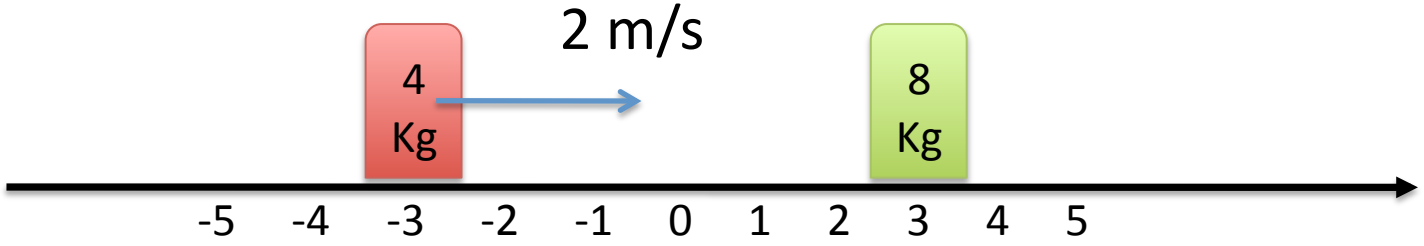
Kinetic energy



A moving object has kinetic energy

$$K.E. = \frac{1}{2} m v^2$$

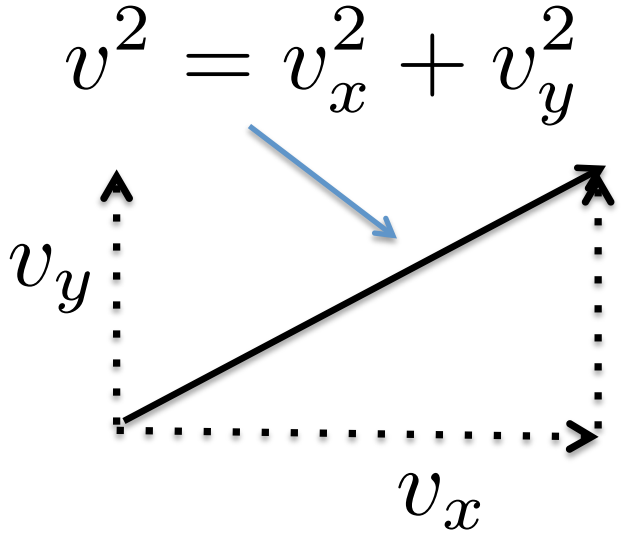
$$K.E._1 = \frac{1}{2}(4)(2)^2 = 8 \text{ Joules}$$

