Clec6

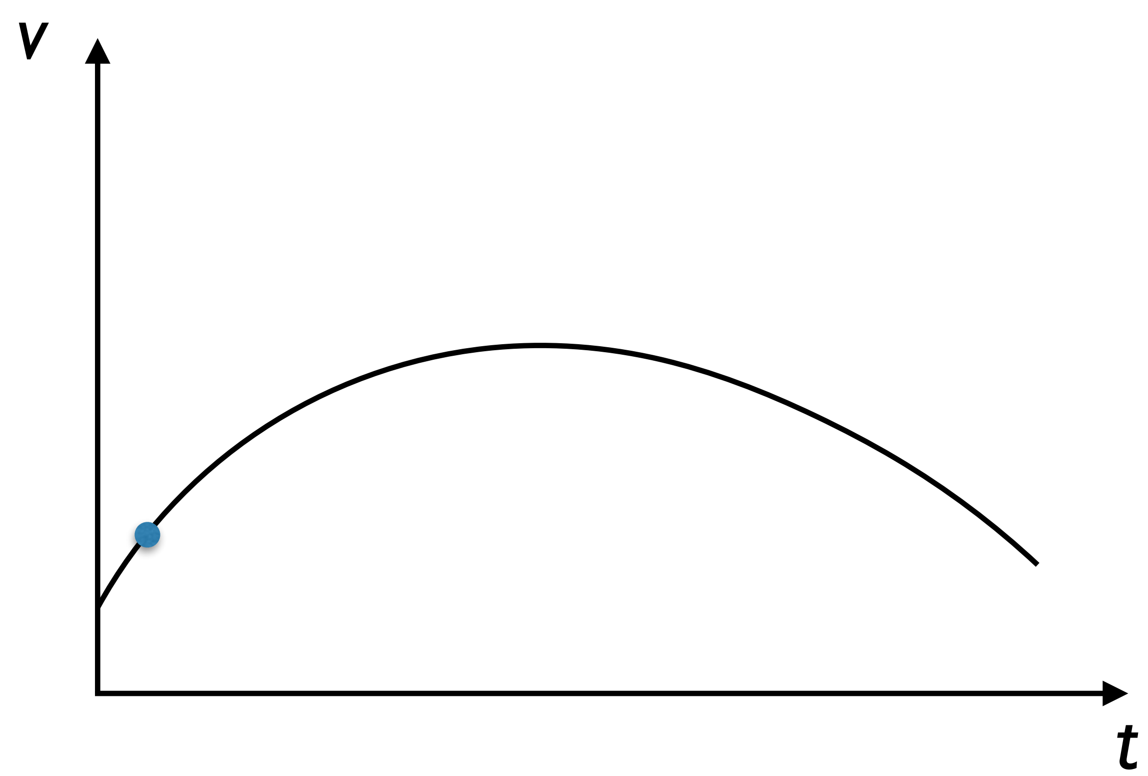
Worksheet

Let's do the Euler method for the drag force of a ball travelling through the air.

$$\vec{r}(t+\varepsilon) \approx \vec{r}(t) + \varepsilon \cdot \vec{v}(t)$$
$$\vec{v}(t+\varepsilon) \approx \vec{v}(t) + \varepsilon \cdot \vec{a}(t)$$

Where the acceleration is determined by the drag force.

