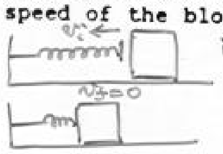
Problems from chapter 8

A 1.00 kg block collides with a horizontal weightless spring of force constant 2.00 N/m. The block compresses the spring 5.00 m from the equilibrium position. The coefficient of kinetic friction between the block and the horizontal surface is 0.25. What was the speed of the block at the time of collision ?

$\Delta E = \Delta K + \Delta U_s = -f_k d$



A. 6.45 m/s
B. 7.18 m/s
C. 4.22 m/s
D. 5.72 m/s
(E) 8.63 m/s

$\left(0 - \frac{1}{2} m v_i^2\right) + \left(\frac{1}{2} k x^2 - 0\right) = -\mu_k m g x$

$\frac{1}{2} m v_i^2 = \frac{1}{2} k x^2 + \mu_k m g x$

$v_i = \sqrt{\frac{k x^2 + 2\mu_k m g x}{m}} = 8.63 \text{ m/s}$

A block of mass 1.00 kg is released from rest at the top of an inclined plane making an angle of 30.0 degrees with the horizontal. The coefficient of kinetic friction is 0.30. What is the speed of the block after it has travelled downwards 1.0 m along the inclined plane ?

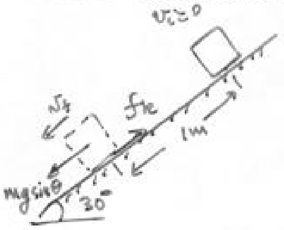
A. 3.58 m/s
B. 2.50 m/s
(C) 2.17 m/s
D. 3.07 m/s
E. 3.33 m/s

$\Delta E = \Delta K + \Delta U_g = -f_k d$

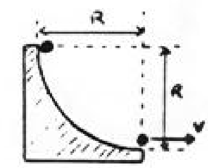
$\left(\frac{1}{2} m v^2 - 0\right) - m g h = -\mu_k m g \cos\theta \, d$

$v = \sqrt{2 g (d \sin\theta - \mu_k d \cos\theta)}$

$= 2.17 \text{ m/s}$



A block of mass 2.0 kg is released from rest and slides down a rough track of radius R = 1.0 m, as shown in the figure. If the speed of the block at the bottom is 4.0 m/s, what is the ~~work done by~~ the frictional force acting on the block ? energy dissipated by



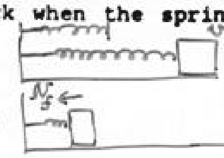
(A) -3.6 J
B. +3.6 J
C. +19.6 J
D. -19.6 J
E. +16.0 J

$\Delta E = \Delta K + \Delta U_g = -f_k d$

$\Delta E = \left(\frac{1}{2} m v^2 - 0\right) + (-m g R) = -f_k d$

-3.6 J — energy dissipated by the force of friction

A 0.20 kg block on a horizontal, frictionless surface, is connected to one end of a spring of force constant 40.0 N/m. The other end of the spring is held fixed. The block is released when the spring is stretched 0.60 m from its equilibrium position. Find the speed of the block when the spring is compressed 0.20 m from its equilibrium position.



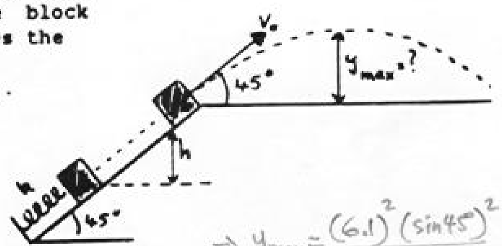
A. 8.94 m/s
B. 6.49 m/s
C. 6.00 m/s
D. 7.50 m/s
(E) 8.00 m/s

$\Delta E = \Delta K + \Delta U_s = 0$

$\left(\frac{1}{2} m v_f^2 - 0\right) + \left(\frac{1}{2} k x_f^2 - \frac{1}{2} k x_i^2\right) = 0$

$v_f = \sqrt{-\frac{k}{m}(x_f^2 - x_i^2)} = 8 \text{ m/s}$

spring of force constant 100 N/m rests on an ıclined frictionless plane that has the same ɛngth as the spring. The inclined plane makes ı angle of 45 deg with the horizontal. A block f mass 0.10 kg is pressed against the spring, ɔmpressing it a distance of 0.20 m, and then ɛleased. Find the maximum height the block ɛaches above the point at which it leaves the ɔring (see figure).
y(max) = v_0**2 sin(theta)**2 / (2 * g)).



