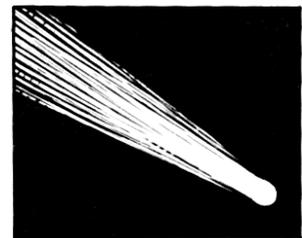


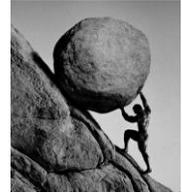
Work and energy.

1. An intern at a local emergency room pushes a 98-kg patient on a 16-kg gurney, producing an acceleration of 0.33 m/s^2 . How much work is done by the intern in pushing the patient and gurney through a distance of 3.3 m?
2. A sledge, including load, weighs 850 N. It is pulled across level snow (with a coefficient of friction of 0.105) by a team of Alaskan malamutes and Siberian huskies, exerting a horizontal force on it. (a) How much force is applied by the dog team pulling the sledge 1200 m if the sledge moves at a constant velocity? (b) How much work is done pulling the sled?
3. A bored tourist drops a 7.6-kg bowling ball off the observation deck of the *Burj Khalifa* Tower in Dubai, United Arab Emirates, 452 m above the parking lot below. (a) What is the bowling ball's kinetic energy after falling for 1.5 s? (b) What is its potential energy? (c) What is the bowling ball's kinetic energy just before impact? (d) What is its velocity at the moment of impact?
4. James Prescott Joule was credited with the discovery of conservation of energy even though a number of other scientists (including Benjamin Thompson and Humphry Davy) also described this behavior. Why did he receive the credit and not the others?
5. A brick and a pebble fall from the roof of an apartment building under construction. At some point, the brick is moving at a speed of 3 m/s and the pebble's speed is 5 m/s. If both objects have the same kinetic energy, what is the ratio of the brick's mass to the pebble's mass?
6. In the middle of yet another failed attempt to catch the Roadrunner, Wile E. Coyote (who has a mass of 15 kg) falls from a height of 135 m onto an Acme™ Super-industrial Spring Scale which has a spring constant of $1.95 \times 10^5 \text{ N/m}$. (a) How far is the spring scale compressed? (b) At the point where Wile E. Coyote's impact on the industrial spring scale is the greatest, what is the reading on the scale? (c) Assuming that all the elastic potential energy in the compressed spring scale is converted into kinetic energy, what is Wile E. Coyote's initial velocity as he's "shot off" the spring scale? (d) How high will Wile E. Coyote go?
7. What is meant by a "closed" or *isolated* system for the purpose of describing conservation of energy?
8. Almost every problem dealing with conservation of energy carefully neglects the effects of friction and air resistance. How would air resistance or friction affect the behavior of a swinging pendulum or a thrown baseball?
9. After politicians ignore repeated warnings by many eminent scientists, Comet *Dingleberry* (which has a mass of $9.45 \times 10^{10} \text{ kg}$) strikes the center of the Washington mall during the midst of another intensive but mindless legislative session with a relative velocity of $16 \times 10^4 \text{ km/h}$. (a) Assuming 15% of the kinetic energy of the comet is lost as a result of air resistance, compute the total energy of the comet upon impact in megatons of TNT, where the detonation of one million tons of TNT releases $4.2 \times 10^{15} \text{ J}$ of energy. The diameter of the crater blasted by a large explosion is proportional to the one-third power of the energy released, or $d = E^{\frac{1}{3}}$, with 1 megaton of a TNT explosion producing a crater about 1 km in diameter; that is, $1 \text{ km} = (1 \text{ Mt})^{\frac{1}{3}}$. (b) What is the diameter of the crater produced by the impact of the comet?

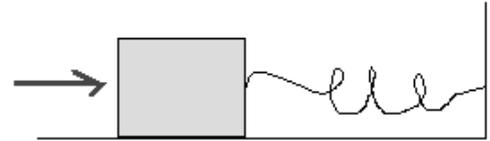


10. Is it possible to do work on an object that remains at rest? If so, how?
11. A candy bar called the Everest Bar™ has a caloric content of 210 Cal (equivalent to 8.791×10^5 J). If an 82-kg mountain climber eats an Everest Bar™ and converts it all to potential energy, what gain in altitude would be possible?

12. In Greek mythology, the overly cunning King Sisyphus cleverly cheated Death. As his punishment, he was condemned to spend eternity pushing a huge boulder up a steep mountain. Upon reaching the summit, the rock would always roll back down to the bottom of the mountain. Does King Sisyphus do any work on the rock? Explain your reasoning.

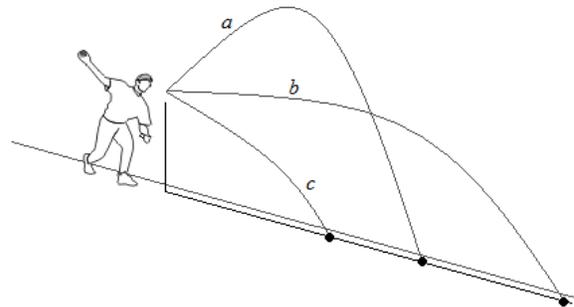


13. A 1.6-kg block slides with a speed of 1.6 m/s on a frictionless, horizontal surface until it encounters a spring. If the block compresses the spring 6.1 cm before coming to rest, (a) what is the spring constant? (b) How much kinetic energy does the block have just before it hits the spring? (c) How much elastic potential energy is stored in the spring when the block comes to rest? (d) What initial speed would the block have if it compresses the spring 1.6 cm?



14. What does it mean to say that energy and mass are *equivalent*? Why is it useful to think of the two being this way?
15. Unfortunately, your escape . . . er, “arrival” in Nigeria is marred by the airplane you smuggled yourself onto undergoing a crash landing on the Obudu Plateau. The box of agricultural products you’ve been hiding behind begins sliding across the floor of the storage container. It strikes the far wall and breaks into two separate pieces, each filled with several hundred bags of what appears to be either cocaine or powdered sugar. Realizing what a prize you may have stumbled onto, you dig around in the baggage compartment and find an empty suitcase. After filling the suitcase with 450 lb of the stuff, you drag it 24 ft across the floor of the airplane to the exit. If you have to apply a force of 210 lb at an angle of 55° above the horizontal, (a) how much work do you do? (b) How much work is done by friction? (c) What is the coefficient of friction between the bottom of the suitcase and the floor of the aircraft? (d) What is going to happen when Nigerian customs officers discover you in the airplane surrounded by several million dollars worth of cocaine?

16. You are practicing your bowling for the upcoming Annual KAMSC Cricket Championship Test matches in the spring. Which of the three tosses shown will have the fastest velocity upon impact on the pitch? Assume no air resistance and all three throws have the same initial speed. Use conservation of mechanical energy.



17. Energy is radiated by our Sun at a rate of approximately 3.92×10^{26} W. How much mass does the Sun lose every second through this radiation?
18. Andrea Mayr of Austria set a new world record in the Empire State Building Run-Up in 2006 when she ran up all 1576 steps in 11:23. If the height gain of each step was 0.20 m and her mass was 55 kg, what was her average power output during the climb?