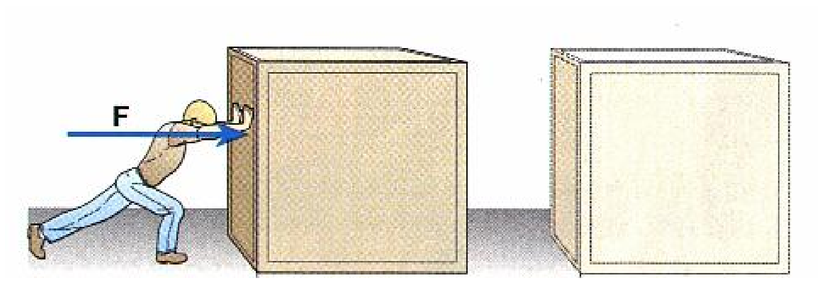
WORK

(a)



(b)

Who is doing more work?

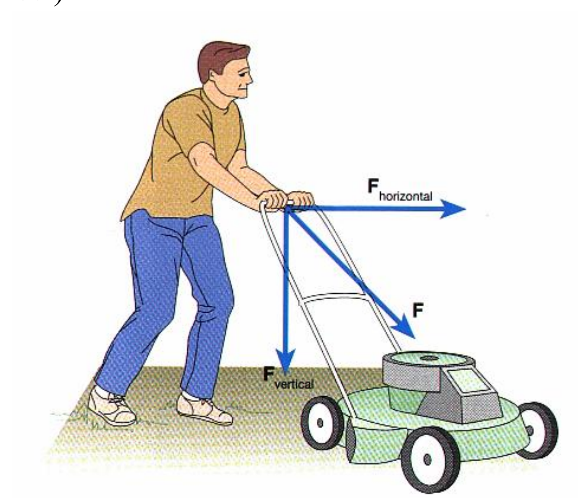
- **Work** is defined as the product of the **net force** acting on a body and the **distance** moved in the direction of the force.

Work = force x parallel distance

W= F x d

- SI Units of work are **joules** (1 joule =1 Nm= 1 kgm^2/s^2)

- Only the **component** of the applied force, **F**, in the **direction** of the **motion** of the lawn mower, $\mathbf{F_{Horizontal}}$, is used to do **work** on the lawn mower.



Examples:

1. An object is moved with a force of 15 N across a horizontal surface. How much work is done if the object is moved 50 m?

   F=

   d=

   W=

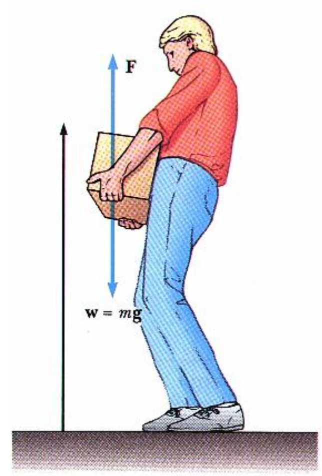
2. 650 J of work is done in moving a desk a horizontal distance of 5 m. How much force is used to move the desk?

   F=

   d=

   W=

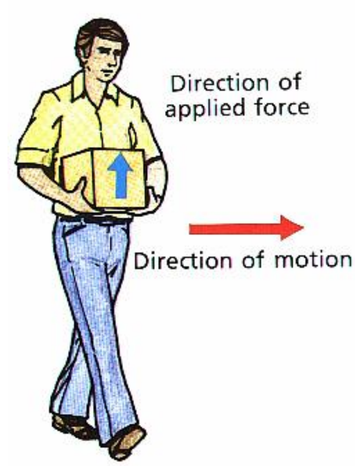
3. How much work is done in lifting a 10 kg box 1.5 m off the floor?



F=w=mg=(10 kg)(10 m/s^2)=100 N

W=F x d =(100 N)(1.5 m)=150 Joules

4. How much work is done while walking 5.0 m holding an object with mass of 3.0 kg?



POWER

- **Power** is the **rate** at which work is done.

$$\textbf{Power} = \frac{\textbf{work}}{\textbf{time}} \qquad P = \frac{W}{t} = \frac{Fd}{t}$$

- SI units of power are **watts** (1 watt=1 joule/s).