. 0.55 m
. 5.30 m
. 0.95 m
. 1.02 m
. 1.30 m

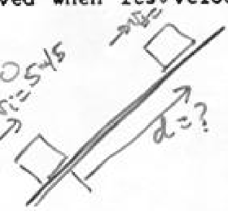
$\Delta E = \Delta K + \Delta U_g + \Delta U_s = 0$

$(\frac{1}{2}mv^2 - 0) + mg\,x\sin45^\circ + (0 - \frac{1}{2}kx^2) = 0$

$v = \sqrt{\frac{kx^2 - 2mgx\sin45^\circ}{m}} = 6.1\ m/s$

$\Rightarrow y_{max} = \frac{(6.1)^2(\sin45^\circ)^2}{2\times9.8} = 0.95\ m$

A 5.00 kg block is given an initial velocity of 5.00 m/s up a smooth 20 deg incline. How far up the incline has the block moved when its velocity is 1.50 m/s ?



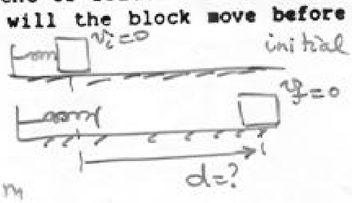
A. 1.45 m
B. 33.3 m
C. 3.39 m
D. 15.1 m
E. 5.68 m

$\Delta E = \Delta K + \Delta U_g = 0$

$(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + mgd\sin20^\circ = 0$

$d = -\frac{\frac{1}{2}m(v_f^2 - v_i^2)}{mg\sin20^\circ} = 3.39\ m$

A block of mass 1.00 kg is forced against a horizontal spring of negligible mass, compressing the spring an amount x = 0.200 m. When released, the block moves on a horizontal table with coefficient of friction mu = 0.200. The spring constant is 100 N/m. What distance will the block move before coming to rest.



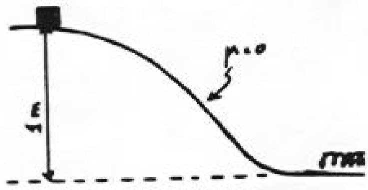
A. 1.51 m
B. 0.72 m
C. 1.02 m
D. 1.87 m
E. 5.33 m

$\Delta E = \Delta K + \Delta U_s = -f_k d$

$0 - \frac{1}{2}kx^2 = -\mu_k mgd$

$d = \frac{kx^2}{2\mu_k mg} = 1.02\ m$

A block of mass 1 kg is released from rest and slides down a frictionless track of height 1 m above a table. At the bottom of the track, where the surface is horizontal, the block strikes and compresses a spring of spring constant 400 N/m (see figure). Find the maximum distance through which the spring is compressed.



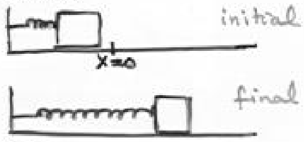
A. 0.532 m
B. 0.710 m
C. 0.615 m
D. 0.221 m
E. 0.935 m

$\Delta E = \Delta K + \Delta U_g + \Delta U_s = 0$

$(-mgh - 0) + (\frac{1}{2}kx^2 - 0) = 0$

$x = \sqrt{\frac{2mgh}{k}} = 0.221\ m$

A 1-kg block is attached to a spring of force constant 100 N/m. The spring is lying on a horizontal rough surface with one end fixed. The spring is compressed 0.196 m from its equilibrium position and then released. If the block first comes to rest when the spring is stretched 0.049 m, find the coefficient of friction between the block and the surface.



