp of vertical height ______.



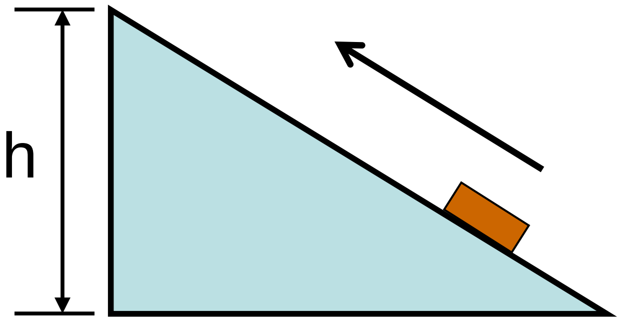
1. *h*
2. 1.41*h*
3. 2*h*
4. 3*h*
5. 4*h*
6. 6*h*

A block of mass *m* is at rest at the top of a ramp of vertical height h. The block starts to slide down the frictionless ramp and reaches a speed *v* at the bottom. If a block of **mass 2*m*** were to reach the same speed *v* at the bottom, it would need to slide down the ramp at the height of ______.



1. *h*
2. 1.41*h*
3. 2*h*
4. 3*h*
5. 4*h*
6. 6*h*

A block is launched up a frictionless 40° slope with an initial speed *v and* reaches a maximum vertical height *h*. The same block is launched up a frictionless 20° slope with the same initial speed *v*. On this slope, the block reaches a maximum vertical height of _____

