- Flow in: If there are V_0 mL of fluid in a tank at time $t = 0$, and fluid is flowing in at a rate of $P(t)$ mL/min, then at time t the volume of the fluid in the tank is

  $V(t) =$

  _____

- Flow in and flow out: If there are V_0 mL of fluid in a tank at time $t = 0$, and the fluid is flowing in at a rate of $P(t)$ mL/min and dropping out of the bottom at a rate of $D(t)$ mL/min, then at time t the volume of the fluid in the tank is

  $V(t) =$

  _____

1. Snow is falling at a rate $r(t) = \dfrac{6t - 3t^2}{t^2 - 2t + 2}$, in inches per hour, where $t = 0$ at 8 am and t=2 at 10 am.

   (a) When is the rate of snowfall zero?

   (b) When $t = 1$, what is $r(t)$ and what does it represent? Include units.
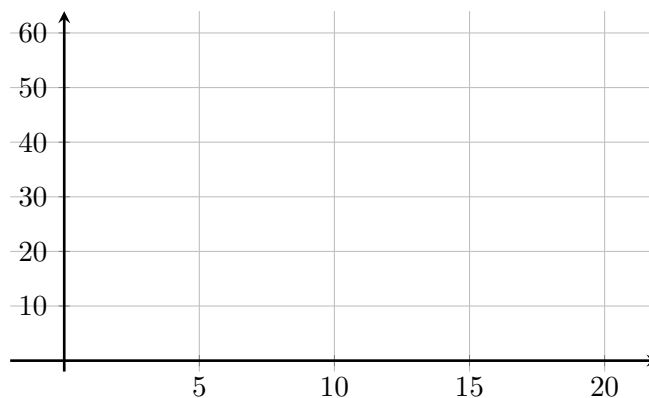
   (c) What is the maximum value of $r(t)$ and when does it occur? Interpret in the context of the problem.

   (d) How much snow has fallen between 8 am and 10 am?

2. A 1 L bottle contains 200 mL of water. Water is being poured in at a rate $P(t) = 30 + 30\cos\left(\frac{\pi t}{20}\right)$, from $t = 0$ minutes to $t = 20$ minutes. Water is simultaneously dripping out at a rate $D(t)$ defined by

$$D(t) = \begin{cases} 50 & 0 \le t \le 10 \\ 15 & 10 < t \le 20 \end{cases}$$

   (a) Graph $P(t)$ and $D(t)$ below

   (b) How many milliliters of water were poured into the tank from $t = 0$ to $t = 20$?

   (c) When is the total volume of water in the tank increasing? Justify your answer.

   (d) What is the maximum amount of water in the bottle during the time $0 \le t \le 20$? At what time does this occur? Fully explain.

3. Runners from the Bolder Boulder are finishing their 10K race at Folsom Field. at 9:00 am there are 1200 people in the stadium. Between 9:00 and 9:30 runners are arriving at the rate $P(t)$ shown in the table below, and then exiting the stadium at a constant rate of 75 people per minute. Time t is in minutes after 9:00, and the rate is given in people per minute. For answers below that require you to estimate an integral, use the Trapezoid rule.

t (in minutes)	0	10	20	30
$P(t)$	100	150	200	175

   (a) Estimate the number of runners arriving at the stadium between 9:00 and 9:30.

   (b) Do you think the rate at which people are arriving is increasing or decreasing at 9:25?

   (c) What is the average rate people are entering the stadium between 9:00 and 9:30? Include units.

   (d) What is the average rate of change of $P(t)$ between 9:00 and 9:30? Include units.

   (e) Estimate the number of people in the stadium at 9:30.