$$K.E._2 = \frac{1}{2}(8)(0)^2 = 0$$

2-dimensions

$$K.E. = \frac{1}{2} m\, v^2$$

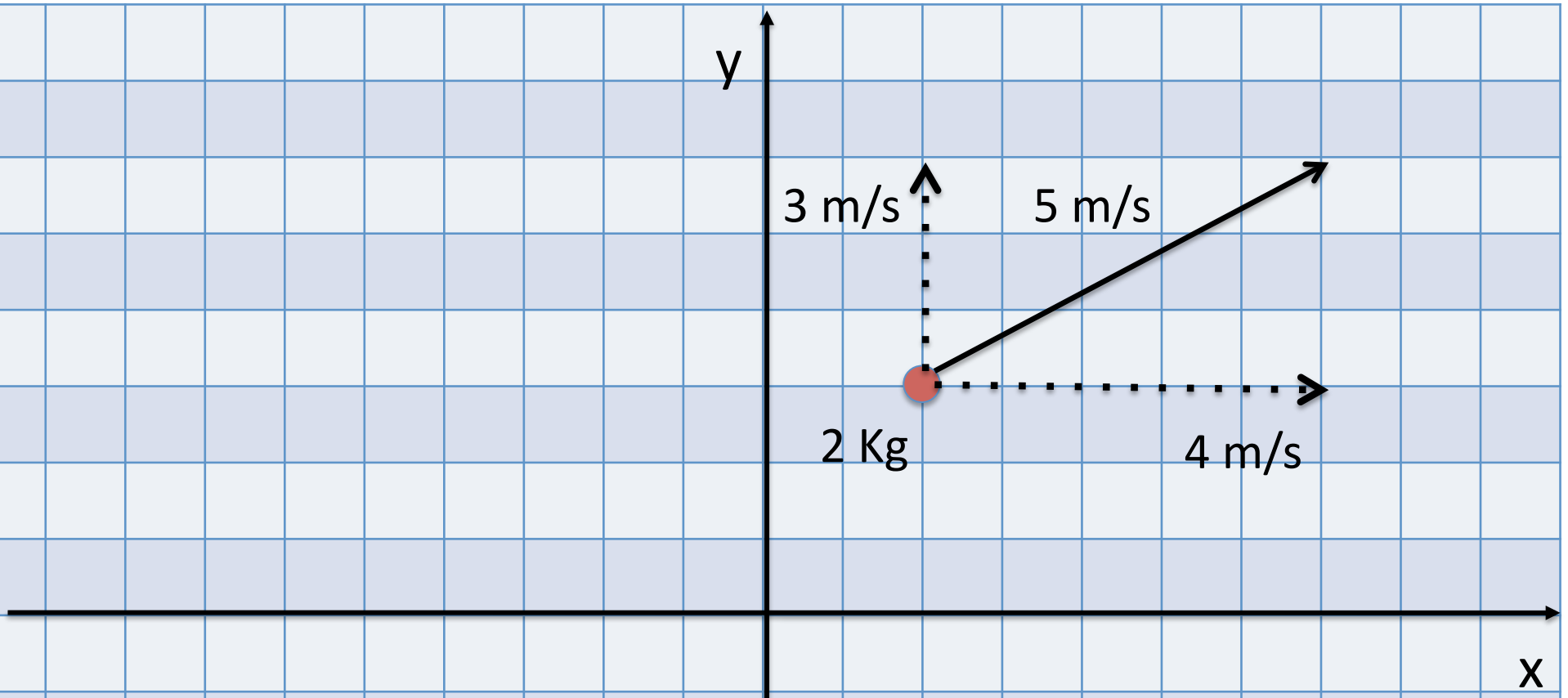
$$= \frac{1}{2} m(v_x^2 + v_y^2)$$



3-dimensions

$$K.E. = \frac{1}{2} m\, v^2$$

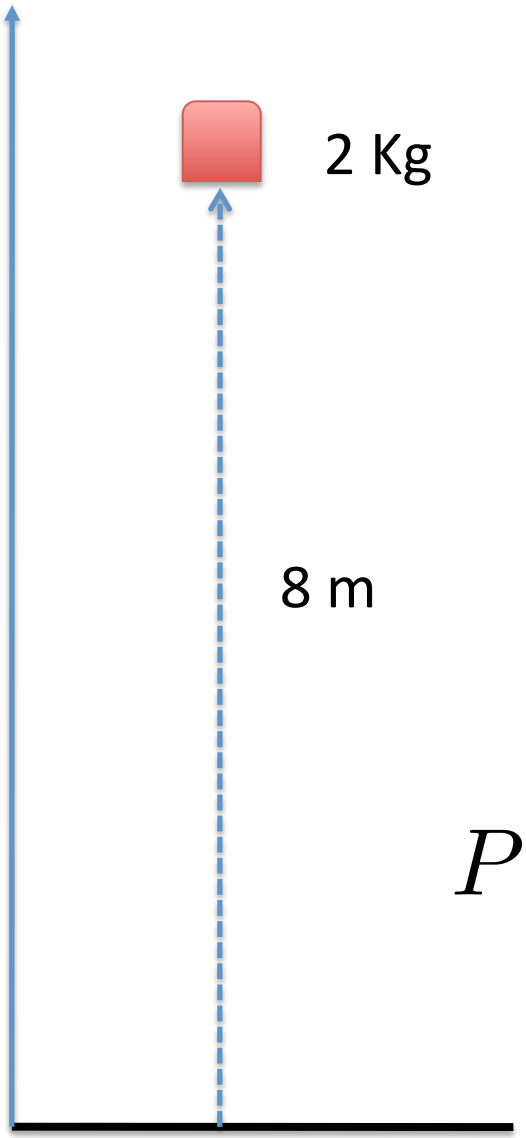
$$= \frac{1}{2} m(v_x^2 + v_y^2 + v_z^2)$$



