Outline

Oscillations

Office hours Thursday after spring break 4-5.30

Quiz 6

- Average 4.6

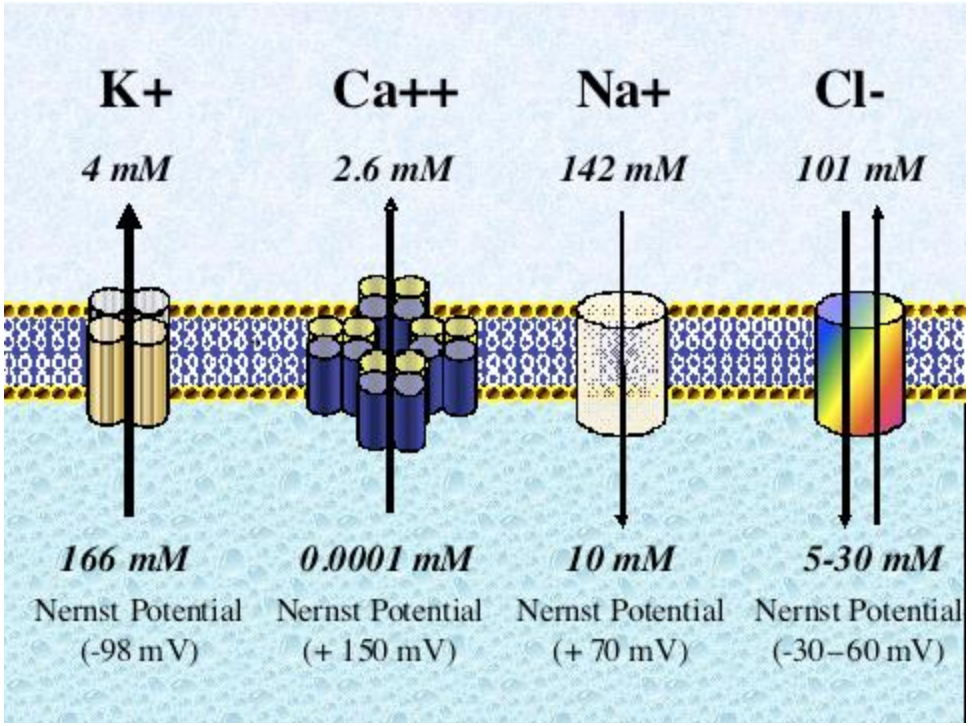
Correct	CF	B	C	B
INC	G	D	BD	all
# correct	4	5	3	2

Nernst Equation

- Diffusion: Concentration gradient in the presence of ion channel -> ions flow to equilibrate concentration
- Electrostatic potential: only one ion species can flow -> electrostatic potential builds up -> makes it less likely for ions to keep flowing across channel

