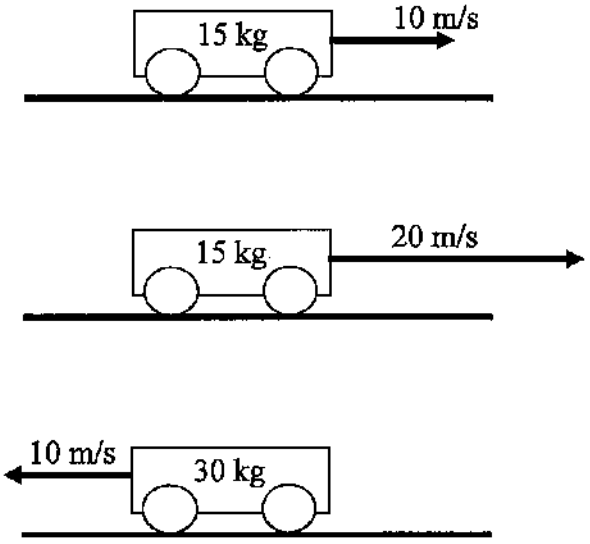
Physics First Name_____

POGIL: Kinetic Energy and Gravitational Potential Energy

Energy can be thought of as the capacity of an object to enact change. We have seen that energy can be transferred between different mechanisms and thus cause changes in a system. In this POGIL we will learn how to calculate the amount of energy stored in two mechanisms: kinetic energy (E_k) and gravitational potential energy (E_g).

Kinetic Energy (E_k)

The energy stored in *kinetic energy* (E_k) is associated with a system's motion. The diagrams below show several objects of different masses moving at different velocities. The energy stored in kinetic energy is calculated. Note that we use Joules as the unit of energy, abbreviated with the letter J.



kinetic energy = ½ × (mass) × (velocity)^2

$$E_k = \frac{1}{2}mv^2 = \frac{1}{2}(15\text{ kg})(10\text{ m/s})^2$$

E_k = 750 Joules = 750 J

kinetic energy = ½ × (mass) × (velocity)^2

$$E_k = \frac{1}{2}mv^2 = \frac{1}{2}(15\text{ kg})(20\text{ m/s})^2$$

E_k = 3000 Joules = 3000 J

kinetic energy = ½ × (mass) × (velocity)^2

$$E_k = \frac{1}{2}mv^2 = \frac{1}{2}(30\text{ kg})(10\text{ m/s})^2$$

E_k = 1500 Joules = 1500 J

1. Calculate the energy, in Joules, stored in E_k for the following objects.
   (a) a 70 kg person running at 4 m/s

   (b) a 1000 kg car traveling at 30 m/s

   (c) a 0.05 kg ball moving at 25 m/s

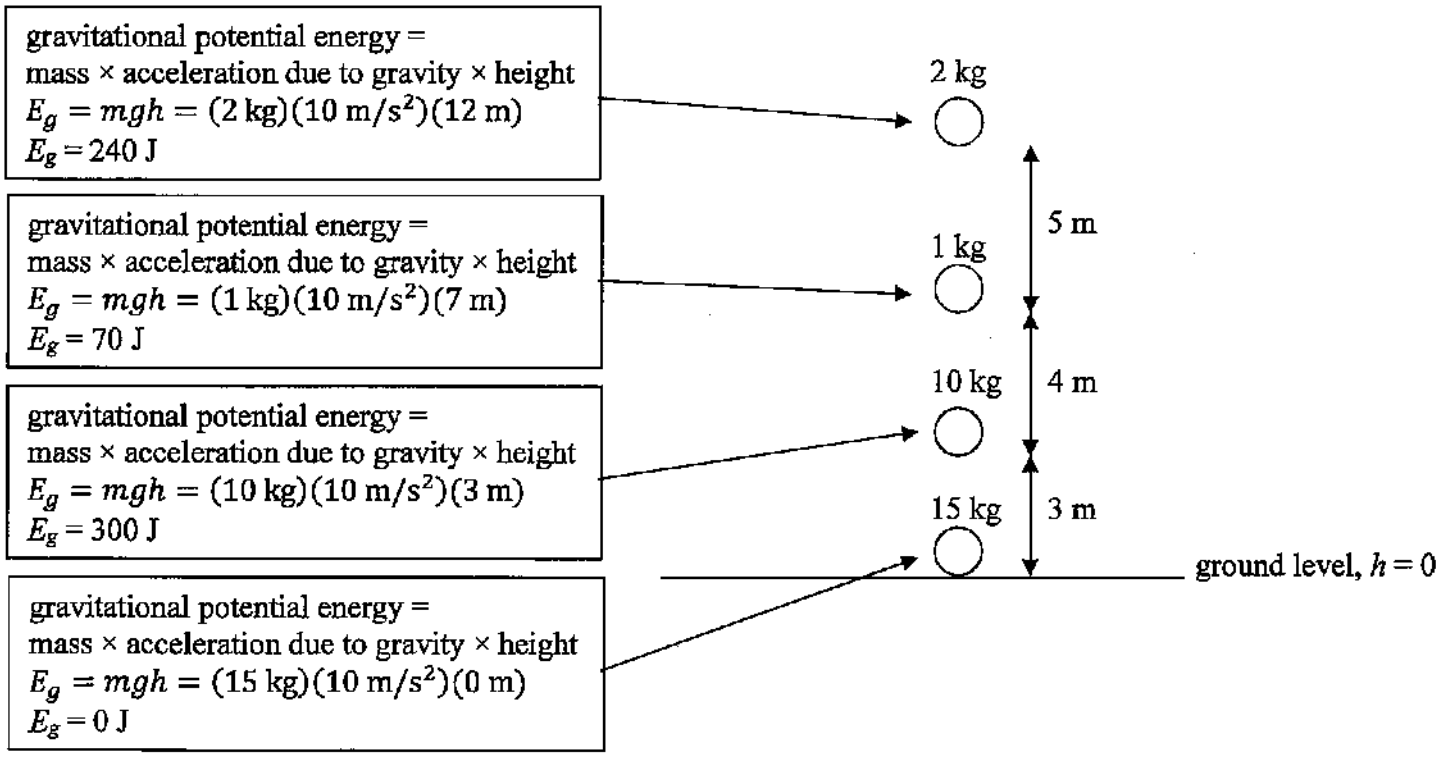
   (d) a 0.001 kg ant moving at a speed of 0.02 m/s

