تم تحميل هذا الملف من موقع المناهج الإماراتية

ملزمة الوحدة السادسة Energy and Energy Potential Conservation انسباير منهج

موقع المناهج ⇦ المناهج الإماراتية ⇦ الصف الحادي عشر المتقدم ⇦ فيزياء ⇦ الفصل الثاني ⇦ ملفات متنوعة ⇦ الملف

تاريخ إضافة الملف على موقع المناهج: 26-01-2025 19:53:00

المزيد من مادة فيزياء:	ملفات ا كتب للمعلم ا كتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس
	إعداد: Zewin Adham

التواصل الاجتماعي بحسب الصف الحادي عشر المتقدم

صفحة المناهج الإماراتية على فيسبوك

المواد على تلغرام	التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات

المزيد من الملفات بحسب الصف الحادي عشر المتقدم والمادة فيزياء في الفصل الثاني

1	أسئلة الامتحان النهائي منهج بريدج القسم الالكتروني للعام 2023-2024
2	أسئلة الامتحان النهائي منهج بريدج القسم الورقي للعام 2023-2024
3	مراجعة نهائية الوحدة الخامسة Kinetic energy and work power الطاقة الحركية والعمل والاستطاعة منهج انسباير
4	الدروس المطلوبة في الفصل الثاني منهج انسباير

المزيد من الملفات بحسب الصف الحادي عشر المتقدم والمادة فيزياء في الفصل الثاني

5	أوراق عمل الدرس السابع Power الاستطاعة من الوحدة الخامسة

6. Potential Energy and Energy Conservation

6.1 Potential energy

the gravitational potential energy $U_g = mgh$

The change in the gravitational potential energy of the mass:

$$\Delta U_g \equiv U_g(y) - U_g(y_0) = mg(y - y_0) = mgh$$

the work done by the gravitational force on an object that is lift ed through a height *h* is:

$$W_g = -mgh$$

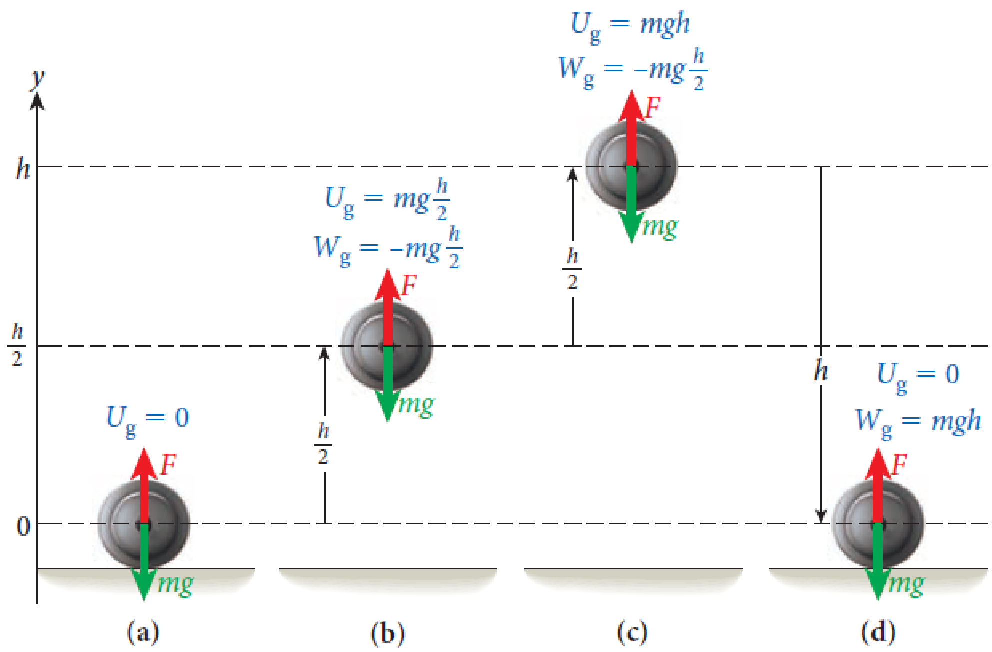


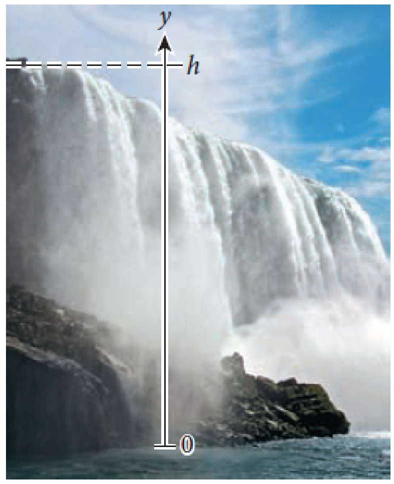
FIGURE 6.2 Lifting a barbell and potential energy (the diagram shows the barbell in side view and omits the weightlifter). The weight of barbell is *mg*, and the normal force exerted by the floor or the weightlifter to hold the weight up is *F*. (a) The barbell is initially on the floor. (b) The weightlifter lifts the barbell of mass *m* to a height of *h*/2 and holds it there. (c) The weightlifter lifts the barbell an additional distance *h*/2, to a height of *h*, and holds it there. (d) The weightlifter lets the barbell drop to the floor.

SOLVED PROBLEM 6.1 Power Produced by Niagara Falls

PROBLEM

The Niagara River delivers an average of 5520 m^3 of water per second to the top of Niagara Falls, where it drops 49.0 m. If all the potential energy of that water could be converted to electrical energy, how much electrical power could Niagara Falls generate?

SOLUTION



$$\bar{P} = \frac{W}{t} = \frac{mgh}{t} = \left(\frac{m}{t}\right)gh$$

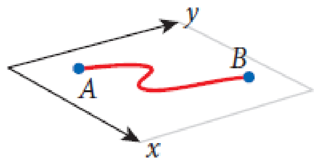
$$\frac{m}{t} = \left(5520\ \frac{\text{m}^3}{\text{s}}\right)\left(\frac{1000\ \text{kg}}{1\ \text{m}^3}\right) = 5.52 \cdot 10^6\ \text{kg/s}$$

$$\bar{P} = \left(5.52 \cdot 10^6\ \text{kg/s}\right)\left(9.81\ \text{m/s}^2\right)\left(49.0\ \text{m}\right) = 2653.4088\ \text{MW}$$

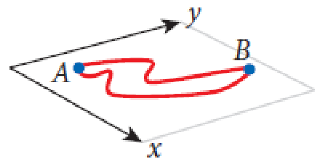
6.2 Conservative and Nonconservative Forces

conservative forces	Non-conservative forces
any force for which the **work** done over any **closed** path is **zero**.	any force for which the **work** done over any **closed** path is **not zero**.
Work done is independent of the path	Work done depends upon the path
Total energy remains constant (conserved)	Energy is dissipated as heat energy
Force is the negative gradient of potential energy	No such relation exists.
Example: (i) Elastic spring force (ii) Electrostatic force	Examples: (i) The force due to air resistance (ii) friction