$$K.E. = \frac{1}{2}(2)(5)^2$$

$$= 25\ J$$

Potential energy



$$P.E. = m\,g\,h$$

$$g = 9.8\ m/s^2$$

$$\approx 10\ m/s^2$$

$$PE = 2 \times 9.8 \times 8$$

$$= 156.8\ J$$

Total energy is conserved

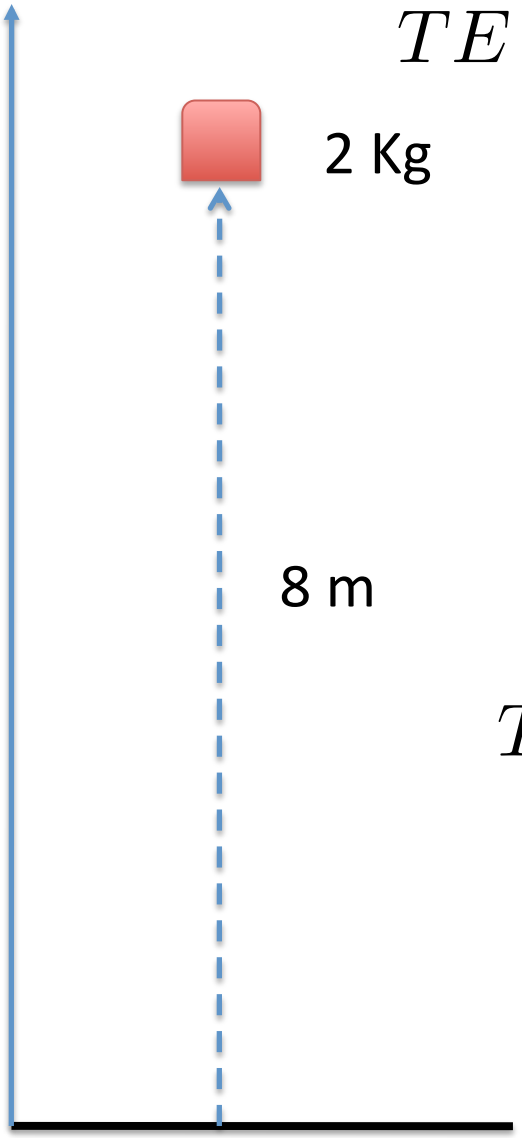
Total energy TE = KE +PE + heat + …

If there is no friction, then we do not generate heat etc.

Then KE +PE is conserved

This is called Total Mechanical energy

Drop box from rest: What is its velocity at the bottom ?