Clicker Question



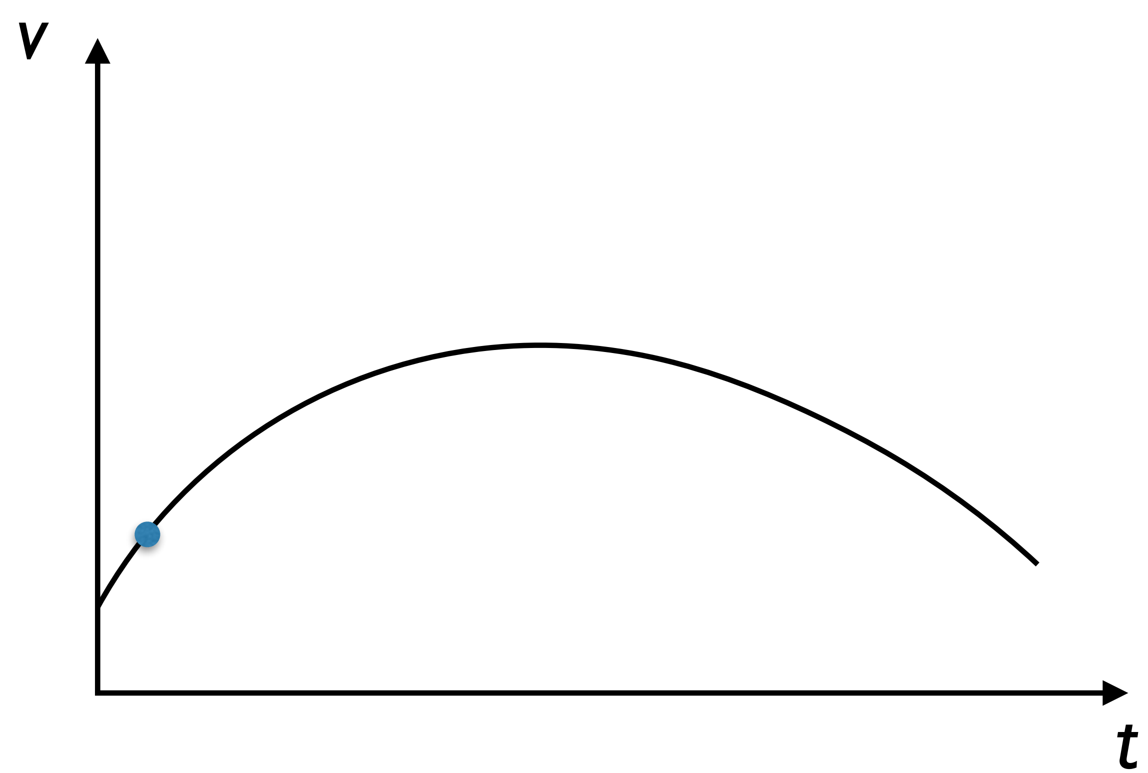
Given *F(r, v)* we can estimate *x(t)* and *v(t)* using the Euler method.

Suppose I know what *v(t)* looks like, but I want to approximate it using the Euler method starting from the dot.

The curve calculated from the Euler method lies

a) above the curve drawn.
b) on the curve dawn.
c) below the curve drawn.
d) no idea.

Clicker Question



Given *F(r, v)* we can estimate *x(t)* and *v(t)* using the Euler method.

Suppose I know what *v(t)* looks like, but I want to approximate it using the Euler method starting from the dot.

The curve calculated from the Euler method lies

a) above the curve drawn.
b) on the curve dawn.
c) below the curve drawn.

The Euler method approximates the next point by using the slope of the previous point. to draw a straight line. Because the slope changes over the interval, the estimation diverges from the real value. To model something, the time step much be much shorter than the rate of change of the system!

Solving Newton's Equations

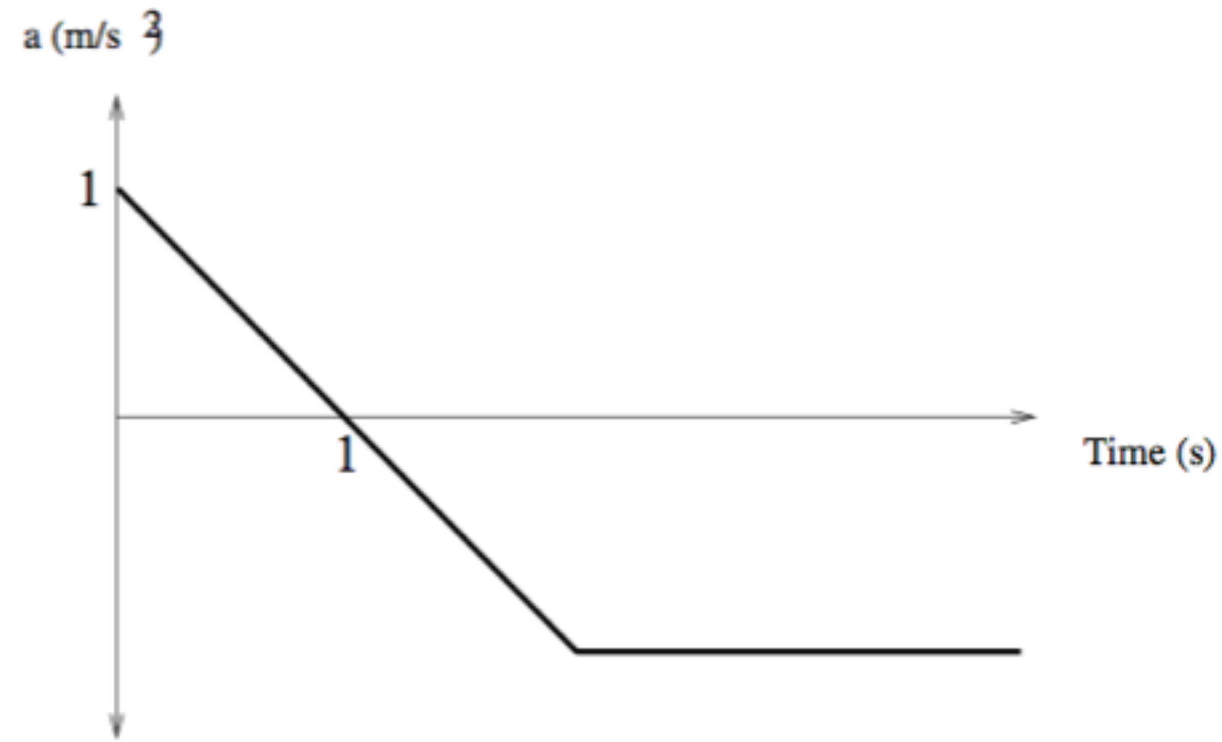
There are many ways to solve differential equations.