(for conservative forces)



$$W_{B \to A} = -W_{A \to B}$$



$$W_{A \to B,\text{path } 2} = W_{A \to B,\text{path } 1}$$

$$W_{A \to B,\text{path } 2} + W_{B \to A,\text{path } 1} = 0$$

Friction Forces

$$W_{f1} = \vec{f} \bullet \Delta\vec{r}_1 = -f \cdot (x_B - x_A) = -\mu_k mg \cdot (x_B - x_A).$$

$$W_{f2} = \vec{f} \bullet \Delta\vec{r}_2 = f \cdot (x_A - x_B) = \mu_k mg \cdot (x_A - x_B)$$

$$\boxed{W_f = W_{f1} + W_{f2} = -2\mu_k mg(x_B - x_A) < 0}$$

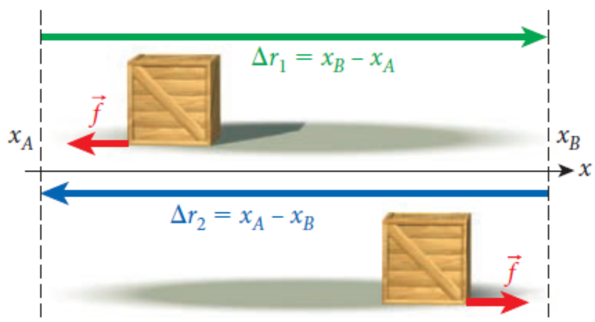


FIGURE 6.6 Friction force vector and displacement vector for the process of sliding a box back and forth across a surface with friction.

The box starts with zero kinetic energy and at a certain position, and it ends up with zero kinetic energy and at the same position.

According to the work–kinetic energy theorem, the total work done should be zero.

This leads us to conclude that the friction force does not do work in the way that a conservative force does.

- Instead, the friction force converts kinetic and/or potential energy into internal excitation energy of the two objects that exert friction on each other

- internal excitation energy is not reversible; that is, the internal excitation energy cannot be fully converted back into kinetic and/or potential energy.

Notes

1. Friction force is an example of a nonconservative force.
2. The friction force always acts in a direction opposite to the displacement.
3. The dissipation of energy due to the friction force always reduces the total mechanical energy.
4. The dissipation from the friction force, W_f, is always negative.

6.3 Work and Potential Energy

$$\Delta U = -W$$

$$\Delta U = U(x) - U(x_0) = -\int_{x_0}^{x} F_x(x')dx'$$

$$\Delta U_g = U_g(y) - U_g(y_0) = -\int_{y_0}^{y} (-mg)dy' = mg\int_{y_0}^{y} dy' = mgy - mgy_0$$

In the same way, we find for the spring force that

$$\Delta U_s = U_s(x) - U_s(x_0)$$

$$= -\int_{x_0}^{x} F_s(x')dx'$$

$$= -\int_{x_0}^{x} (-kx')dx'$$

$$= k\int_{x_0}^{x} x'dx'$$

$$\Delta U_s = \tfrac{1}{2}kx^2 - \tfrac{1}{2}kx_0^2.$$

Thus, the potential energy associated with elongating a spring from its equilibrium position, at $x = 0$, is

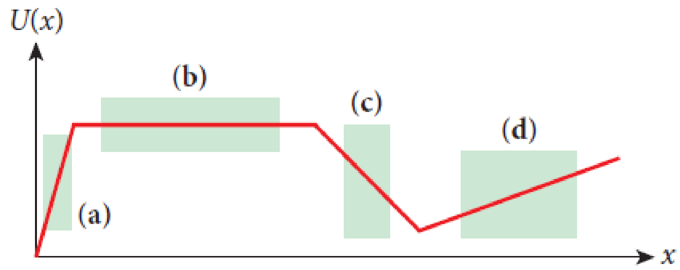
$$U_s(x) = \tfrac{1}{2}kx^2 + \text{constant}.$$

6.4 Potential Energy and Force Enrichment

$$F_x(x) = -\frac{dU(x)}{dx}$$

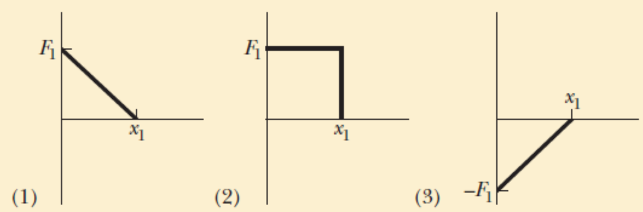
Concept Check 6.2

The potential energy, *U*(*x*), is shown as a function of position, *x*, in the figure. In which region is the magnitude of the force the highest?



Checkpoint 2

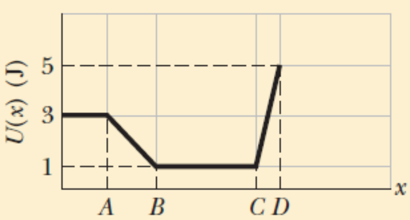
A particle is to move along an x axis from $x = 0$ to x_1 while a conservative force, directed along the x axis, acts on the particle. The figure shows three situations in which the x component of that force varies with x. The force has the same maximum magnitude F_1 in all three situations. Rank the situations according to the change in the associated potential energy during the particle's motion, most positive first.



3, 1, 2

Checkpoint 4

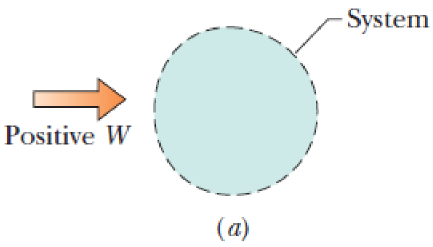
The figure gives the potential energy function $U(x)$ for a system in which a particle is in one-dimensional motion. (a) Rank regions AB, BC, and CD according to the magnitude of the force on the particle, greatest first. (b) What is the direction of the force when the particle is in region AB?

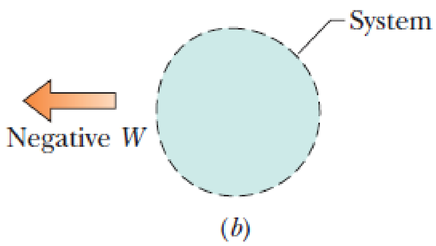


(a) *CD*, *AB*, *BC* (0)

(b) positive direction of *x*

WORK DONE ON A SYSTEM BY AN EXTERNAL FORCE





Positive work W done on an arbitrary system means a **transfer of energy to the system**.

