Name:_____ Peer-Leader:_____

Date: _____ _____

Displacement, Velocity, and Acceleration

This workshop focuses on the relationships between position, displacement, velocity and speed in one dimension.

Excercise 1:

Acceleration

For an object that moves at an initial velocity v_i at an initial time t_i and a final velocity v_f at the final time t_f, the average **acceleration** during the time interval $t_f - t_i$ is defined as

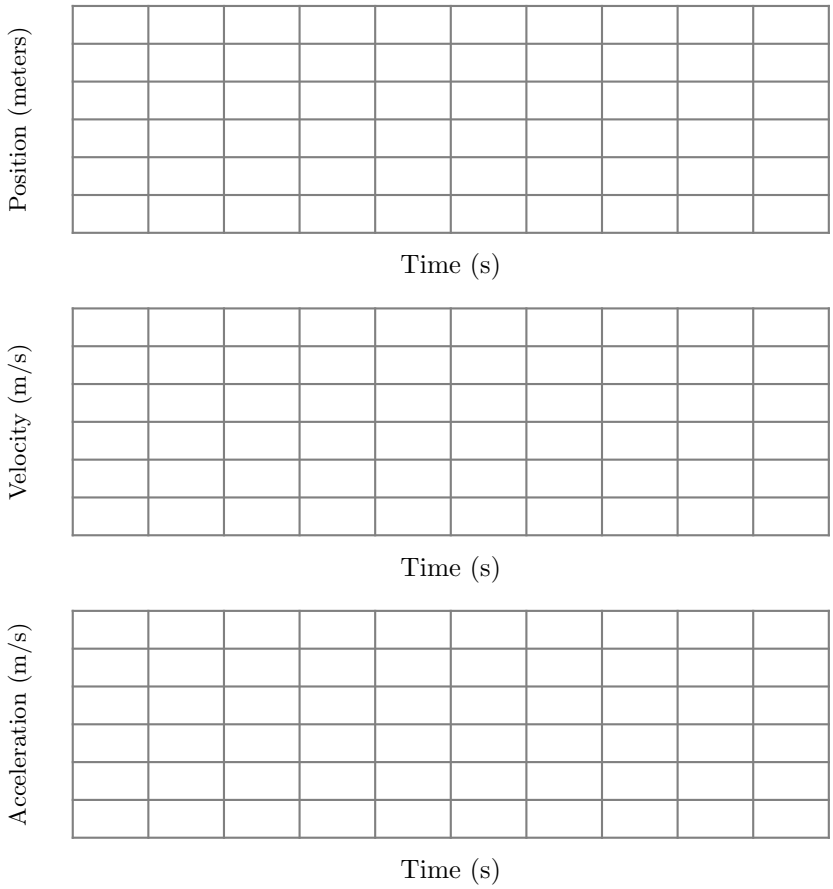
$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}.$$

The position of an object that moves with a constant acceleration is given by

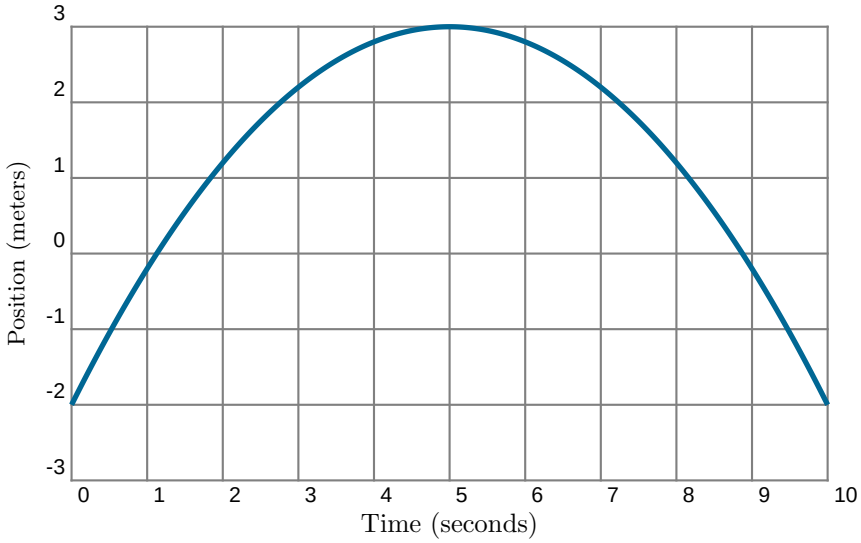
$$x_f = x_i + v_i(t_f - t_i) + \frac{1}{2}a(t_i - t_f)^2$$

where x_i and v_i are the initial position and initial velocity at time t_i

Question 1.1 *Starting from rest, you accelerate your bike as quickly as you can until you reach a constant speed. Make a sketch of your position, velocity and acceleration versus time for this process on the graphs below.*



Question 1.2 *The figure below shows the position of a cart as a function of time. How is the slope or steepness of this curve related to the velocity? Explain.*



Question 1.3 *On the figure above, at what times, if any, is the cart at rest?*

Question 1.4 *On the figure above, at what times is the cart traveling the fastest. Explain.*

Question 1.5 *On the figure above, is the velocity changing? If so describe how it is changing, explaining both the magnitude and sign of the velocity.*

Question 1.6 *Brian and his dog Rufus are playing chase. Brian runs in a straight line at a constant velocity of* $4\,\mathrm{m/s}$. *He runs past Rufus at* $t = 0$. *Rufus waits until* $t = 2$ *seconds and then accelerates at* $8\,\mathrm{m/s^2}$ *until he reaches a top speed of* $12\,\mathrm{m/s}$. *After reaching this speed Rufus continues to run at* $12\,\mathrm{m/s}$. *When does Rufus catch up to Brian? How far are Rufus and Brian away from Rufus's initial position when they meet?*