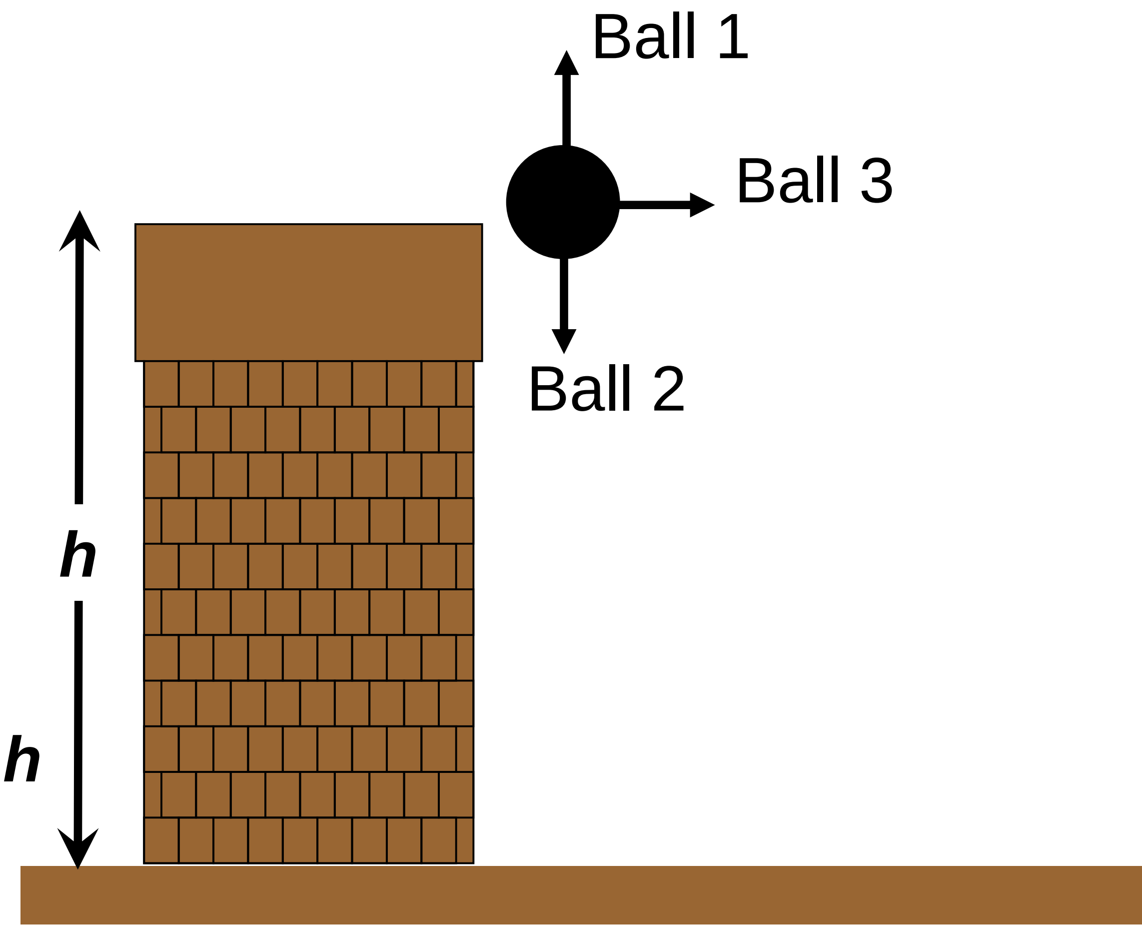


1. *h*
2. *h*/2
3. 2*h*
4. A height greater than *h* but less than 2*h*.
5. A height greater than *h*/2 but less than *h*.

Two balls, one twice as massive as the other, are dropped from the roof of a building (freefall). Just before hitting the ground, the more massive ball has ______ the kinetic energy of the less massive ball. (Neglect air friction.)

1. One half
2. The same
3. Twice
4. Four times

Three balls of equal mass are fired simultaneously with ***equal*** speeds from the same height *h* above the ground. Ball 1 is fired straight up, ball 2 is fired straight down, and ball 3 is fired horizontally. Rank in order from largest to smallest their speeds $\boldsymbol{v_1}$, $\boldsymbol{v_2}$, and $\boldsymbol{v_3}$ an instant before they hit the ground. (Neglect friction.)