$$\Delta V = \frac{k_B T}{q} \ln\left(\frac{c_2}{c_1}\right)$$

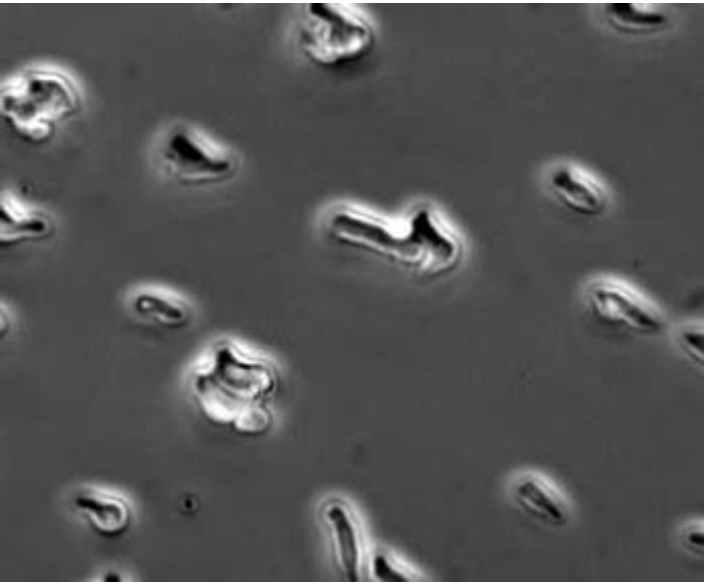
Ions in a Cell

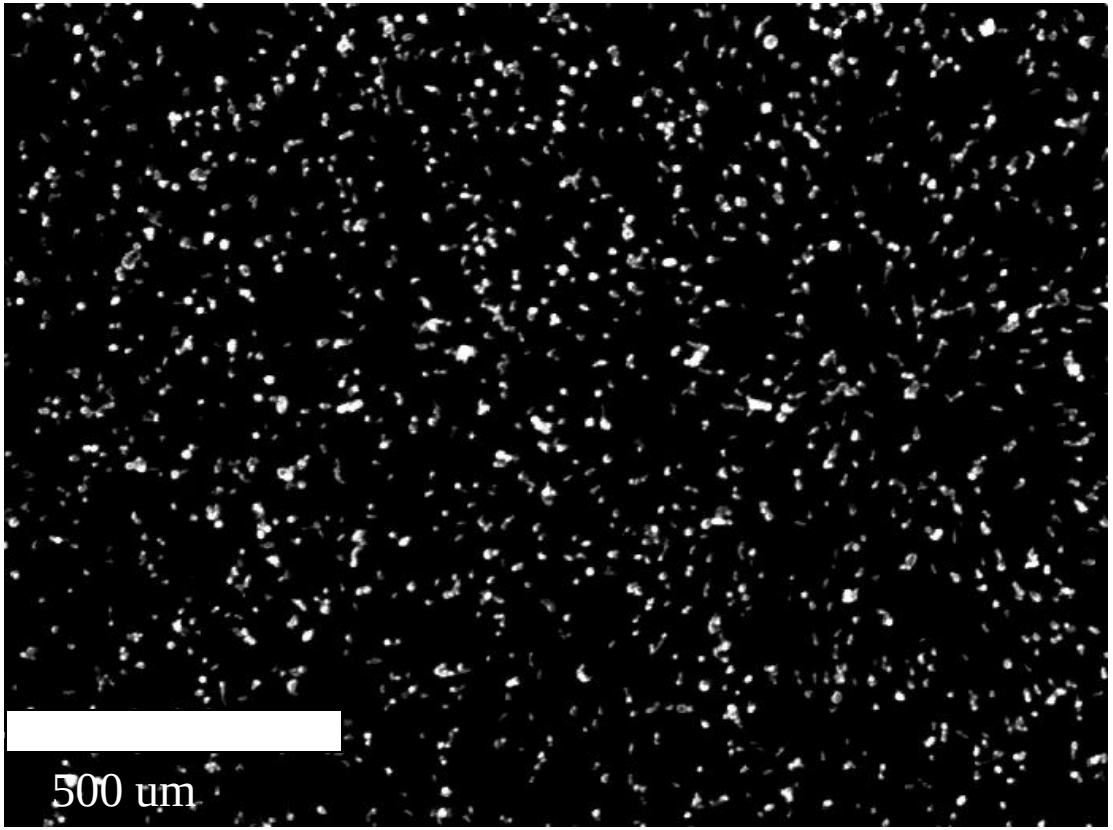


http://www.dev.urotoday.com

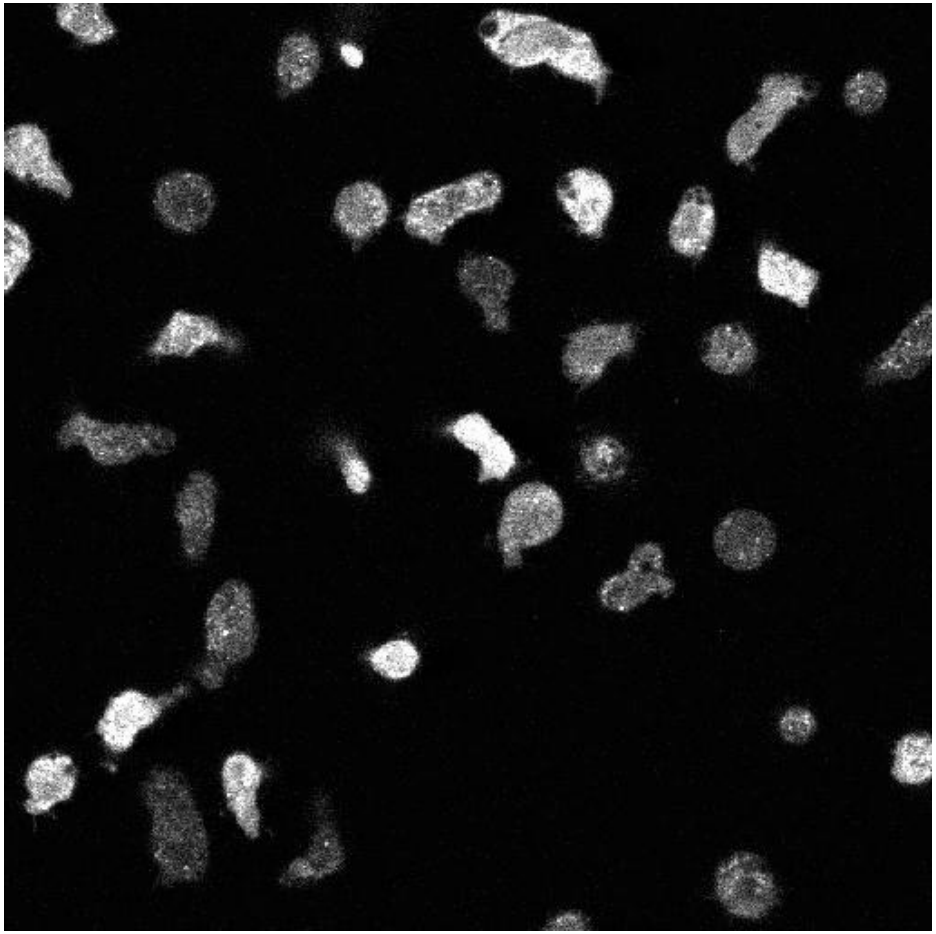
Oscillations and Waves

Oscillations of amoeboid cells





We are physicists – try to understand how cells move on a frictionless surface -> Oscillations

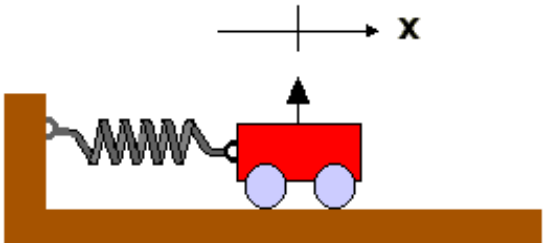


- Heart beat
- http://www.youtube.com/watch?annotation_id=annotation_611436&feature=iv&src_vid=Pes9O5z8efk&v=uR4t__B-Zwg

- Ventricular Fibrillation

