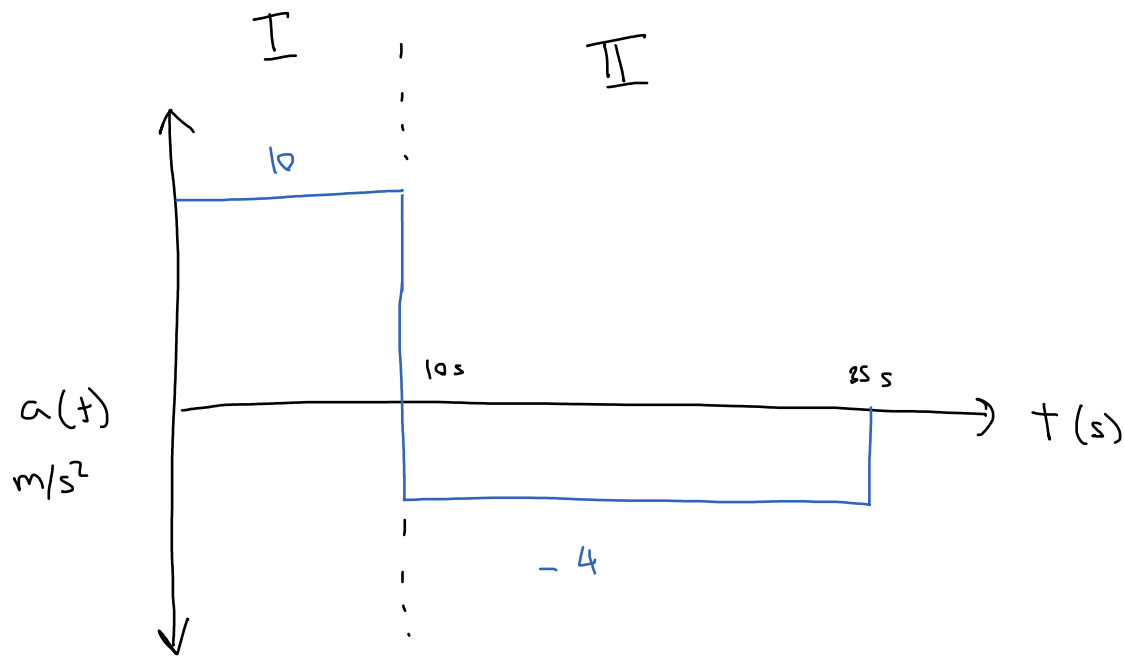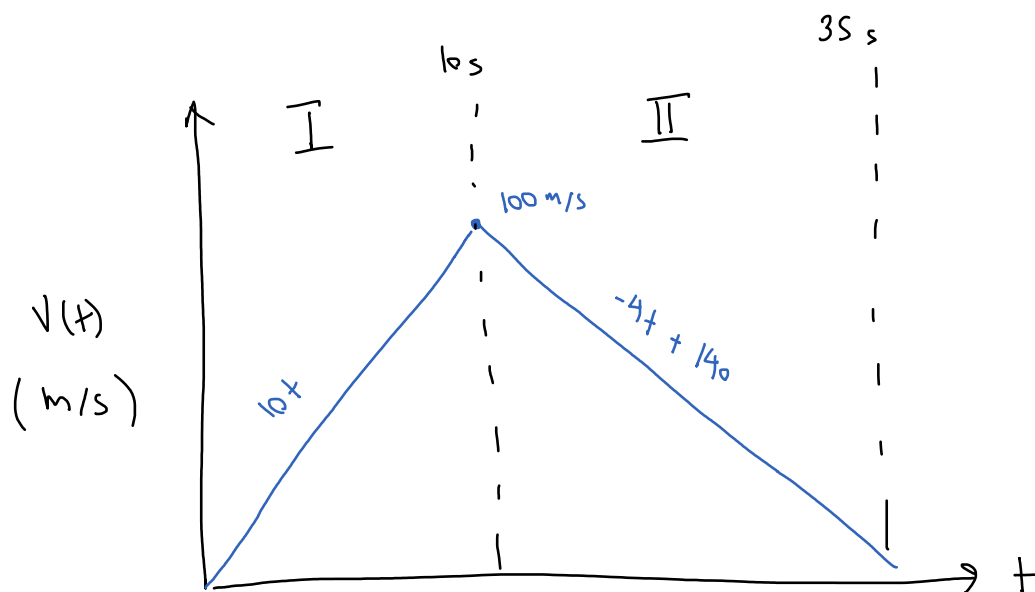# Question 1:

A car accelerates from rest at a rate of 10 m/s^2 for 10 seconds. The car then immediately begins decelerating at a rate of 4 m/s^2 for another 25 seconds before coming to a stop. Find the equations for the acceleration, velocity, and position functions over the full 35 second time period and plot these functions.