Negative work ***W*** **means a transfer of energy from the system.**

6.5 Conservation of Mechanical Energy

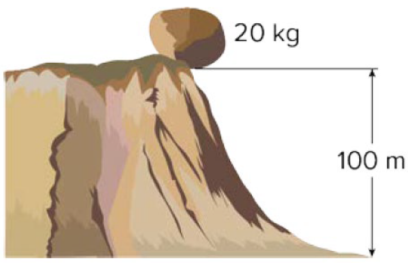
mechanical energy, *E,* as the sum of kinetic energy and potential energy:

$$E = K+U$$

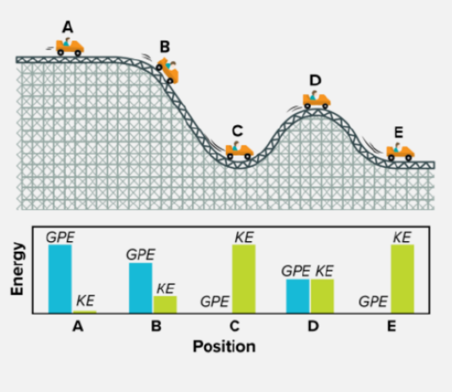
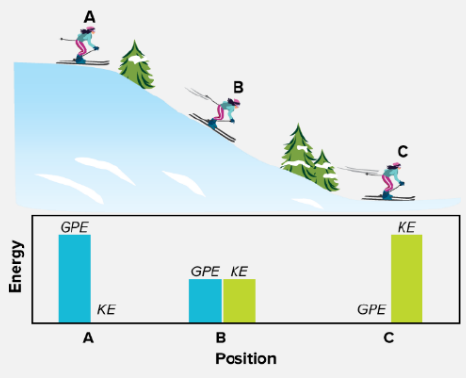
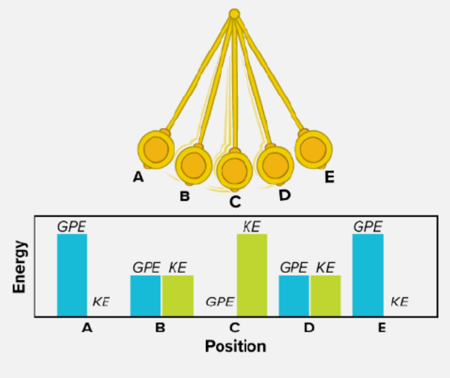
This means that the total mechanical energy of an isolated system remains constant in time:

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

A rock sits on the edge of a cliff, as shown



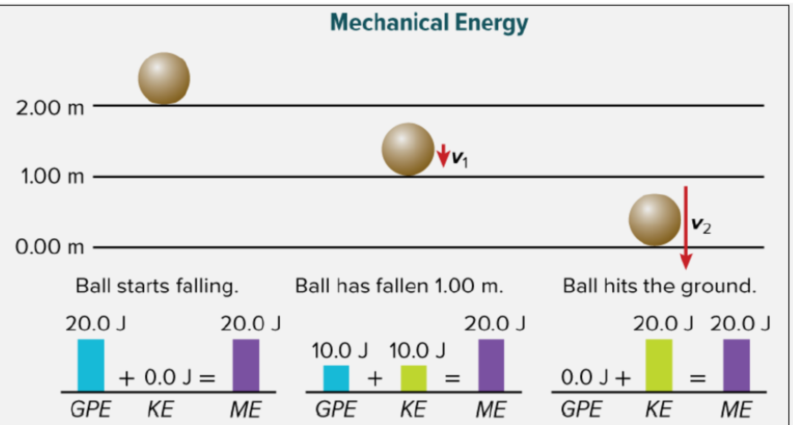
	Maximum potential energy (J)	the rock's speed as it hits the ground? (m/s)
A	3.4×10^4	80.22
B	2.0×10^4	44.72
C	4.0×10^4	44.72
D	2.0×10^4	80.22

Roller coaster	Skiing	Pendulum
		

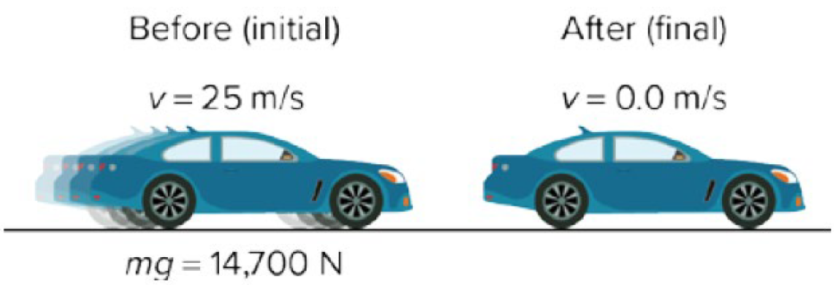
KE + GPE = CONSTANT.

Figure 22: when a bowling ball is dropped, mechanical energy is conserved.

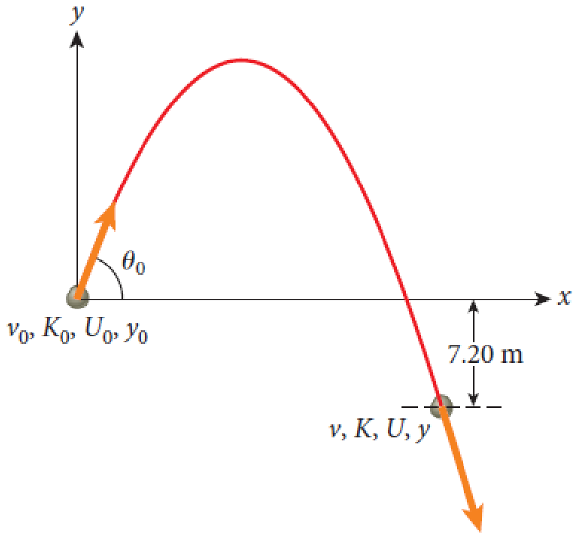
$m_{ball} = 1.02\ kg$



The driver of the car in the image suddenly applies the brakes and the car slides to a stop. The average force between the tires and the road is 7100 N. How far will the car slide after the brakes are applied?



a rock with a launch speed of 14.2 m/s from the courtyard over the castle walls onto the attackers' camp in front of the castle at an elevation 7.20 m below that of the courtyard.



