Today: HW 5pm

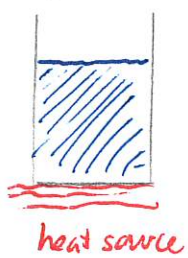
Fri: Fall break.

Mon: Read. 8.1 , 8.2

Power

It is often important to quantify the rate at which energy is absorbed or lost or transfered. Examples where this matters are:

1) heating water:
   - given mass of water 1kg (1 liter)
   - given temp change 20°C (68F) to 100°C (212F)
   - requires 329600J assuming no heat lost regardless of how rapidly this occurs.
   - how rapidly can this be done.



2) light bulb:
   - how much energy does a light bulb consume?
   - depends on time for which bulb is on.

So we want to consider

Energy absorbed / lost / transfered AND Time taken for this process

We combine these via

Power → rate at which energy is delivered

$$\text{Power} = \frac{\text{energy absorbed or lost or transfered}}{\text{time taken}}$$

Power → in Watts; energy → in Joules; time → in seconds

Quiz! 90%

Note that the definition implies

$$\text{energy} = \text{power} \times \text{time}$$

Quiz 2 80%

1 Energy consumed by a bulb

A bulb consumes 45 W of power. How much energy does it consume in 10 minutes?

energy = power × time   10 minutes = 10 min × 60 s = 600 s

= 45 W × 600 s

= 27000 J

2 Paying for electricity

A utility company pays for the fuel to deliver electricity to houses. One house has ten 20 W bulbs. Another has two 20 W bulbs and a 500 W microwave oven. Does it make sense for the utility to charge based on the total power of all of the appliances in the two houses? If so, why? If not, is there a more sensible way?

These appliances /devices will not be on for the same amounts of time.

We can assume that in an evening

* bulbs are on for 2 hrs each = 2 × 60 min × 60 s = 7200 s
* microwave is on for 10 min = 10 min × 60 s = 600 s.

So the first house uses

energy = power × time × number bulbs

= 20 W × 7200 s × 10 = 1.44×10^6 J = 1.44 MJ.

The second house uses

energy = energy bulbs + energy microwave

= 20 W × 7200 s × 2 bulbs + 500 W × 600 s

= 0.588×10^6 J = 0.588 MJ

First house uses more

Electric Forces

Newton's system of mechanics requires that one can describe the details of the forces acting on an object of interest. The first detailed forces were:

* gravitational forces -> Newton (late 17th century)
* spring forces - Robert Hooke (late 17th century)

There are phenomena that cannot be described by these forces.

next class

DEMO: Suspended ~~Rod/Ba~~ Ball /Rod.

1) neutral rod near ball
2) rubbed rod near ball
3) touched rubbed rod near ball.

In some situations we find that there are repulsive forces and these cannot be gravitational forces. We say that in such situations

* forces are electric forces
* the forces are produced by and felt by electric charges

Electric charges

Observations like this lead to the conclusion that there are two basic types of charged particle / charged objects

1) positively charged (+)
2) negatively charged (−)

They interact via:

Objects with like types of charge repel each other.
Objects with opposite types of charge attract each other.