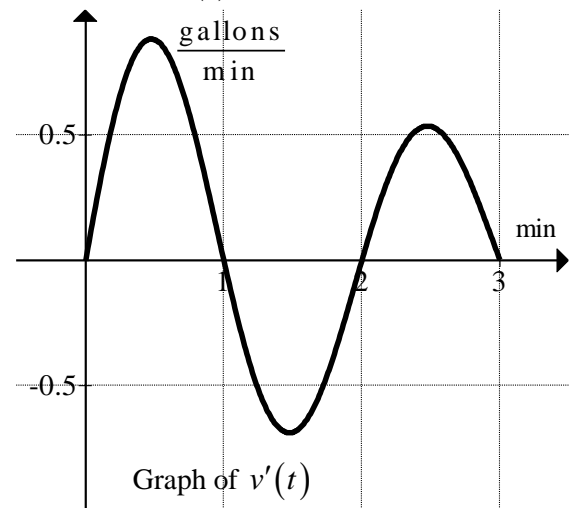# The Definite Integral of the Rate of Change is NET Change

A water tank has 3 gallons of water in it at time $t = 0$ minutes. The graph shows $v'(t)$, measured in gallons per minute, of the rate of change of water in the tank for $0 \le t \le 3$.

1.   When is the amount of water in the tank increasing? Justify your answer.

Graph of $v'(t)$

2.   Write, but do not evaluate an expression involving an integral for each of the following
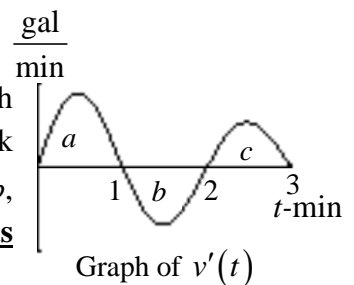
   a.   The amount of water in the tank at $t = 1$

   _____

   b.   The amount of water in the tank at $t = 2$

   _____

   c.   The amount of water in the tank at $t = 3$

   _____

   d.   The amount of water in the tank at $t = x$
         (assume $0 \le x \le 3$)

   _____

As before, a water tank has 3 gallons of water in it at time $t = 0$ minutes. The graph shows $v'(t)$, measured in gallons per minute, of the rate of change of water in the tank for $0 \le t \le 3$ minutes. The horizontal intercepts are at 0, 1, 2, and 3. In this graph a, b, and c are the areas of the three regions determined by $v'(t)$ and the t- axis. These **areas** are all positive, and $0 < c < b < a$.

Graph of $v'(t)$

4.   In terms of a, b and c, write expressions for

   a.   The amount of water in the tank at $t = 1$ _____

   b.   The amount of water in the tank at $t = 2$ _____

   c.   The amount of water in the tank at $t = 3$ _____

5.   Interpret the statement "$b = 0.4382$" in the context of the problem. Use appropriate units.

6.   Given that $v'(t) = e^{-0.25t} \sin(\pi t)$ gal/minute at time t minutes, use your method in Problem 2 to find

a.   The amount of water in the tank at $t = 1$ _____

b.   The amount of water in the tank at $t = 2$ _____

c.   The amount of water in the tank at $t = 3$ _____

7. A tank initially has 13 gallons in it. From $t = 0$ to $t = 3$ min the rate of change of water in the tank is $v'(t) = (t^3 - 4.7t^2 + 5.1t) e^{-0.25t}$ gal/min.

a.   Find the amount of water in the tank when $t = 3$ min.

b.   Write an integral expression for the amount of water in the tank at time x, where $0 \le x \le 3$.

c.   Find the maximum amount of water in the tank on the closed interval $[0,3]$. You must demonstrate an analysis using EVT.