Problem

What is the speed with which a rock will hit the ground at the attackers' camp? (Neglect air

We substitute for K and U in $E = K + U$ to get

$$E = \tfrac{1}{2}mv^2 + mgy = \tfrac{1}{2}mv_0^2 + mgy_0.$$

m, cancels out, and we are left with

$$\tfrac{1}{2}v^2 + gy = \tfrac{1}{2}v_0^2 + gy_0.$$

$$v = \sqrt{v_0^2 + 2g(y_0 - y)}.$$

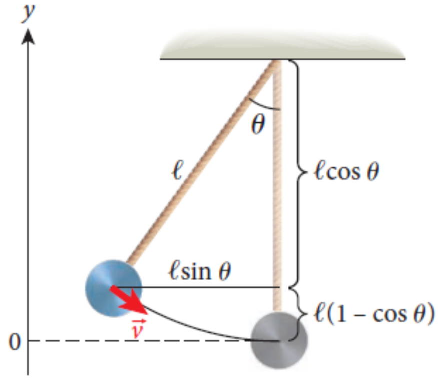
$$v = \sqrt{(14.2 \text{ m/s})^2 + 2(9.81 \text{ m/s}^2)(7.20 \text{ m})} = 18.51766724 \text{ m/s}.$$

SOLVED PROBLEM 6.3 Trapeze Artist

PROBLEM

A circus trapeze artist starts her motion with the trapeze at rest at an angle of 45.0° relative to the vertical. The trapeze ropes have a length of 5.00 m. What is her speed at the lowest point in her trajectory?

SOLUTION



$$0 + U = U + K$$

$$0 + mg\ell(1-\cos\theta_0) = mg\ell(1-\cos\theta) + \tfrac{1}{2}mv^2 \Rightarrow$$

$$mg\ell(\cos\theta - \cos\theta_0) = \tfrac{1}{2}mv^2 \Rightarrow$$

$$|v| = \sqrt{2g\ell(\cos\theta - \cos\theta_0)}.$$

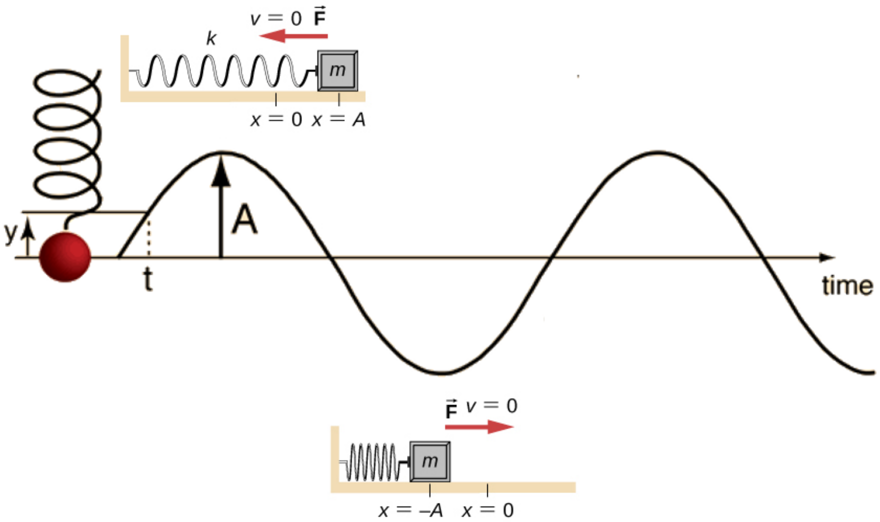
Here, we are interested in the speed for $|v(\theta=0)|$, which is

$$|v(\theta=0)| = \sqrt{2g\ell(\cos 0 - \cos\theta_0)} = \sqrt{2g\ell(1-\cos\theta_0)}.$$

CALCULATE The initial condition is $\theta_0 = 45.0°$. Inserting the numbers, we find

$$|v(0°)| = \sqrt{2(9.81\text{ m/s}^2)(5.00\text{ m})(1-\cos 45.0°)} = 5.360300809\text{ m/s}.$$

6.6 Work and Energy for the Spring Force



The point of maximum elongation of a spring from the equilibrium position is called the **amplitude,** *A*.

When the displacement reaches the amplitude, the velocity is briefly zero. At this point, the total mechanical energy of an object oscillating on a spring is:

$$E = \tfrac{1}{2}kA^2.$$

However, conservation of mechanical energy means that this is the value of the energy for any point in the spring's oscillation.

$$\tfrac{1}{2}kA^2 = \tfrac{1}{2}mv^2 + \tfrac{1}{2}kx^2.$$

we can get an expression for the speed as a function of the position:

$$v = \sqrt{(A^2 - x^2)\frac{k}{m}}.$$

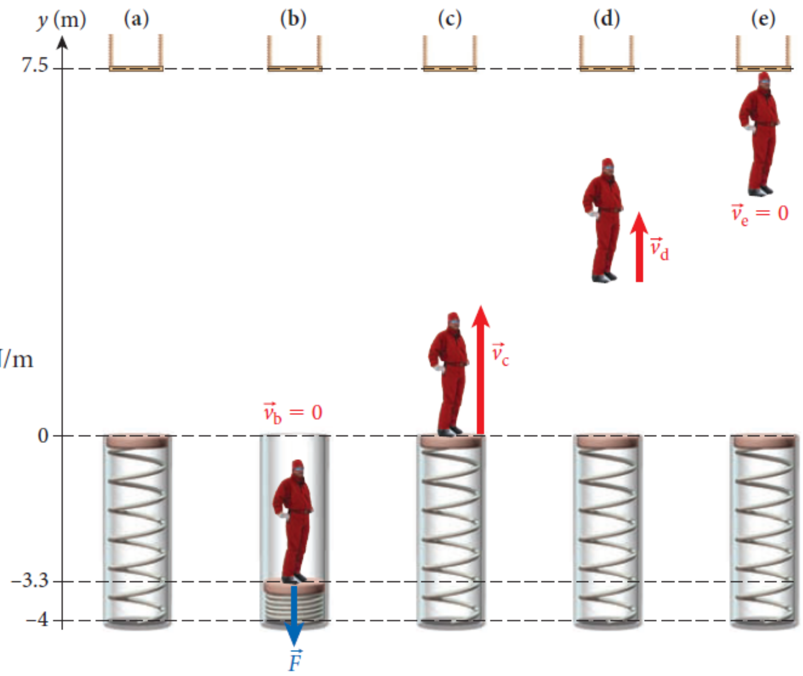
SOLVED PROBLEM 6.4 Human Cannonball

An external force is added to compress the spring even further, to a length of only 0.70 m. At a height of 7.50 m above the top of the barrel is a spot on the tent that the human cannonball, of height 1.75 m and mass 68.4 kg, is supposed to touch at the top of his trajectory. Removing the external force releases the spring and fires the human cannonball vertically upward.

Problem 1

What is the value of the spring constant needed to accomplish this stunt?

SOLUTION 1



$$\tfrac{1}{2}ky_b^2 + mgy_b = mgy_e$$

$$\boxed{k = 2mg\frac{y_e - y_b}{y_b^2}}$$

$$k = 2(68.4\text{ kg})(9.81\text{ m/s}^2)\frac{5.75\text{ m} - (-3.30\text{ m})}{(3.30\text{ m})^2} = 1115.26\text{ N/m}$$

Problem 2

What is the speed that the human cannonball reaches as he passes the equilibrium position of the spring?