Examples:

1. A force of 150 N is used to push a motorcycle 10 m along a road in 20 s. Calculate the power in watts.

   F=

   d=

   t=

   P= ???

2. An 80 kg man runs up a flight of stairs 5.0 m high in 10 seconds. What is the man's power output in watts?

$$F = m \times g = (80\text{ kg})(10\text{ m/s}^2) = 800\text{ N}$$

$$P = \frac{W}{t} = \frac{F \times d}{t} = \frac{(800\text{ N})(5.0\text{ m})}{10\text{ s}} = 400\text{ watts}$$

3. A pump lifts 30 kg of water a vertical distance of 20 m each second. What is the power output?

   m=

   d=

   t=

   P= ???

4. A crane uses 750 kW of power to lift a car 0.5 m in 12 seconds. How much work is done? What force did the crane use?

    d=

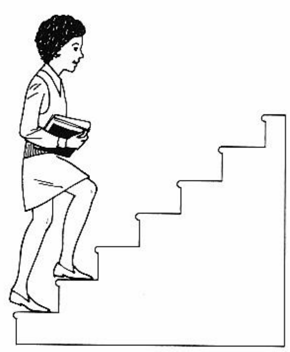
    t=

    P=

    W=???

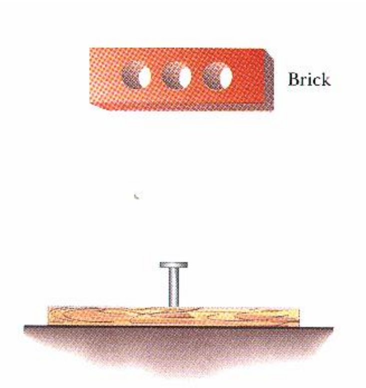
    F=???

5. Which person below does more work? Which person has greater power? Explain.

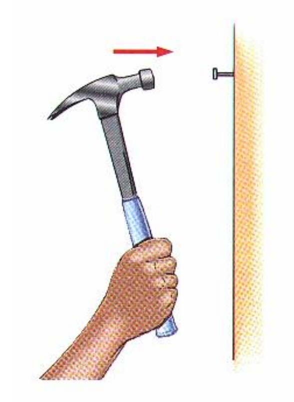



ENERGY

- **Energy** is defined as the **ability** to do **work**.

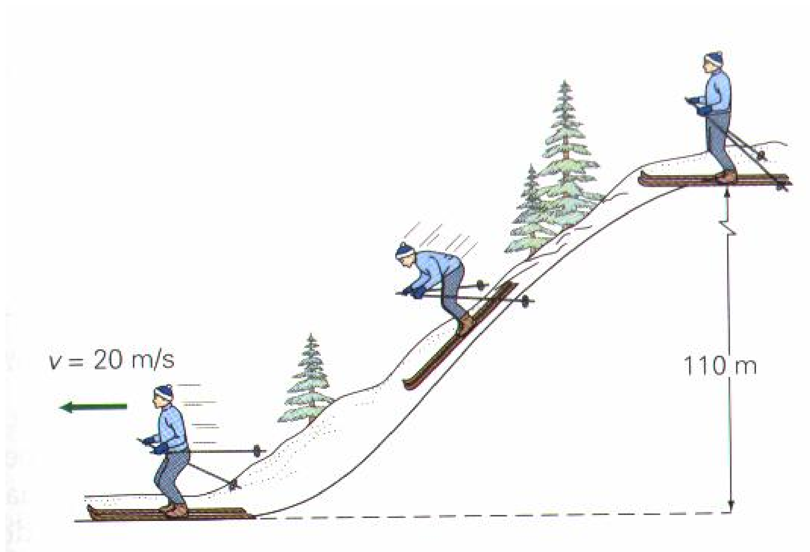


The brick and the hammer possess **energy** and thus can **do work** on the nail



- Two types of energy: **kinetic** (motion) and **potential** (stored)
- SI units of energy are **joules** (1 joule = $1 kgm^2/s^2$)

Potential energy



Kinetic Energy

KINETIC ENERGY

- KE is energy of ***motion***:

$$KE = \frac{1}{2}mv^2$$

- KE is a ***scalar*** quantity.