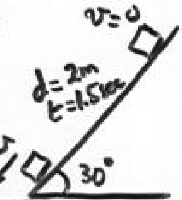
A. 0.75
B. 0.186
C. 0
D. 0.5
E. 1.0

$\Delta U_s = -f_k d = -\mu_k m g d$

$\frac{1}{2} k x_f^2 - \frac{1}{2} k x_i^2 = -\mu_k m g d$

$\mu_k = \frac{\frac{1}{2} k x_i^2 - \frac{1}{2} k x_f^2}{m g d} = \frac{1.801}{2.401} = 0.75$

A 3 - kg block starts from rest at the top of a 30 deg incline and slides a distance of 2 m down the incline in 1.5 seconds. Find the frictional force acting on the block.



A. 13.5 N
B. 1.5 N
C. 8.90 N
D. 9.37 N
E. 14.7 N

$x - x_0 = v_0 t + \frac{1}{2} a t^2 \Rightarrow a = 1.78\ m/s^2$

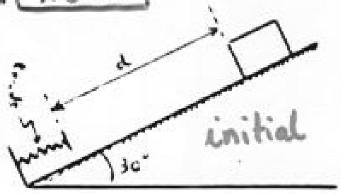
$v = v_0 + at = 2.67\ m/s$

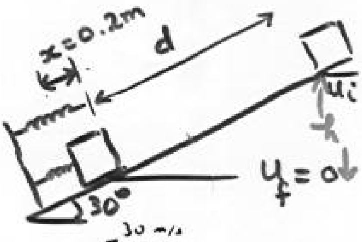
$\Delta K + \Delta U_g = -f_k d$

$\left(\frac{1}{2} m v^2 - 0\right) + (0 - mgh) = -f_k d$

$f_k = (-\frac{1}{2} m v^2 + mg d \sin\theta)/d = 9.37\ N$

A 3-kg mass starts at rest and slides a distance d down a smooth 30-deg incline, where it contacts a spring of negligible mass, as shown in the figure. It slides an additional 0.2 m as it is brought momentarily to rest by compressing the spring. The force constant of the spring is 400 N/m. Find the initial separation d between the mass and the spring.





A. 0.566 m
B. 0.344 m
C. 0.211 m
D. 0.722 m
E. 0.435 m

$\Delta K + \Delta U_g + \Delta U_s = 0$

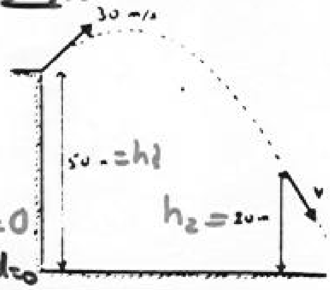
$(0 - mgh) + \left(\frac{1}{2} k x^2 - 0\right) = 0$

$+ mg(d + x)\sin\theta = \frac{1}{2} k x^2$

$mg\, d \sin\theta + mg\, x \sin\theta = \frac{1}{2} k x^2$

$d = \frac{1}{2} \frac{k x^2}{mg \sin\theta} - x = 0.344\ m$

A stone is thrown up at an angle with a speed of 30.0 m/s from the top of a building which is 50 m high, as shown in the figure. Find the speed of the stone when it is 20 m above the ground.



A. 49.7 m/s
B. 38.6 m/s
C. 27.3 m/s
D. 20.2 m/s
E. 12.5 m/s

$\Delta K + \Delta U_g = 0$

$\frac{1}{2} m (v^2 - v_0^2) + mg(h_2 - h_1) = 0$

$v^2 = v_0^2 - 2g\,\Delta h$

$v = \sqrt{v_0^2 - 2g\,\Delta h} = \sqrt{30^2 - 2 \times 9.8 \times (-30)} = 38.6\ m/s$