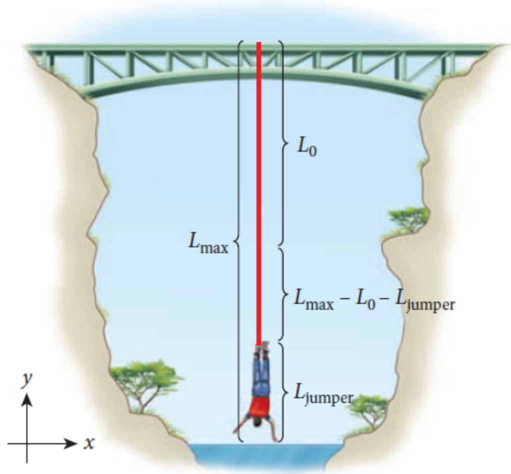
SOLUTION 2

$$\tfrac{1}{2}mv_c^2 = mgy_e \Rightarrow$$

$$v_c = \sqrt{2gy_e} = \sqrt{2(9.81\text{ m/s}^2)(5.75\text{ m})} = 10.6\text{ m/s}.$$

EXAMPLE 6.3 Bungee Jumper

A bungee jumper locates a suitable bridge that is 75.0 m above the river below, as shown in Figure 6.14. The jumper has a mass of $m = 80.0$ kg and a height of $L_{jumper} = 1.85$ m. We can think of a bungee cord as a spring. The spring constant of the bungee cord is $k = 50.0$ N/m. Assume that the mass of the bungee cord is negligible compared with the jumper's mass.



PROBLEM

The jumper wants to know the maximum length of bungee cord he can safely use for this jump.

SOLUTION

$$U_g = mgy = mgL_{max}$$

$$E_{top} = mgL_{max}$$

At the bottom of the jump, where the jumper's head just touches the water, the potential energy stored in the bungee cord is

$$U_s = \tfrac{1}{2}ky^2 = \tfrac{1}{2}k\left(L_{max} - L_{jumper} - L_0\right)^2$$

$$E_{bottom} = \tfrac{1}{2}k\left(L_{max} - L_{jumper} - L_0\right)^2$$

From the conservation of mechanical energy, we know that $E_{top} = E_{bottom}$, and so we find

$$mgL_{max} = \tfrac{1}{2}k\left(L_{max} - L_{jumper} - L_0\right)^2$$

Solving for the required unstretched length of bungee cord gives us

$$L_0 = L_{max} - L_{jumper} - \sqrt{\frac{2mgL_{max}}{k}}.$$

Putting in the given numbers, we get

$$L_0 = (75.0 \text{ m}) - (1.85 \text{ m}) - \sqrt{\frac{2(80.0 \text{ kg})(9.81 \text{ m/s}^2)(75.0 \text{ m})}{50.0 \text{ N/m}}} = 24.6 \text{ m}.$$

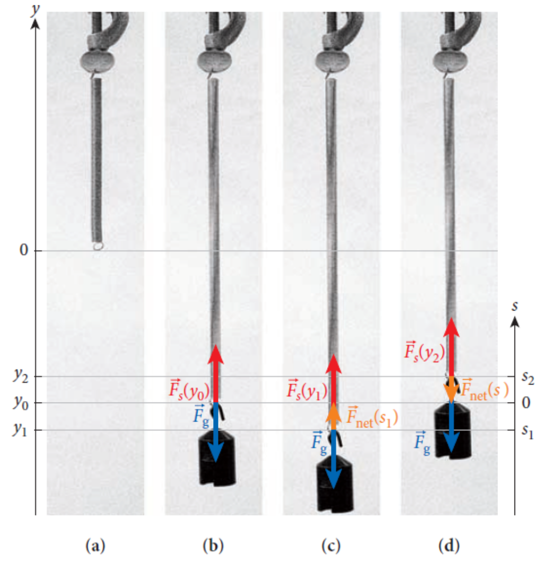


Figure 6.15b
The end of the spring is located at $s = 0$. The system is in equilibrium because the force exerted by the spring on the object balances the gravitational force acting on the object

$$\vec{F}_s(y_0)+\vec{F}_g=0.$$

In Figure 6.15c, the object has been displaced downward away from the new equilibrium position, so $y = y_1$ and $s = s_1$. Now there is a net upward force tending to restore the object to the new equilibrium position:

$$\vec{F}_{net}(s_1)=\vec{F}_s(y_1)+\vec{F}_g.$$

in Figure 6.15d, there is a net downward force that tends to restore the object to the new equilibrium position:

$$\vec{F}_{net}(s_2)=\vec{F}_s(y_2)+\vec{F}_g$$

potential energy of the object connected to the spring, taking y as the variable and assuming that the potential energy is zero at $y = 0$:

$$U(y)=\tfrac{1}{2}ky^2+mgy.$$

Using the relation $y = s + y_0$, we can express this potential energy in terms of the variable s:

$$U(s)=\tfrac{1}{2}k(s+y_0)^2+mg(s+y_0).$$

Rearranging gives us

$$U(s)=\tfrac{1}{2}ks^2+ksy_0+\tfrac{1}{2}ky_0^2+mgs+mgy_0.$$

Substituting $ky_0 = -mg$, from equation 6.24, into this equation, we get

$$U(s)=\tfrac{1}{2}ks^2-(mg)s+\tfrac{1}{2}(mg)y_0+mgs-mgy_0.$$

Thus, we find that the potential energy in terms of s is

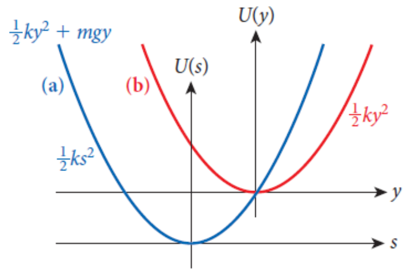
$$U(s)=\tfrac{1}{2}ks^2-\tfrac{1}{2}mgy_0.$$

Thus, we can express the potential energy of an object of mass m hanging from a vertical spring in terms of the displacement s about an equilibrium point as

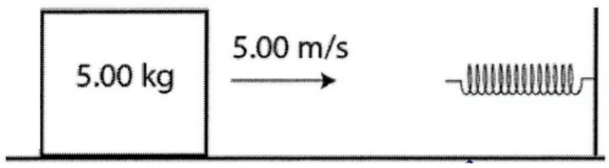
$$U(s)=\tfrac{1}{2}ks^2+C,$$

where C is a constant. For many problems, we can choose zero as the value of this constant, allowing us to write

$$U(s)=\tfrac{1}{2}ks^2.$$



Q#3: In Figure 2, a 5.0-kg block is moving at 5.0 m/s along a horizontal frictionless surface toward an ideal spring that is attached to a wall. After the block collides with the spring, the spring is compressed a maximum distance of xm. What is the speed of the block when the spring is compressed to only xm/2 ? (Ans: 4.3 m/s)



A block of mass 4 kg slides on a horizontal frictionless surface with a speed of 2 m/s. It is brought to rest in compressing a spring in its path. If the force constant of the spring is 400 N/m, by how much the spring will be compressed?