http://www.youtube.com/watch?v=riUAFkV7HCU

Model system: Mass on a Spring

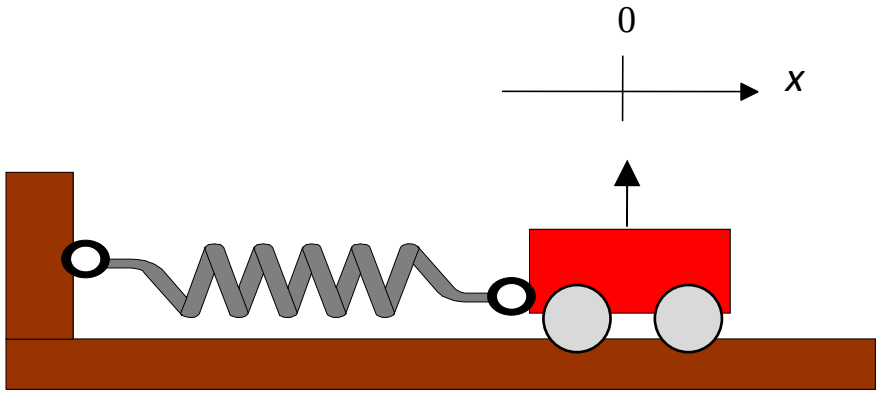


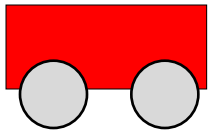
- Consider a cart of mass *m* attached to a light (mass of spring << *m*) spring.
- Choose the coordinate system so that when the cart is at 0 the spring it at its rest length
- Recall the properties of a (nice) spring.
  - When it is pulled or pushed on both ends it changes its length.

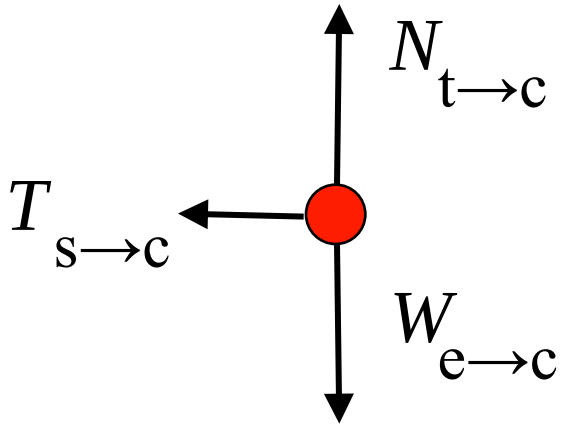
$$T = k\Delta l$$

Analyzing the forces: cart & spring

- What are the forces acting on the cart?



