HW 1 due today: Put in pile at front.
HW 2 is posted (I handed it out last time)
Get out Application Sheet
(handed out last time)

**2.3 Applications (continued)**
Last time we saw:

**Mixing problems**
y(t) = amount of substance
V(t) = volume of water in container

$$\frac{dy}{dt} = (concentration\ in)(flow\ in) - (concentration\ out)(flow\ out)$$

$$\frac{dy}{dt} = (\quad)(\quad) - \left(\frac{y}{V(t)}\right)(\quad)$$

Note: We mentioned how we should watch the units! (Let the units help you).

**Temperature**

The study of temperature is a big subject. But one common basic assumption is Newton's Law of Cooling.

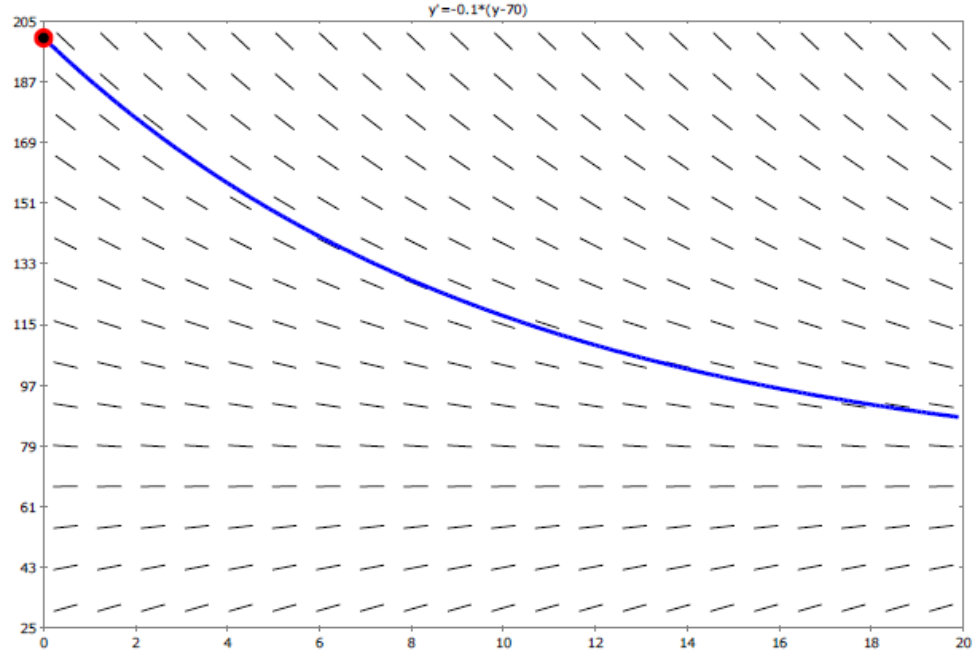
T(t) = temperature of an object at time *t*

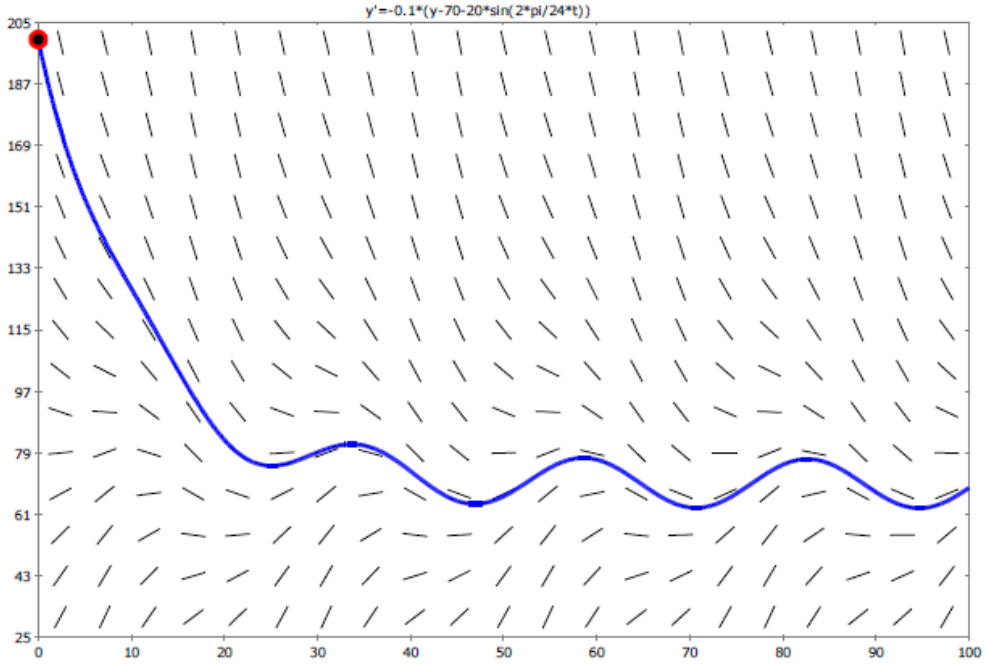
$T_s$ = temperature of surroundings

"The rate of change of temperature for an object is proportional to the difference between the temp of the object and the temp of its surroundings"

k = `proportionality constant'
it depends on the object, the surroundings and the units.