A 2×10^{-2} m

B 0.2 m

C 20 m

D 200 m

6.7 Nonconservative Forces and the Work-Energy Theorem

Even for nonconservative forces.

The total energy—the sum of all forms of energy, mechanical or other—is *always* conserved in an isolated system

$$\Delta E_{total} = 0$$

Conservative forces	Nonconservative forces
$W_f = 0 \quad \Delta K = -\Delta U$	$W_f = \Delta K + \Delta U$

W_f is the total energy dissipated by nonconservative forces into internal energy and then into other energy forms besides mechanical energy.

$$E_{total} = E_{mechanical} + E_{other} = K + U + E_{other}.$$

Here E_{other} stands for all other forms of energy that are not kinetic or potential energies.
The change in the other energy forms is exactly the negative of the energy dissipated by the friction force in going from the initial to the final state of the system:

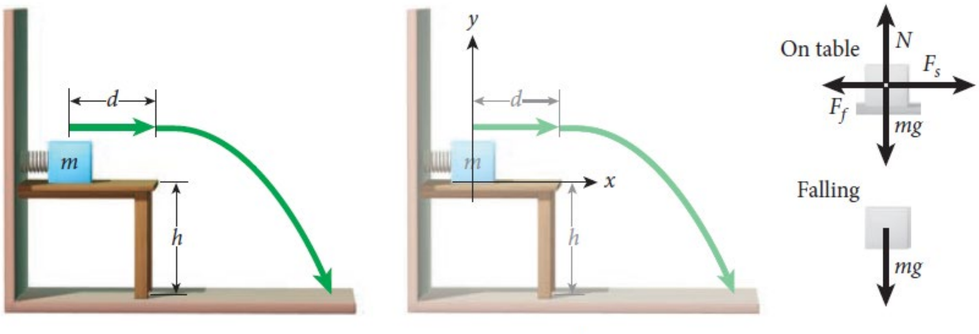
$$\Delta E_{other} = -W_f$$

Solved Problem 6.5 Block Pushed Off a Table

Consider a block on a table. This block is pushed by a spring attached to the wall, slides across the table, and then falls to the ground. The block has a mass **m = 1.35 kg**. The spring constant is **k = 560. N/m**, and the spring is initially compressed by **0.110 m**. The block slides a distance d = 0.65 m across the table of height **h = 0.750 m**. The coefficient of kinetic friction between the block and the table is **μ_k = 0.160**.

Problem

What speed will the block have when it lands on the floor?



(a) (b) (c)

$$K_0 + U_0 = K + U \Rightarrow$$
$$0 + \tfrac{1}{2}kx_0^2 = \tfrac{1}{2}mv^2 - mgh.$$

$$v = \sqrt{\frac{2}{m}\left(\tfrac{1}{2}kx_0^2 + mgh\right)} = \sqrt{\frac{2}{1.35\text{ kg}}(3.39\text{ J} + 9.93\text{ J})} = 4.44\text{ m/s}.$$

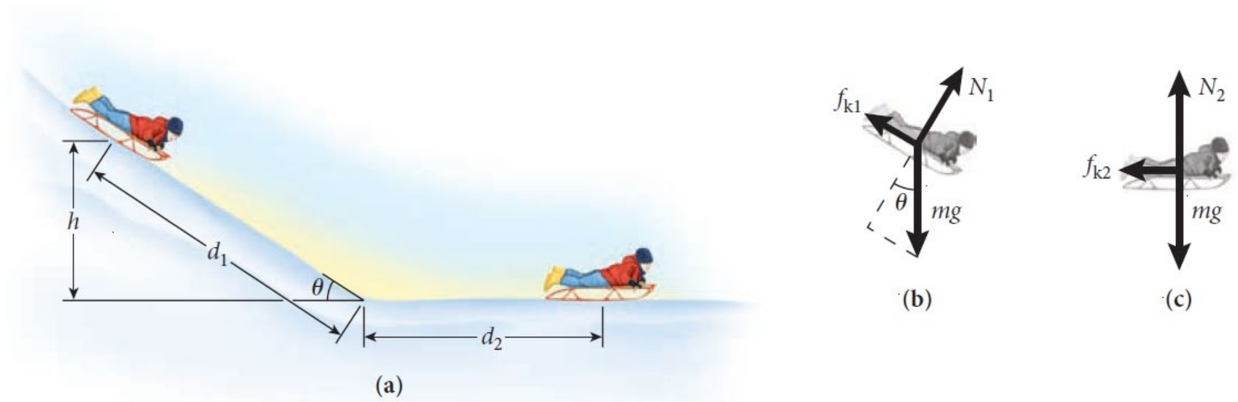
$$F_k = \mu_k N = \mu_k mg.$$
$$W_f = -\mu_k mgd.$$

$$W_f = \Delta K + \Delta U = K_{top} - \tfrac{1}{2}kx_0^2 = -\mu_k mgd$$
$$K_{top} = \tfrac{1}{2}kx_0^2 - \mu_k mgd$$
$$= 3.39\text{ J} - (0.16)(1.35\text{ kg})(9.81\text{ m/s}^2)(0.65\text{ m})$$
$$= 3.39\text{ J} - 1.38\text{ J} = 2.01\text{ J}.$$

$$W_f = \Delta K + \Delta U = 0$$
$$\tfrac{1}{2}mv^2 - K_{top} + 0 - mgh = 0,$$
$$v = \sqrt{\frac{2}{m}(K_{top} + mgh)}.$$
$$v = \sqrt{\frac{2}{1.35\text{ kg}}(2.01\text{ J} + 9.93\text{ J})}$$
$$= 4.20581608\text{ m/s}.$$