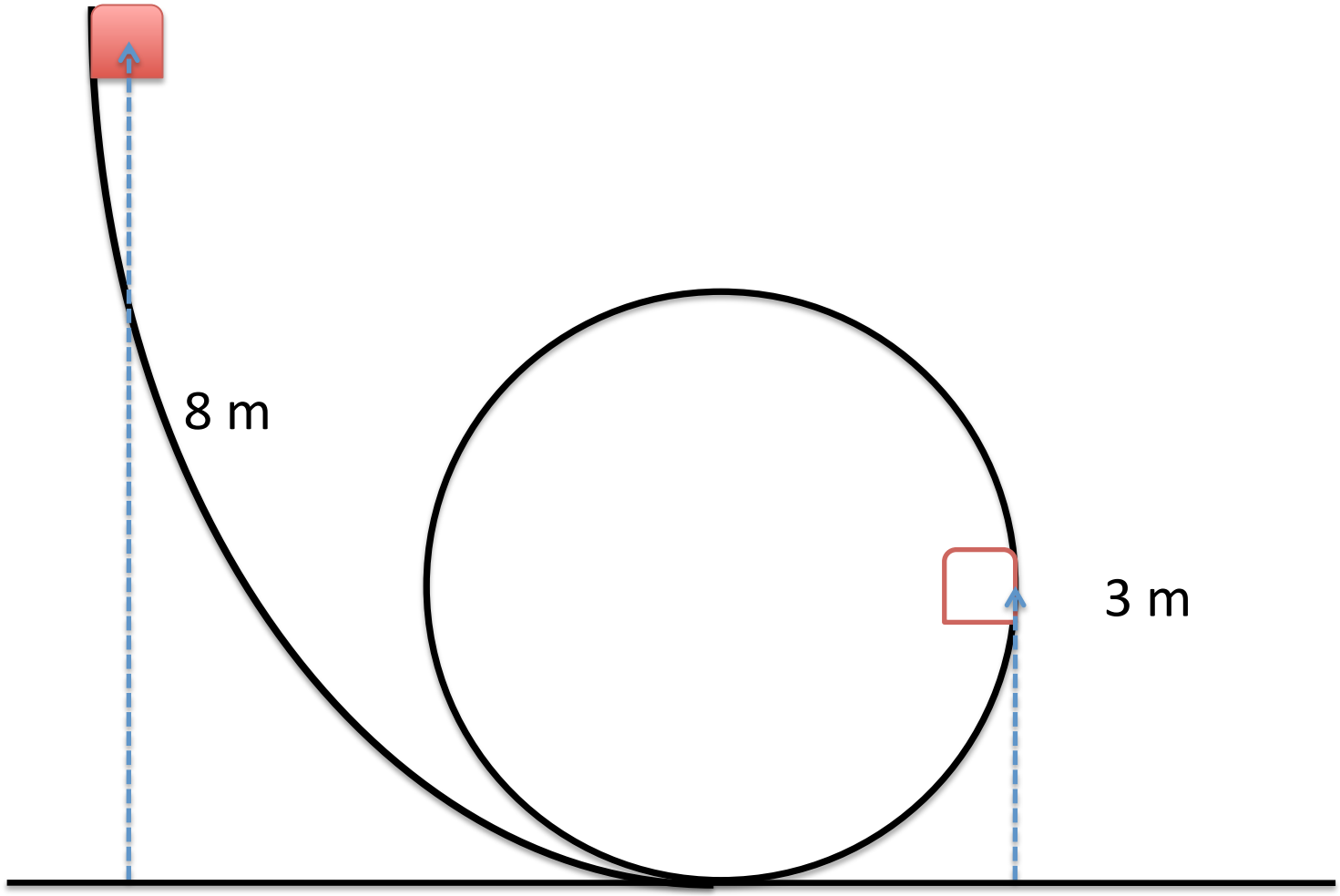


$$TE = KE + PE$$
$$= 0 + 2 \times 10 \times 8$$
$$= 160\,J$$

$$TE = KE + PE$$
$$= \frac{1}{2} \times 2 \times v^2 + 0$$
$$= v^2\,J$$

$$v^2 = 160$$
$$v = \sqrt{160}$$
$$= 12.6\,m/s$$

Drop the block from rest: What is its speed at the given point ?



