1. Mike pulls a 4.50-kg sled across level snow with a force of 250.00-N along a rope that is 35.00° above the horizontal. If the sled moves 62.90-m, how much work does Mike do? (**1.29×10^4-J**)

2. Sau-Lan has a mass of 57.00-kg. She rides the up escalator at Ocean Park in Hong Kong. This is the world's longest escalator, with a length of 227.00-m and an average inclination of 31.00°. How much work does the escalator do on Sau-Lan? (**6.54×10^4-J**)

3. Chris carries a carton of milk, weight 11.00-N, along a level hall to the kitchen, a distance of 3.50-m. How much work does Chris do? (**0.00-J**)

4. A student librarian picks up a 2.20-kg book from the floor to a height of 1.30-m. He carries the book 7.70-m to the stacks and places the book on a shelf that is 0.35-m above the floor. How much work does he do on the book? (**7.55-J**)

5. Brutus, a champion weightlifter, raises 238.00-kg of weights a distance of 2.65-m.
   (a) How much work is done by Brutus lifting the weights? (**6180.86-J**)
   (b) How much work is done by Brutus holding the weights above his head? (**0.00-J**)
   (c) How much work is done by Brutus lowering them back to the ground? (**-6180.86-J**)
   (d) If Brutus completes the lift up in 2.70-s, how much power is developed? (**2289.21-W**)

6. A force of 296.00-N is used to push a 150.00-kg mass 30.00-m horizontally in 3.00-s.
   (a) Calculate the work done on the mass. (**8.88-kJ**)
   (b) Calculate the power developed. (**2.96-kW**)

7. Robin pushes a wheelbarrow by exerting a 130.00-N force horizontally. Robin moves it 59.00-m at a constant speed for 25.00-s.
   (a) What power does Robin develop? (**306.80-W**)
   (b) If Robin moves the wheelbarrow twice as fast, how much power is developed? (**613.60-W**)

8. A horizontal force of 782.00-N is needed to drag a crate across a horizontal floor with a constant speed. You drag the crate using a rope held at an angle of 28.00° (from the horizontal).
   (a) What force do you exert on the rope? (**885.67-N**)
   (b) How much work do you do on the crate when moving it 22.00-m? (**1.72×10^4-J**)
   (c) If you complete the job in 8.0 s, what power is developed? (**2150.50-W**)

9. Stan raises a 1200.00-N piano a distance of 5.00-m using a set of pulleys. Stan pulls in 20.00-m of rope.
   (a) How much effort force would Stan apply if this were an ideal machine (**300.00-N**)
   (b) What is the work output? (**6000.00-J)**
   (c) If the actual effort force is 340-N what is the work input? (**6800.00-J**)
   (d) What is the actual efficiency (**88.24%**)

10. What work is required to lift a 215.00-kg mass a distance of 5.65-m using a machine that is 72.50% efficient? (**1.64×10^4-J**)

1. A 1590.00-kg car travels at a speed of 15.00-m/s. What is its kinetic energy? Assume that air resistance is negligible. (**1.79×10^5-J**)

2. Toni has a mass of 40.00-kg and is moving with a speed of 8.20-m/s. Assume that air resistance is negligible.

(a) Find Toni's kinetic energy. (**1344.80-J**)
(b) Toni's speed changes to 4.10 m/s. Now what is her kinetic energy? (**336.20-J**)
(c) What is the ratio of the initial velocity to final velocity? (**2:1**)
(d) What is the ratio of the initial kinetic energy to final kinetic energy? (**4:1**)
(e) What is the relationship between answer (c) and (d)? (**squared**)

3. In the 1950s, an experimental train that had a mass of 2.70 $x10^4$-kg was powered across a level track by a jet engine that produced a thrust of 4.65 x 10^5-N for a distance of 509.00-m. Assume that air resistance is negligible.

