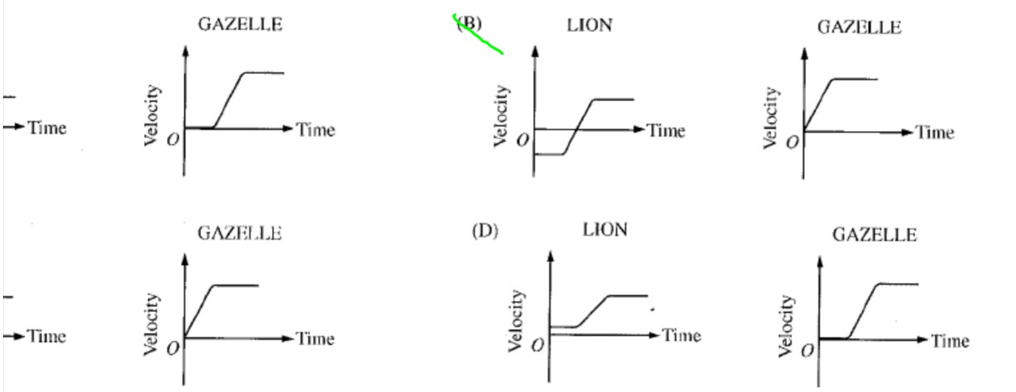
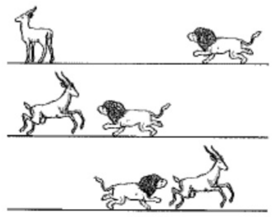
Warm Up

ıing at constant speed toward a gazelle that is standing still, as shown in the top figure above. ıds, the gazelle notices the lion and accelerates directly toward him, hoping to pass the lion an reverse direction. As the gazelle accelerates toward and past the lion, the lion changes directic ı pursuit of the gazelle. The lion and the gazelle eventually each reach constant but different sı following sets of graphs shows a reasonable representation of the velocities of the lion and th ıctions of time?





Objective: SWBAT determine the position and velocity of an object moving at constant acceleration or in free fall

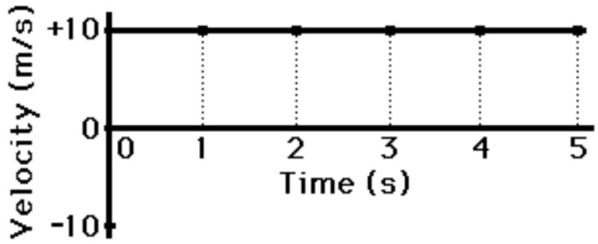
Agenda:
- Warm Up
- Notes
- Practice
- Reflection

HW:
pg. 54 #35-51 odd, 61

Reading Velocity vs. Time Graphs

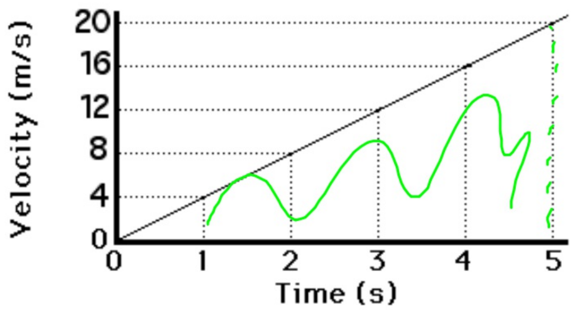
How can we get acceleration from these graphs?

slope of the graph



How can we get displacement?

area under the graph



Notes: Kinematics Equations

Here are the equations we had earlier:

$x = x_0 + \bar{v}t$ (average velocity)

$v = v_0 + at$

We'll use these and an expression for average velocity to get another equation:

$$\bar{v} = \frac{v_0 + v}{2}$$

$$x = x_0 + \left(\frac{v_0 + v}{2}\right)t$$

$$x = x_0 + \left(\frac{v_0 + v_0 + at}{2}\right)t$$

$$x = x_0 + \frac{1}{2}(2v_0 + at)t$$

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

Notes: Kinematics Equations

There's one more equation to find, but we'll solve the velocity equation for time first:

$$v = v_0 + at$$

$$v - v_0 = at$$

$$t = \frac{v - v_0}{a}$$

Now plug it in to the displacement equation and solve for velocity:

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

$$-x_0 \quad -x_0$$

$$x - x_0 = v_0\left(\frac{v - v_0}{a}\right) + \frac{1}{2}a\left(\frac{v - v_0}{a}\right)^2$$

$$\Delta x = \frac{v_0 v - v_0^2}{a} + \frac{1}{2a}\left(v^2 - 2v_0 v + v_0^2\right)$$

$$2a\Delta x = \cancel{2v_0 v} - \cancel{2}v_0^2 + v^2 \cancel{- 2v_0 v} + \cancel{v_0^2}$$

$$2a\Delta x = -v_0^2 + v^2 \rightarrow v^2 = v_0^2 + 2a\Delta x$$

Notes: Free Fall

Free fall is a condition in which an object moves only under the influence of gravity (ignoring air resistance). The acceleration due to gravity is $g = 9.8\ m/s^2$ or $32\ ft/s^2$

Otherwise, the equations we've developed still apply.

Example

pg. 43, example 2.7

Example

pg. 46 example 2.8

$y_0 = 50.0\,m$, $v_0 = 20.0\,\frac{m}{s}$, $a = -9.8\,m/s^2$

max y & max t

$y = 50.0 + 20.0t + \frac{1}{2}(-9.8)t^2$

$t = \frac{-b}{2a} = \frac{-20.0}{2(\frac{1}{2}(-9.8))} = \frac{20.0}{9.8} \approx 2.04s$

$y_{max} = 50.0 + 20.0(2.04) + \frac{1}{2}(-9.8)(2.04)^2$

$\approx 80.804 \approx 70.4\,m$

Practice

pg. 54 sections 2.5 and 2.6

Reflection

How does the equation for displacement relate to topics in mathematics?