Learning Exercise 2:
Kinematics of Straight Line Translation

Objective: **To recognize the relationships between position, speed, acceleration and time for motion along a given straight line.**

A point on body moves along a straight line. Its position, speed, and acceleration along that line at a given time are s, v, a, respectively, at time t. Let us say that at the initial time $t = 0$, the initial position and speed are both also equal to zero. Let all dimensions be consistent in feet and seconds. In the first 3 and 6th questions, information is known and wanted as functions of time. In the 4th question, information is known and wanted as functions of speed. In the 5th and 7th questions, information is known and wanted as functions of position.

Answer the following:

1. Given position as a function of time, $s = 15t^2$, find v and a as functions of time.

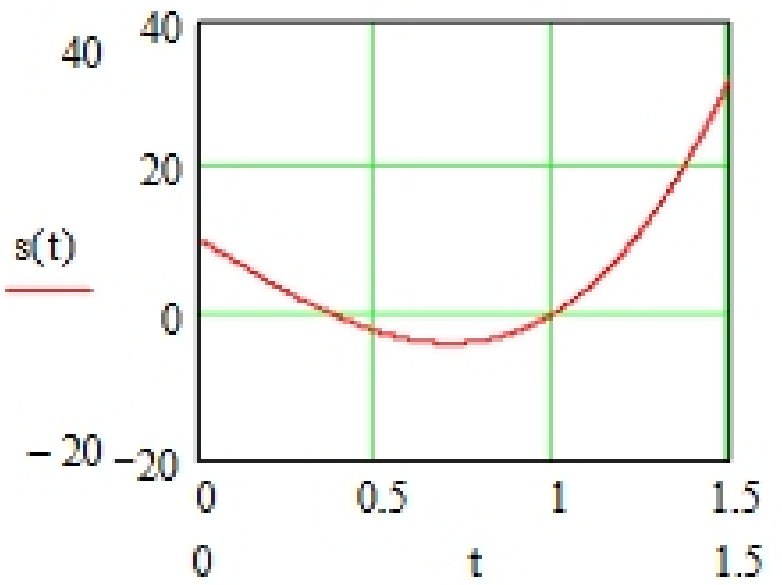
2. Given speed as a function of time, $v = 10\sin(2t)$, find s and a as functions of time.

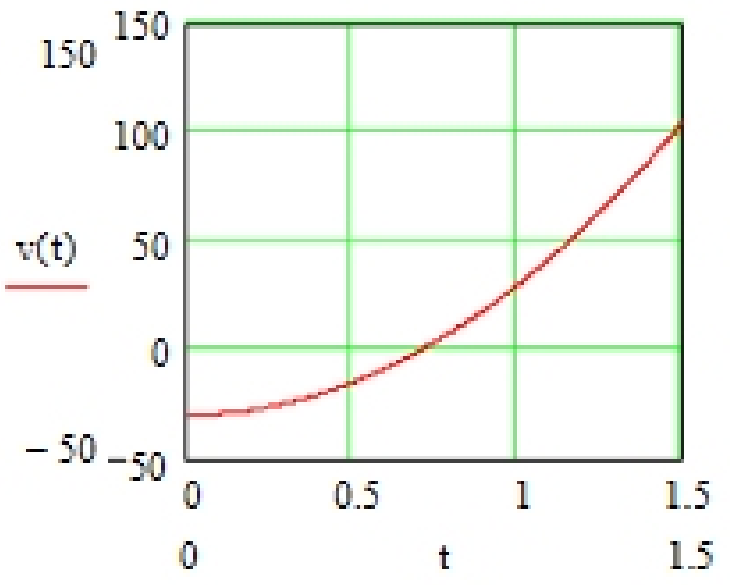
3. Given acceleration as a function of time, $a = 1 - 15t^2$, find s and v as functions of time.

4. Given acceleration as a function of speed, $a = 10 + v^2$, find s and t as functions of speed. You may want to use your calculator or computer to solve this one.

5. Given speed as a function of position, $v = 10(1+s)^3$, find a and t as functions of position. You may want to use your calculator or computer to solve for the time.

6. **Functions of Time:** The following graphical computations will be approximate. All units are in meters and seconds. (1) Use the s vs t plot to graphically determine the speed at $t = 0$ and at $t = 1$. Compare your numbers with values in the speed plot. (2) Then use the v vs t plot to graphically determine the acceleration at $t = 0$ and $t = 1$. (3) Then use the v vs t plot to graphically determine the position at $t = 1.5$. Compare your numbers with the values in the position plot.





7. **Functions of Position:** The following graphical computations will be approximate. All units are in feet and seconds. Due to the plotting routine, the position is called "x" rather than "s". (1) Use the v vs x plot to graphically determine the acceleration at $x = 2$ and at $x = 10$. Compare your numbers with the values in the acceleration plot.