(a) Find the work done on the train. (**2.37×10^8-J**)
(b) Find the change in kinetic energy. (**2.37×10^8-J**)
(c) Find the final kinetic energy of the train if it started from rest. (**2.37×10^8-J**)
(d) Find the final speed of the train if there were no friction. (**132-m/s**)

4. A 14.50-kg cart is moving with a velocity of 7.55-m/s down a level hallway. A constant force of -10.00-N acts on the cart, and its velocity becomes 3.20-m/s. Assume that air resistance is negligible.

(a) What is the change in kinetic energy of the cart? (**-339-J**)
(b) How much work was done on the cart? (**-339-J**)
(c) How far did the cart move while the force acted? (**33.9-m**)

5. It is not uncommon during the service of a professional tennis player for the racket to exert an average force of 148.00-N on the ball. If the ball has a mass of 0.055-kg and is in contact with the strings of the racket for 0.030-s, what is the kinetic energy of the ball as it leaves the racket? Assume that the ball starts from rest. Assume that air resistance is negligible. (**179-J**)

6. A 22.00-kg rock is on the edge of a 110.00-m cliff. Assume that air resistance is negligible.

(a) What potential energy does the rock possess relative to the base of the cliff? (**2.37×10^4-J**)
(b) The rock falls from the cliff. What is its kinetic energy just before it strikes the ground? (**2.37×10^4-J**)
(c) What speed does the rock have as it strikes the ground? (**46.43-m/s**)

7. A 2.00-kg rock initially at rest loses 386.00-J of potential energy while falling to the ground. Assume that air resistance is negligible.

(a) Calculate the kinetic energy that the rock gains while falling. (**386.00-J**)
(b) What is the rock's speed just before it strikes the ground? (**19.65-m/s**)

8. A physics book of unknown mass is dropped 4.35-m. What speed does the book have just before it hits the ground? Assume that air resistance is negligible. (**9.24-m/s**)

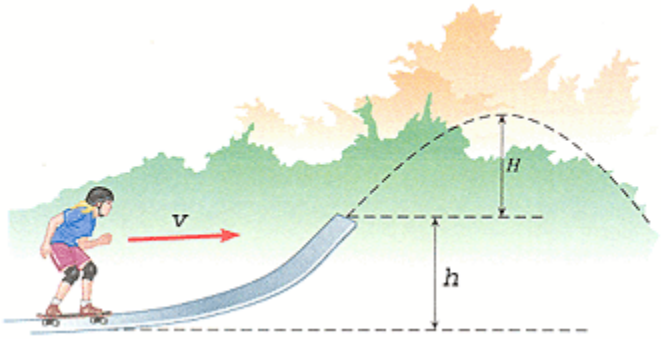
9. A 28.50-kg gun is resting on a frictionless surface. The gun fires a 50.00-g bullet with a muzzle velocity of 311.50-m/s. Assume that air resistance is negligible.

(a) Calculate the momenta of the bullet and the gun after the gun is fired. (**b:15.58-kg·m/s g:-**)
(b) Calculate the kinetic energy of the bullet and the gun just after firing. (**b:2430-J g:4.26-J**)

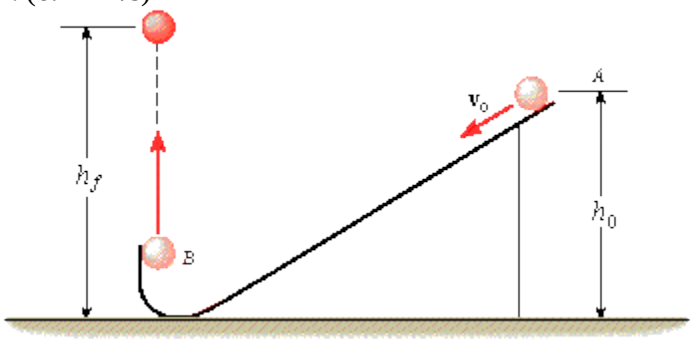
10. Justin throws a 10.50-g ball straight down from a height of 2.00-m. The ball strikes the floor at a speed of 7.10-m/s. What was the initial speed of the ball? (**3.35-m/s**)