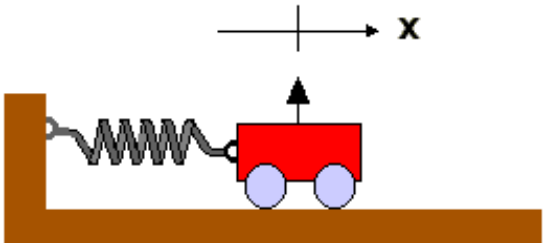




A mass connected to a spring is oscillating back and forth. Consider two possibilities:

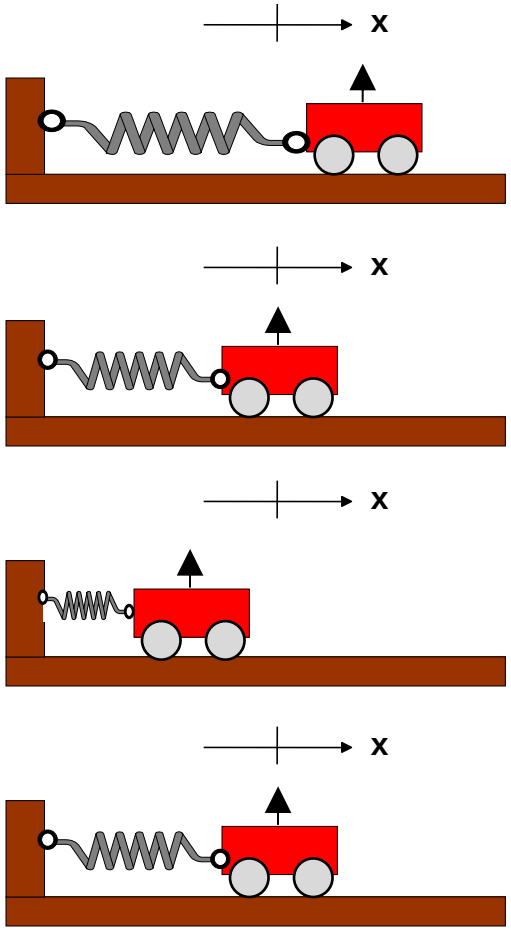
(i) at some point during the oscillation the mass has $v = 0$ but $a \neq 0$

(ii) at some point during the oscillation the mass has $v = 0$ and $a = 0$.



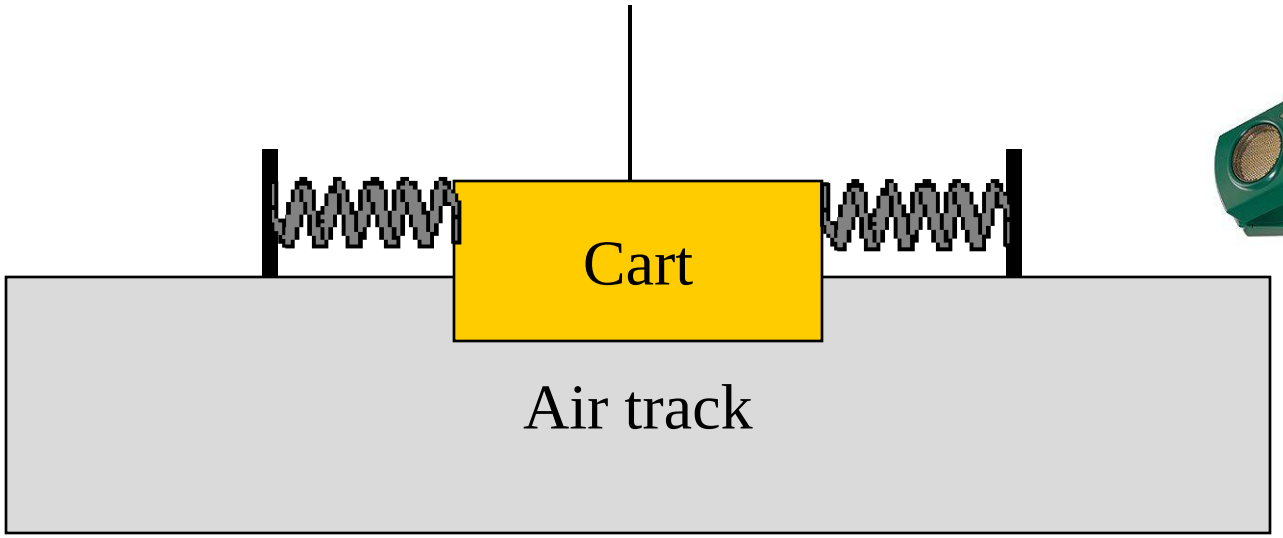
1. Both occur sometime during the oscillation.
2. Neither occurs during the oscillation.
3. Only (i) occurs.
4. Only (ii) occurs.

Tracking the motion



x F^{net} a v

Let's try it



Sonic ranger

Why do we have two springs?

Doing the Math: The Equation of Motion

- The N2 equation for the cart is

$$a = F_{net}/m = -kx/m = -\left(\frac{k}{m}\right)x$$

- What kind of a quantity is k/m?

$$\left[\frac{k}{m}\right] =$$