1) (*Simplest cases*) When the force depends on some known function of time (i.e., it doesn't depend on x or v) use integration.

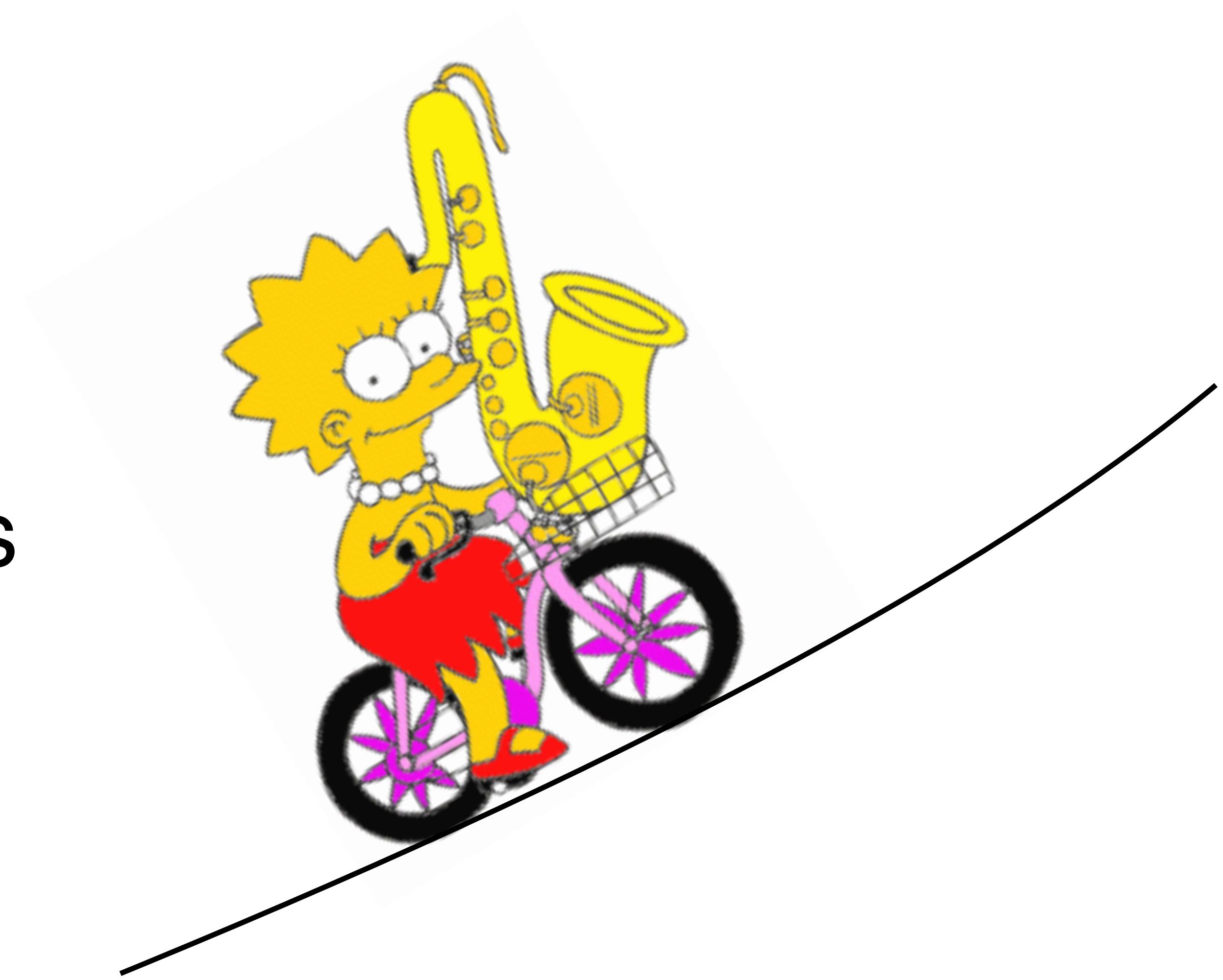
2) (*Simple cases*) Directly find a function that satisfies the equations (Math 215 and 316) or "guess and check"

