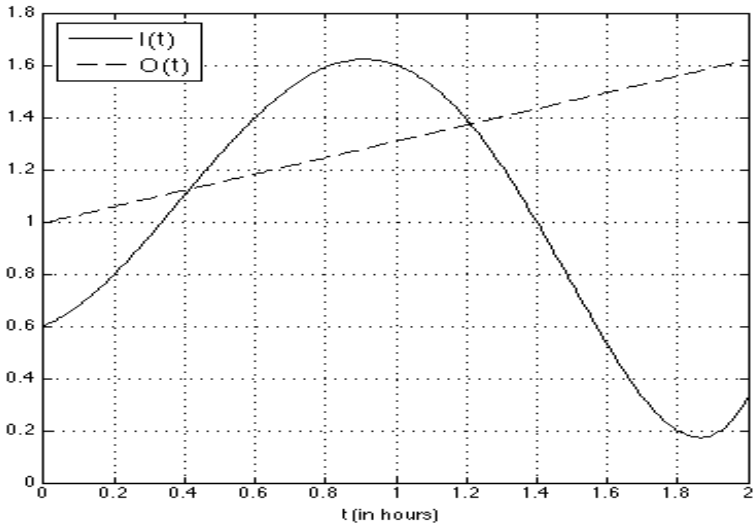
3. [20 points] A tank initially contains 20 m^3 of water. Water is poured into the tank at a rate of $I(t)$ m^3 per hour. At the same time, water is pumped out of the tank at a rate of $O(t)$ m^3 per hour. The graphs of $I(t)$ and $O(t)$ are shown below.

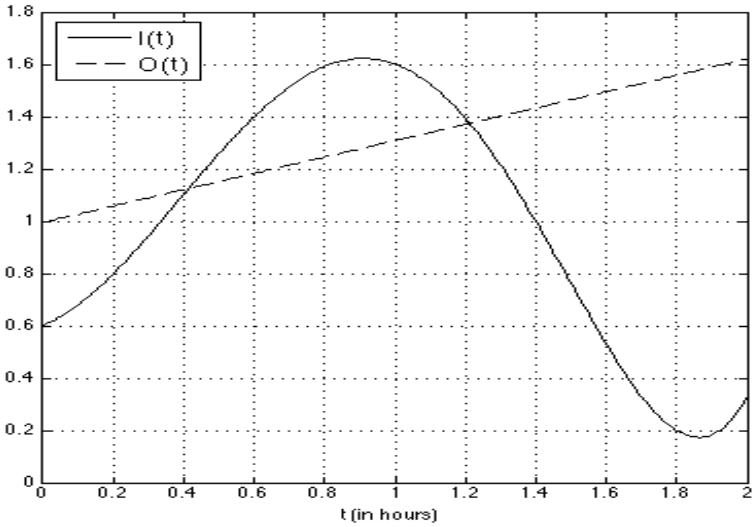


a. [5 points] Find an expression for $V(t)$, the volume of the water in the tank at time t. Include units.

b. [1 point] At what time is the volume of water in the tank at a maximum?

c. [2 points] At what time is the volume of water in the tank at a minimum?

d. [2 points] For which values of t is $V(t)$ increasing?



e. [3 points] For which values of t is $V(t)$ concave up? For which values is it concave down?

f. [4 points] Find an estimate for $\int_0^2 I(t)dt$ using Mid(5). Write all the terms in the sum.

g. [3 points] Suppose instead of the function $O(t)$ shown in the graph above, the water is pumped out of the tank at a constant rate of r m^3 per hour. What must the value of r be so that $V(2) = 20$? Your answer may involve a definite integral of $I(t)$.