I   II

$a(t)$
m/s^2

10

10 s   25 s

$\rightarrow t\,(s)$

-4

I $\quad v(t) = \int a(t) = \int 10$

$$\underline{v(t) = 10t + \cancel{C}} \quad \leftarrow V_0 = 0$$

$$V(10) = 100 \;\Big\}$$

II $\quad V(t) = \int a(t) = \int -4 \qquad \text{when } t = 10$

$$V(t) = -4t + C \quad \leftarrow \qquad V = 100$$

$$C = 140$$

$$\underline{V(t) = -4t + 140}$$

The diagram shows $X(t)$ (m) vs t (s) with regions I and II separated at 10s, and ending at 35s.

- Region I: $5t^2$
- Point at 10s: 500 m
- Region II: $-2t^2 + 140t - 700$
- Point at 35s: 1750 m
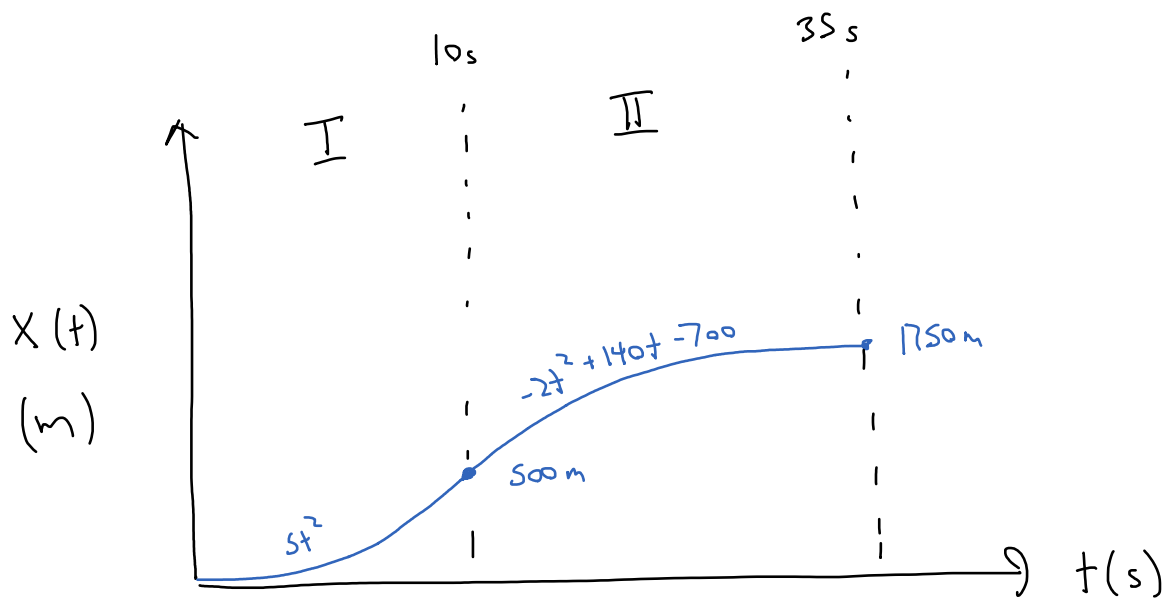
I

$$X(t) = \int V(t) = \int 10t$$

$$\underline{X(t) = 5t^2 + \cancel{C}} \quad \leftarrow X_0 = 0$$

$$X(10) = 500$$

II $\quad X(t) = \int V(t) = \int -4t + 140$

$$X(t) = -2t^2 + 140t + C \quad \leftarrow \begin{array}{l} \text{when } t=0 \\ X = 500 \end{array}$$

$$C = -700$$

$$\underline{X(t) = -2t^2 + 140t - 700}$$