3) (*Everything else*) Numerically solve the equations. (e.g. using the Euler method)

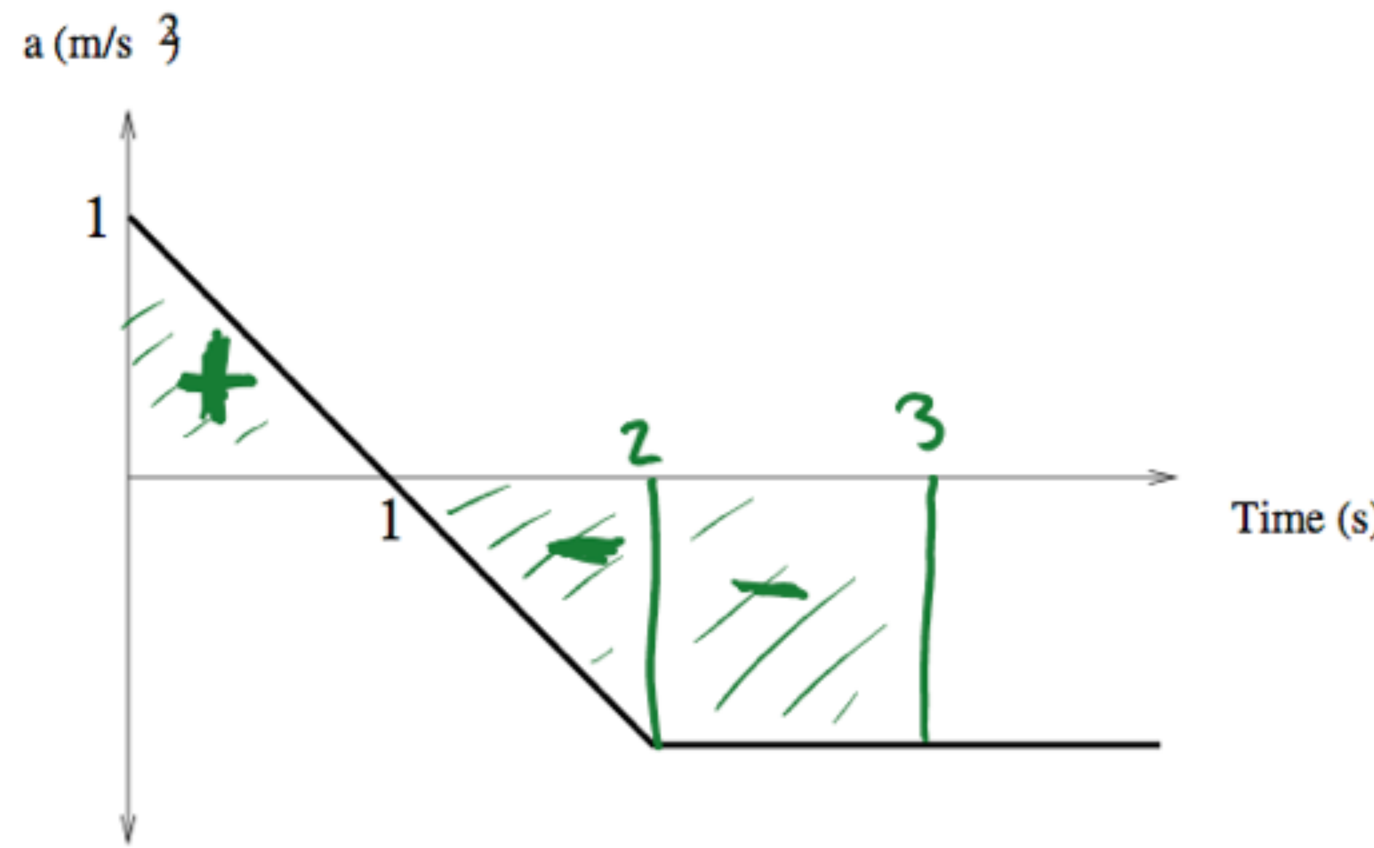
Lisa Simpson has a velocity of 1 m/s at a time of 0. If her acceleration is as shown, when will her velocity be zero?



A) never
B) t = 1s
C) t = 2s
D) t = 2s and all later times
E) t = 3s



Lisa Simpson has a velocity of 1 m/s at a time of 0. If her acceleration is as shown, when will her velocity be zero?



A) never
B) t = 1s
C) t = 2s
D) t = 2s and all later times
E) t = 3s

The change in velocity from 0 to T is the area under the acceleration graph between 0 and T. Between 0 and 1s, this area is 0.5 m/s. Between 0 and 2s the net area is 0. Between 0 and 3s, the net area is -1 m/s. Since the initial velocity is 1 m/s, the velocity at t = 3s will be 0.