Solved Problem 6.6 Sledding down a Hill

A boy on a sled starts from rest and slides down a snow-covered hill. Together the boy and sled have a mass of **23.0 kg**. The hill's slope makes an angle **θ = 35.0°** with the horizontal. The surface of the hill is **25.0 m long**. When the boy and the sled reach the bottom of the hill, they continue sliding on a horizontal snow-covered field. The coefficient of kinetic friction between the sled and the snow is **0.100**. **How far do the boy and sled move on the horizontal field before stopping?**



$$\Delta U = -mgh,$$

$$h = d_1 \sin\theta.$$

$$f_{k1} = \mu_k N_1 = \mu_k mg\cos\theta.$$

$$W_1 = -f_{k1} d_1,$$

$$f_{k2} = \mu_k N_2 = \mu_k mg.$$

$$W_2 = -f_{k2} d_2.$$

$$W_f = W_1 + W_2.$$

$$W_f = -f_{k1} d_1 - f_{k2} d_2.$$

$$W_f = -(\mu_k mg\cos\theta) d_1 - (\mu_k mg) d_2.$$

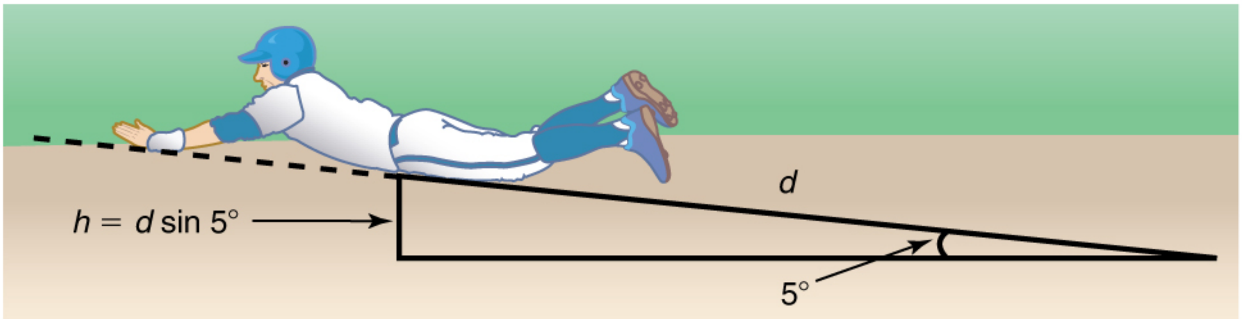
$$\Delta U = -mgd_1 \sin\theta.$$

$$mgd_1 \sin\theta = (\mu_k mg\cos\theta) d_1 + (\mu_k mg) d_2.$$

$$d_2 = \frac{d_1(\sin\theta - \mu_k \cos\theta)}{\mu_k}.$$

$$d_2 = \frac{(25.0\text{ m})(\sin 35.0° - 0.100 \cdot \cos 35.0°)}{0.100} = 122.9153\text{ m}$$

The player is running up a hill having a 5.00° incline upward with a surface similar to that in the baseball stadium. The player slides with the same initial speed. Determine how far he slides.



In this case, the work done by the nonconservative friction force on the player reduces the mechanical energy he has from his kinetic energy at zero height, to the final mechanical energy he has by moving through distanced **d** to reach height h along the hill, with **h = d sin 5.00°**

This is expressed by the equation

$$KE_i + PE_i + W_{nc} = KE_f + PE_f.$$

Solution

The work done by friction is again $W_{nc} = -fd$;initially the potential energy is $PE_i = mg \cdot 0 = 0$and the kinetic energy is$KE_i = \frac{1}{2}mv_i^2$;the final energy contributions are$KE_f = 0$for the kinetic energy and$PE_f = mgh = mgd\sin\theta$for the potential energy.

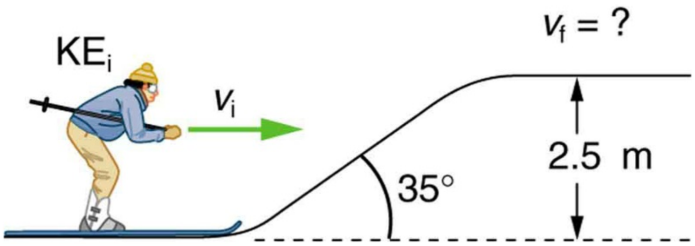
Substituting these values gives

$$\frac{1}{2}mv_i^2 + 0 + (-fd) = 0 + mgd\sin\theta.$$

Solve this for$d$to obtain

$$\begin{aligned} d &= \frac{(\frac{1}{2})mv_i^2}{f + mg\sin\theta} \\ &= \frac{(0.5)(65.0\text{ kg})(6.00\text{ m/s})^2}{450\text{ N} + (65.0\text{ kg})(9.80\text{ m/s}^2)\sin(5.00^0)} \\ &= 2.31\text{ m.} \end{aligned}$$

A 60.0-kg skier with an initial speed of 12.0 m/s coasts up a 2.50-m-high rise



a. Find her final speed at the top, given that the coefficient of friction between her skis and the snow is 0.0800. (Hint: Find the distance traveled up the incline assuming a straight-line path as shown in the figure.)

b. How much work does friction do on the skier?

(a) Let's apply the law of conservation of energy:

$$KE_i + PE_i + W_{NC} = KE_f + PE_f,$$
$$\frac{1}{2}mv_i^2 + 0 + (-F_{fr}d) = \frac{1}{2}mv_f^2 + mgh.$$

We can find the force of friction as follows:

$$F_{fr} = \mu_k N = \mu_k mgcos\theta.$$

We can find the distance traveled up the incline from the geometry:

$$sin\theta = \frac{h}{d},$$
$$d = \frac{h}{sin\theta}.$$

Then, we get:

$$\frac{1}{2}mv_i^2 - \mu_k mgcos\theta \cdot \frac{h}{sin\theta} = \frac{1}{2}mv_f^2 + mgh,$$
$$v_f = \sqrt{v_i^2 - 2gh(\mu_k cot\theta + 1)},$$
$$v_f = \sqrt{(12\ \frac{m}{s^2})^2 - 2 \cdot 9.8\ \frac{m}{s^2} \cdot 2.5\ m \cdot (0.08 \cdot cot35^\circ + 1)},$$
$$v_f = 9.45\ \frac{m}{s}.$$

(b) We can find the work done by the friction force on skier as follows:

$$W_{fr} = -F_{fr}d = -\mu_k mghcot\theta,$$
$$W_{fr} = -0.08 \cdot 60\ kg \cdot 9.8\ \frac{m}{s^2} \cdot 2.5\ m \cdot cot35^\circ = -168\ N.$$

A ball with mass m is thrown vertically into the air with an initial speed v Which of the following equations correctly describes the maximum height h of the ball?	قذفت كرة كتلتها m رأسيًا في الهواء بسرعة ابتدائية v أي من المعادلات التالية تصف بشكل صحيح أقصى ارتفاع h للكرة؟

A) $h = \sqrt{\frac{v}{2g}}$

B) $h = 2mv / g$

C) $h = \frac{mv^2}{g}$

D) $h = \frac{v^2}{2g}$

$$\frac{1}{2}mv^2 = mgh$$
$$\frac{1}{2}v^2 = gh$$
$$h = \frac{v^2}{2g}$$

1. The mechanical energy of an object is always equal to

a. the work done on the object.

b. the change in the object’s kinetic energy.

c. the sum of the object’s kinetic and potential energies.