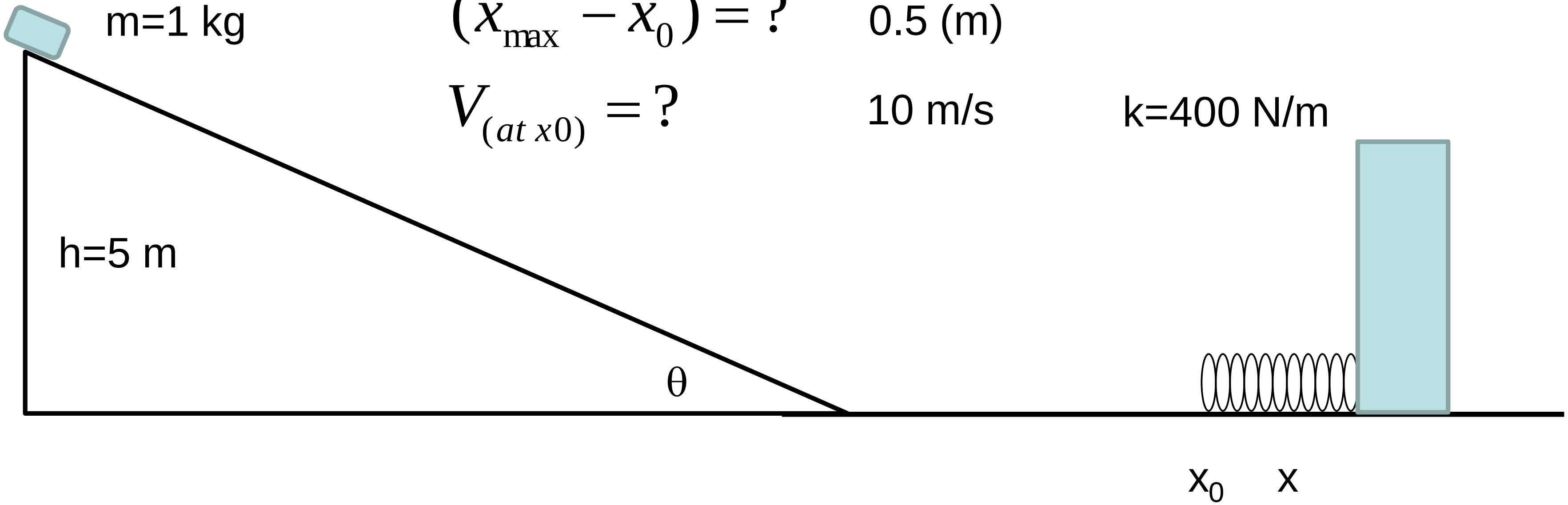


1. $\mathbf{v_1 > v_2 > v_3}$
2. $\mathbf{v_3 > v_2 > v_1}$
3. $\mathbf{v_2 > v_1 > v_3}$
4. $\mathbf{v > v > v}$
5. $\mathbf{v_1 = v_2 > v_3}$
6. $\mathbf{v_1 = v_2 = v_3}$
7. **Need to know height *h***

No Friction. Initially at rest.

$(x_{max} - x_0) = ?$ 0.5 (m)

$V_{(at\ x0)} = ?$ 10 m/s

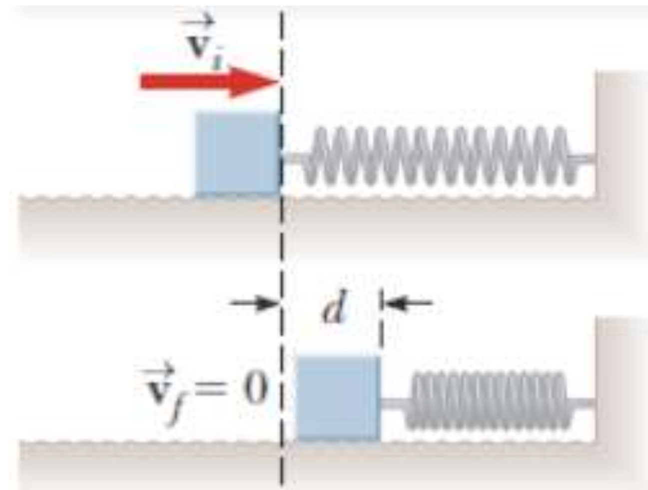


$$U_{G1} + U_{S1} + K_1 = U_{G2} + U_{S2} + K_2$$

$$U_G = mgy \qquad U_s = \frac{1}{2}k(x - x_0)^2$$

A 1.0-kg object slides to the right on a surface having a coefficient of kinetic friction 0.2. The object has a speed of v_i = 3.0 m/s when it makes contact with a light spring that has a force constant of 50.0 N/m. The object comes to rest after the spring has been compressed a distance *d.*

Find the value of d.



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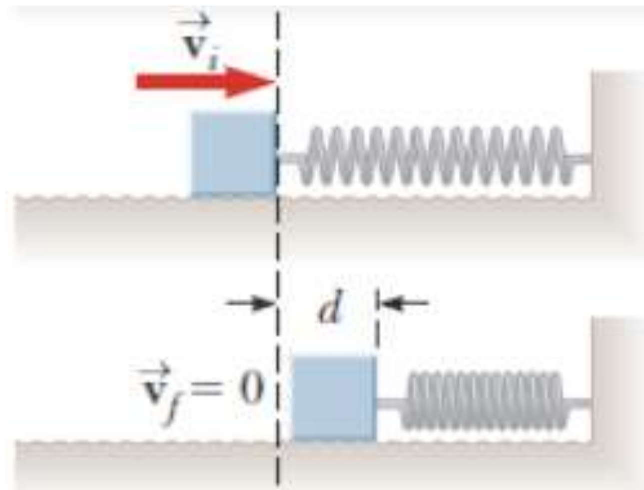

$$U_f + K_f = U_i + K_i + W$$

$$\frac{1}{2}kd^2 + 0 = 0 + \frac{1}{2}mv_i^2 - fd$$

$$fd = \frac{1}{2}mv_i^2 - \frac{1}{2}kd^2$$

$$solve\ \ for\ d: \quad \frac{1}{2}kd^2 + fd - \frac{1}{2}mv_i^2 = 0$$