Examples:

1. What is the kinetic energy of a 60 kg girl on skis traveling at 20 m/s?

   m=

   v=

   KE=

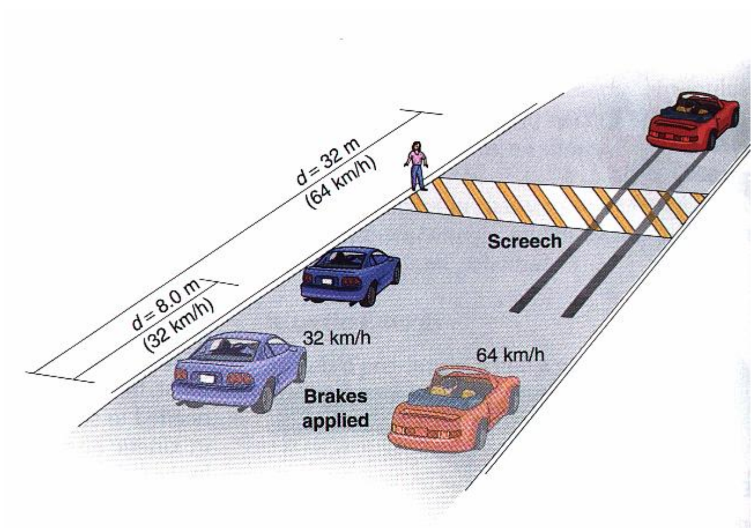
2. A sports car is moving at 4.0 m/s. If the mass of the car is 800 kg, how much kinetic energy does it have?

   m=

   v=

   KE=

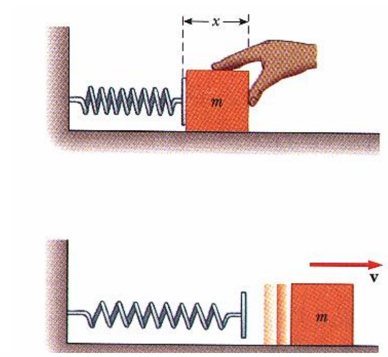
3. Two identical cars are moving, one with twice the velocity of the other. How much more kinetic energy does the faster car possess?



POTENTIAL ENERGY

- PE is ***stored*** energy.

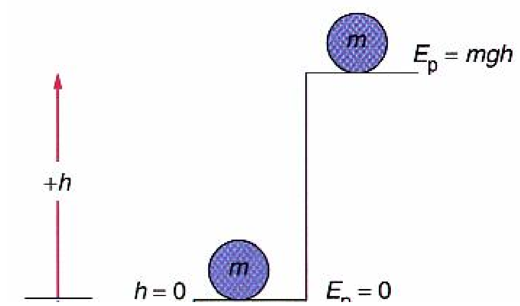
  The compressed spring has ***potential energy*** because when released it can do ***work*** on the mass, ***m***.



- ***Gravitational PE*** is energy of ***position***.

Potential Energy = weight x height

PE = m g h



Examples:

1. A mass of 100 kg is lifted a distance of 50 m. How much potential energy does it possess?

   m=

   h=

   PE=

2. A 70-kg diver standing on a diving platform possesses 35000 J of PE. How high is the platform?

   m=

   h=

   PE=

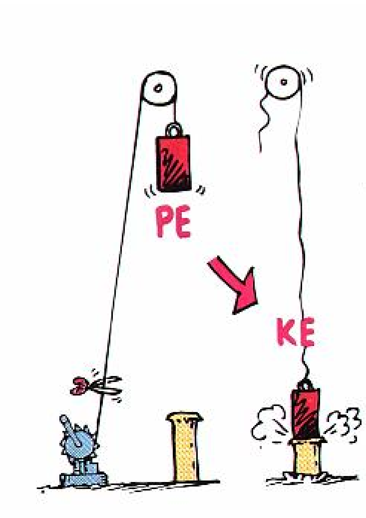
CONSERVATION OF ENERGY

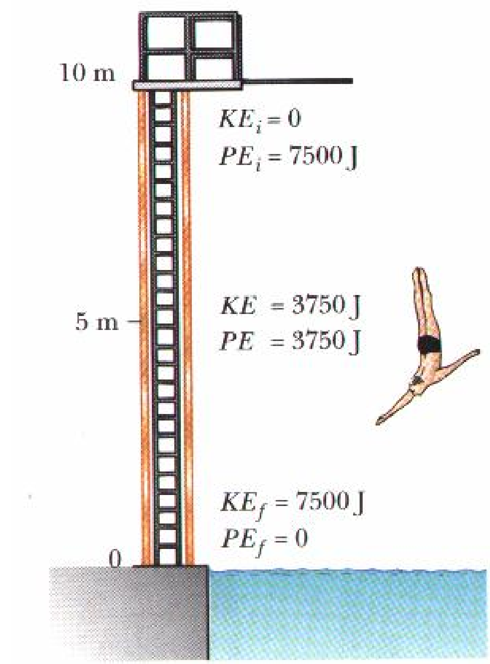
- The **sum** of **kinetic energy** and **potential energy** in a **system** is **constant**, in absence of **friction**.

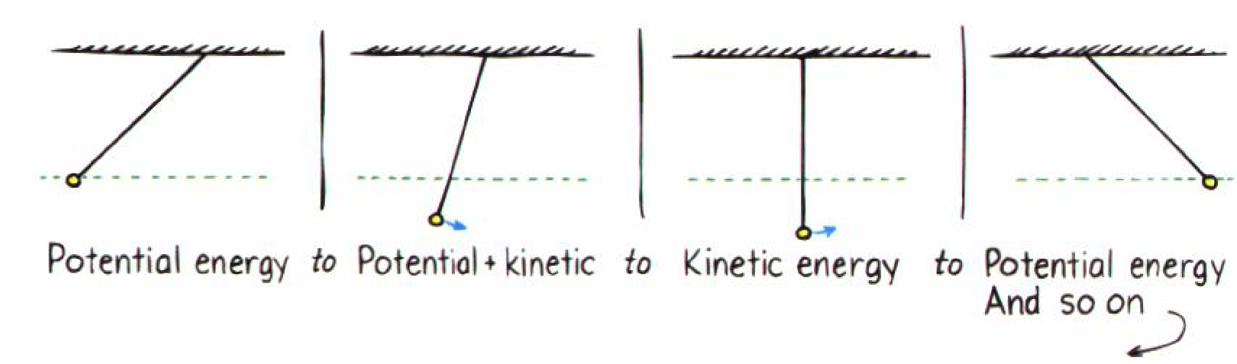
KE + PE = constant

- Energy **cannot be created or destroyed**; it may be **transformed** from **one form to another**, but the **total amount** of energy in a system remains **constant**.

KE + PE= total energy (constant)







Examples:

1. A 10-kg boulder rests at the edge of a 100-m cliff.
   a) How much potential energy does the rock possess?

      m=

      h=

      PE=

   b) The rock rolls off the cliff and falls to the bottom. How much kinetic energy does the rock possess at the bottom of the cliff?

$$\mathbf{KE_{Bottom} = PE_{Top} =}$$

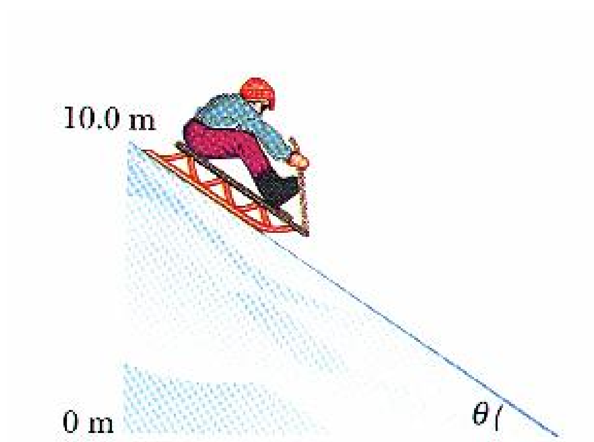
   c) What speed does the rock have just before hitting the ground?

$$\mathbf{KE = \frac{1}{2} m v^2}$$

$$\mathbf{v^2 =}$$

$$\mathbf{v =}$$

2. A 60-kg boy and his sled are at the top of a 10 m high slope.
   a) How much gravitational potential energy do the boy and the sled possess at the top of the slope?



   b) What kinds of energy, and how much of each, do they possess halfway down the slope (5 meters above point 0)?