Energy you get from a candy bar

1 calorie: Energy needed to heat 1 gm of water by
1 degree Centigrde
= 4.2 J

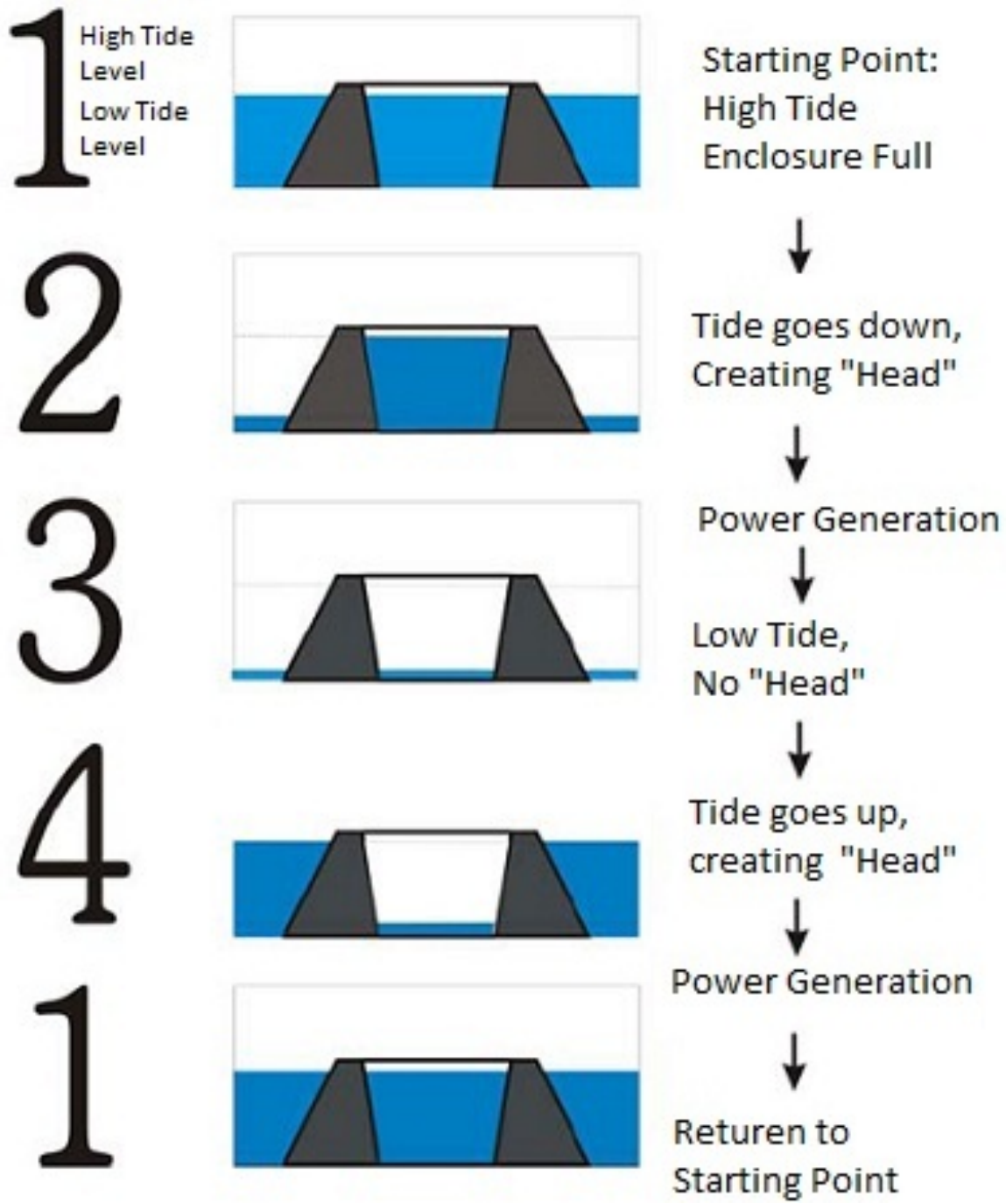
1 Calorie = 1 KiloCalorie = 1000 calories