(You either look it up in a physics/engineering reference book or you experimentally compute it).


y'=-0.1*(y-70)
205
187
169
151
133
115
97
79
61
43
25
0
2
4
6
8
10
12
14
16
18
20


y'=-0.1*(y-70-20*sin(2*pi/24*t))
205
187
169
151
133
115
97
79
61
43
25
0
10
20
30
40
50
60
70
80
90
100

**Savings and Loans**

Many bank and loan accounts all have the same general set up:

The account has a balance, *A(t)*, that is changing in two ways:

1. Regular deposits or withdrawals/payments of
   $\pm K$ dollars/year
2. Compound interest with a decimal rate of *r* annually (compounded continuously) In other words, the amount of interest added each year is approximately
   *r A* dollars/year.

If A(t) = balance after t years, then

$$\frac{dA}{dt} = change\ in\ balance\ per\ year$$
$$= amount\ added\ from\ interest$$
$$\pm\ amount\ deposited/withdrawn$$

**Motion (Air Resistance)**

*Newton's Second Law*:

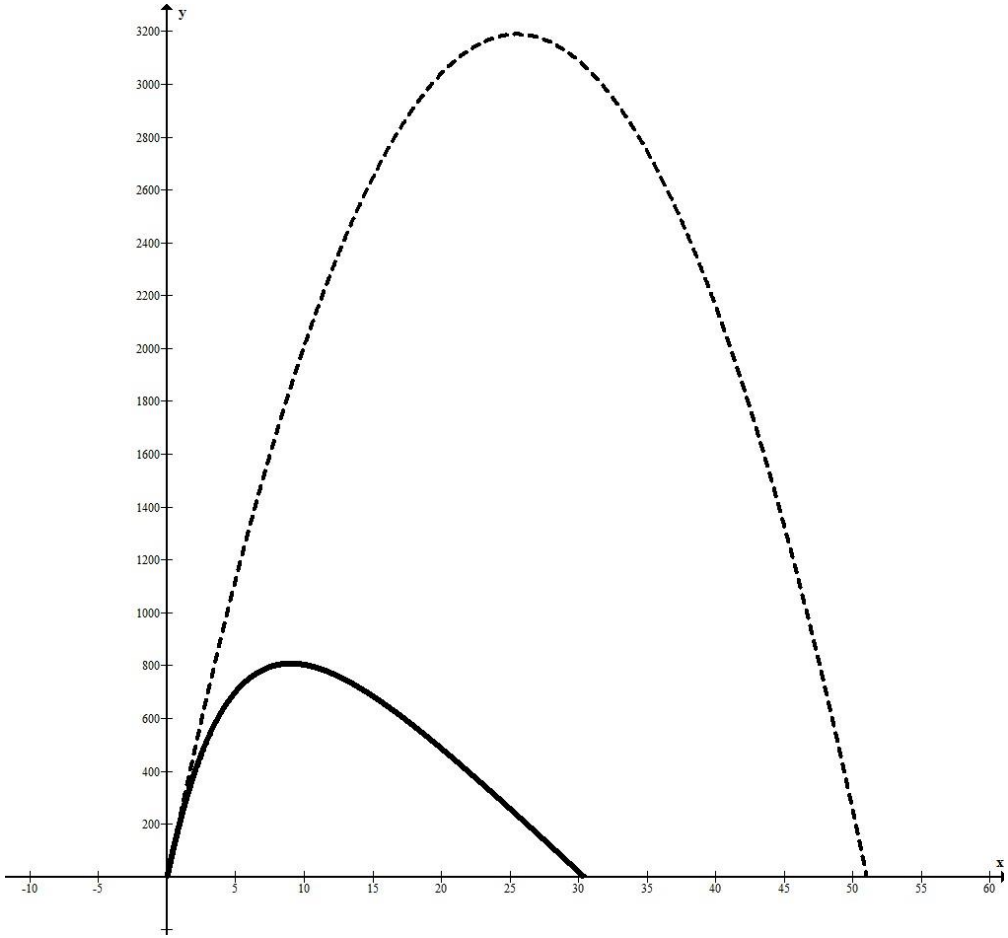
Force = (Mass)(Acceleration)

So if v(t) = velocity and m = mass, then

Force = $m\frac{dv}{dt}$

Force due to gravity has magnitude mg in the downward direction.

Force due to air resistance has magnitude ??? in the direction opposite velocity.


y
x
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
-10
-5
5
10
15
20
25
30
35
40
45
50
55
60