2. Can kinetic energy ever be negative? Why or why not?

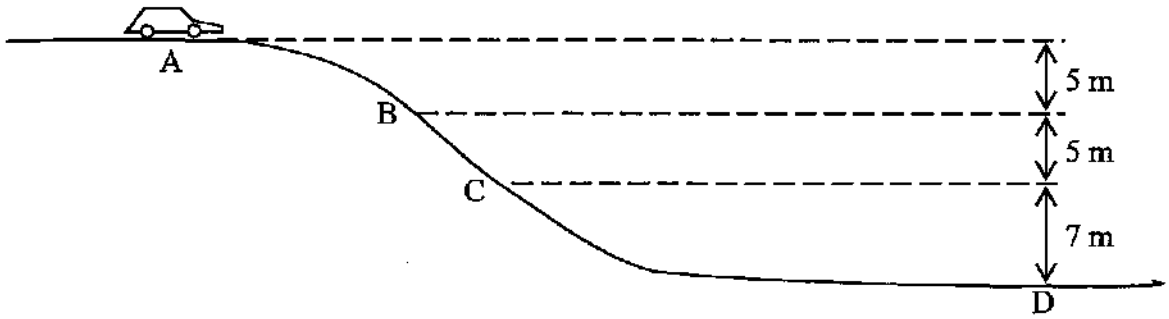
3. Rank the following objects in order from LOWEST energy in E_k to HIGHEST energy in E_k. Indicate a tie with an equal sign.
   (a) an object of mass 1 kg traveling with a speed 1 m/s
   (b) an object of mass 2 kg traveling with a speed 1 m/s
   (c) an object of mass 1 kg traveling with a speed 2 m/s
   (d) an object of mass 0.5 kg traveling at speed 2 m/s
   (e) an object of mass 2 kg traveling at speed 0.5 m/s

Gravitational Potential Energy (E_g)

The energy stored in *gravitational potential energy* (E_g) is associated with an object's position relative to a planet (in most cases, the Earth) while under the influence of a gravitational force. The diagram below shows several objects of different masses at different heights above the ground. The energy stored in gravitational potential energy relative to the ground is calculated.



4. In the picture below, a 1000 kg car starts at point A and travels down a hill through points B, C, and D.



(a) Calculate the energy stored in E_g at points A, B, C, and D.

E_g (point A) = _____ E_g (point B) = _____

E_g (point C) = _____ E_g (point D) = _____

(b) Calculate the *change* in gravitational potential energy (ΔE_g) when the car travels from point A to B, A to C, and A to D.

ΔE_g (A to B) = _____ ΔE_g (A to C) = _____

ΔE_g (A to D) = _____

5. A 5 kg shotput is thrown through the air from an initial height of 1.5 m. Calculate the energy stored in E_g when the shotput is:
(a) at its initial height.

(b) 2 m above the ground.

(c) 2.5 m above the ground.

(d) 1 m above the ground.

(e) hitting the ground.