E1. A 2.00 x 10^2 kg crate is being pushed across a horizontal floor by a force $\vec{\mathbf{P}}$ that makes an angle of 30.00° below the horizontal. The coefficient of kinetic friction is 0.350. What should be the magnitude of $\vec{\mathbf{P}}$, so that the net work done by it and the kinetic frictional force is zero? (**993-N**)

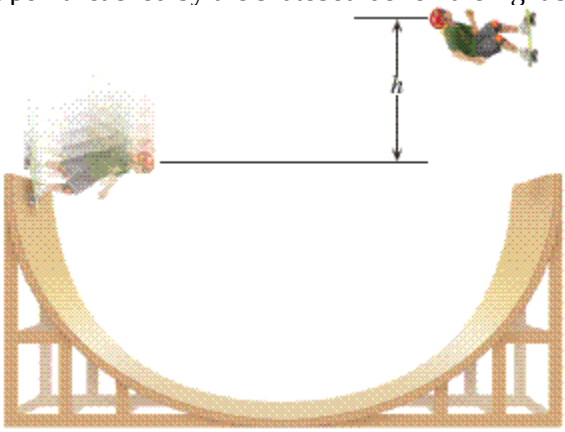
E2. The drawing shows a skateboarder moving at v = 4.60-m/s along a horizontal section of a track that is slanted upward by 48.00° above the horizontal at its end, which is h = 0.46-m above the ground. When she leaves the track, she follows the characteristic path of projectile motion. Ignoring friction and air resistance, find the maximum height H to which she rises above the end of the track. (**3.42 x 10^{-1}-m**)



E3. A particle, starting from point A in the drawing at a height h_o = 2.10-m, is projected down the curved runway. Upon leaving the runway at point B, the particle is traveling straight upward and reaches a height h_f = 4.40-m above the floor before falling back down. Ignoring friction and air resistance, find the speed of the particle at point A. (**6.71-m/s**)



E4. The skateboarder in the drawing below starts down the left side of the ramp with an initial speed of 5.40-m/s. If non-conservative forces, such as kinetic friction and air resistance, are negligible, what would be the height h of the highest point reached by the skateboarder on the right side of the ramp? (**1.49-m**)



E1. When an 81.00-kg adult uses a spiral staircase to climb to the second floor of his house, his gravitational potential energy increases by 2.15 x 10^3-J. By how much does the potential energy of a(n) 21.50-kg child increase when the child climbs a normal staircase to the second floor? (**571-J**)

E2. A 2.80 x 10^2-N force is pulling an 85.00-kg refrigerator across a horizontal surface. The force acts at an angle of 23.00° above the surface. The coefficient of kinetic friction is 0.20, and the refrigerator moves a distance of 5.00-m.

(a) Find the work done by the pulling force. (**1290-J**)
(b) Find the work done by the kinetic frictional force. (**-724-J**)

E3. In 2 minutes, a ski lift raises 6 skiers at constant speed to a height of 160.00-m. The average mass of each skier is 65.00-kg. What is the average power provided by the tension in the cable pulling the lift? (**5100-W**)

E4. A 64.00-kg skier coasts up a snow-covered hill that makes an angle of 25.00° with the horizontal. The initial speed of the skier is 7.40-m/s. After coasting 1.90-m up the slope, the skiers speed is 3.10-m/s.

(a) Find the work done by the kinetic frictional force that acts on the skis. (**-941-J**)
(b) What is the magnitude of the kinetic frictional force? (**495-N**)

E5. A water slide is constructed so that swimmers, starting from rest at the top of the slide, leave the end of the slide traveling horizontally. As the drawing shows, one person hits the water 5.00-m from the end of the slide in a time of 1.00-s after leaving the slide. Ignoring friction and air resistance, find the height *H* in the drawing. (**6.18-m**)