E=100 C = 100,000 c
=420,000 J

m = 1000 Kg

v = 60 mph
=27 m/s

KE = 1/2 1000 (27)^2
= 364,000 J

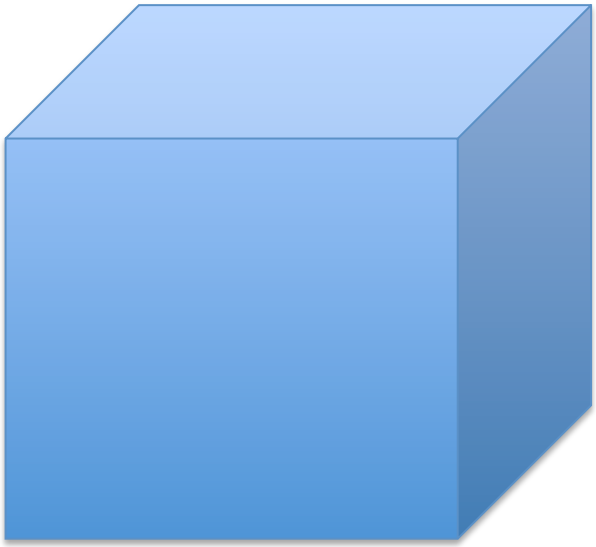


Energy from tides

Mass of water

1 cm

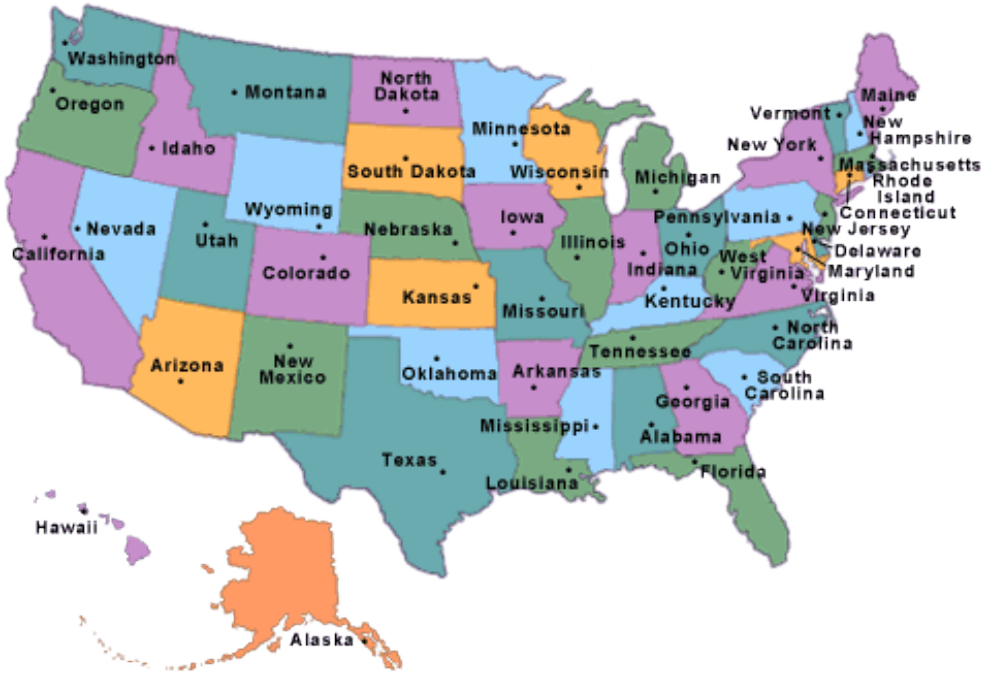
= 1 gm



1 m = 100 cm

$$= (10^2)^3 cm^3 = \text{cubic cm (cc)}$$

$$\rightarrow \ 10^6 \ gm \ = 10^3 \ Kg \ = \ 1 \ Ton$$



1, 000 Km = 1,000,000 m of coastline

Use sea out to 100 m

Sea rises by 10 m

$$\text{Volume of water lifted}$$

$$= 10^6 \times 10^2 \times 10$$

$$= 10^9 \ m^3$$

$$\text{Mass of water lifted}$$

$$= 10^9 \times 10^3$$

$$= 10^{12} \ Kg$$

PE of water lifted = m g h

$$= 10^{12} \times 10 \times 10$$

$$= 10^{14}\ J$$

$$\text{Power} = \text{Energy per unit time}$$

$$= \frac{10^{14}}{12 \times 60 \times 60}$$

$$= 2 \times 10^{9}\ \text{J/s} = 2 \times 10^{9}\ \text{Watts}$$

Power consumption in home:

Fridge: 100 V X 10 A = 1000 W

Room heater: 1000 W

Light bulb: 50-100 W each

Total per person : 2500 W

Population of Columbus:
1,000,000

Power needed:

$$10^6 \times 2500$$

$$= 2.5 \times 10^9 \ W$$