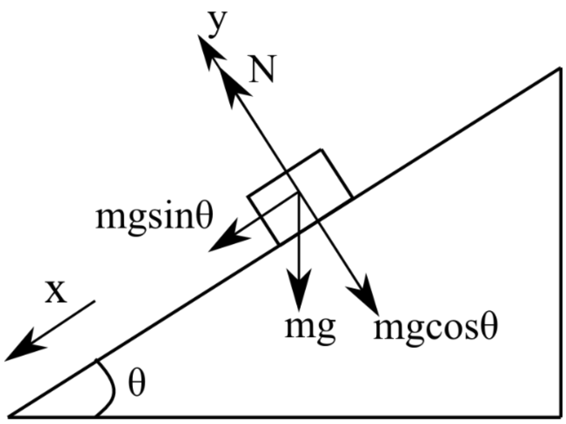
d. All are correct.

A 50 Kg block slides down a frictionless plane having an inclination of = 15.0° .The block starts from rest at the top, and the length of the incline is 2.00 m.

(a) Draw a free body diagram of the block.

(b)Find the acceleration of the block and

(c) its speed when it reaches the bottom of the incline.



$\sum F_x = ma_x,$ $mgsin\theta = ma,$ $a = gsin\theta = 9.8\,\frac{m}{s^2} \cdot sin15^\circ = 2.54\,\frac{m}{s^2}.$: $v_f^2 - v_i^2 = 2a\,\text{d}$ $v_f = \sqrt{2a\text{d}} = \sqrt{2 \cdot 2.54\,\frac{m}{s^2} \cdot 2.0\,m} = 3.19\,\frac{m}{s}.$	$K_i + U_i = K_f + U_f$ $0 + mgh = ½\, mv_f^2 + 0$

A stone is thrown up in the air and it reaches a maximum height of 10.0 m. What is the initial speed of the stone?

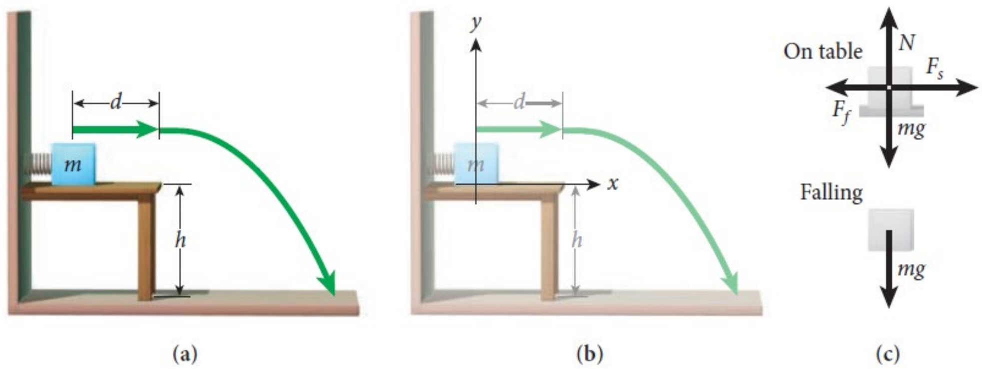
a. 10.0 m/s

b. 12.0 m/s

c. 14.0 m/s

d. 19.0 m/s

A block of mass 1.40 kg is attached to a spring and sits on a frictionless table which is a height *h* = 4.0 m above the floor. The spring is compressed by *d* = 0.11 m initially. If the spring constant is *k* = 600 N/m, what is the speed of the block when it leaves the spring?



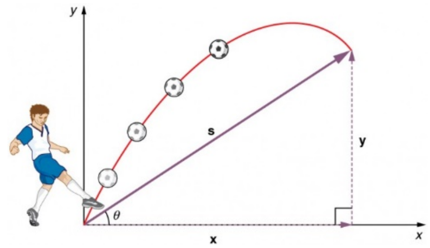
a. 1.2 m/s

b. 2.3 m/s

c. 3.4 m/s

d. 4.7 m/s

A ball of mass 2.00 kg is launched from the ground with a speed 10.0 m/s at an angle 20.0° above the horizontal. Assume that air drag is negligible. What is the kinetic energy of the ball 0.500 seconds after it is launched?



a. 60.5 J

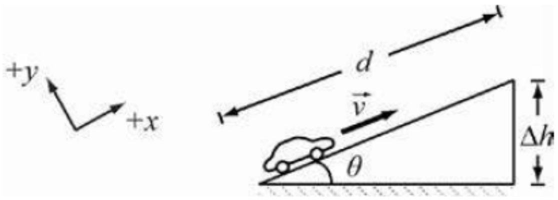
b. 70.5 J

c. 80.5 J

d. 90.5 J

A 103-kg car travels 2.50 km up an incline at constant velocity.
The incline has an angle of 3.00° with respect to the horizontal.

- **A- What is the change in the car's potential energy?**
- **B- What is the net work done on the car?**



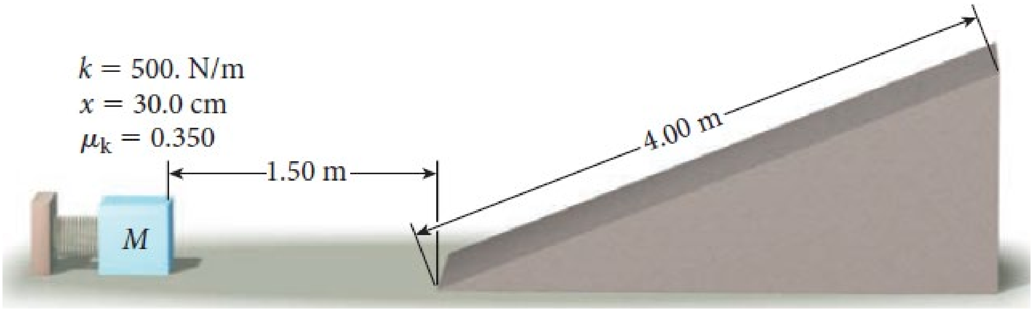
SIMPLIFY: $\Delta U = mg\Delta h = mgd\sin\theta$

$$W_{net} = \Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2 = \frac{1}{2}m\left(v_f^2 - v_0^2\right)$$

CALCULATE: $\Delta U = \left(1.50\cdot10^3 \text{ kg}\right)\left(9.81 \text{ m/s}^2\right)\left(2.50\cdot10^3 \text{ m}\right)\sin\left(3.00°\right) = 1925309 \text{ J}$

$$W_{net} = \frac{1}{2}m\left(v_f^2 - v_0^2\right) = \frac{1}{2}m(0) = 0$$

spring with a spring constant of 500. N/m is used to propel a 0.500-kg mass up an inclined plane. The spring is compressed 30.0 cm from its equilibrium position and launches the mass from rest across a horizontal surface and onto the plane. The plane has a length of 4.00 m and is inclined at 30.0°. Both the plane and the horizontal surface have a coefficient of kinetic friction with the mass of 0.350. When the spring is compressed, the mass is 1.50 m from the bottom of the plane.



a) What is the speed of the mass as it reaches the bottom of the plane?

b) What is the speed of the mass as it reaches the top of the plane?

c) What is the total work done by friction from the beginning to the end of the mass's motion?