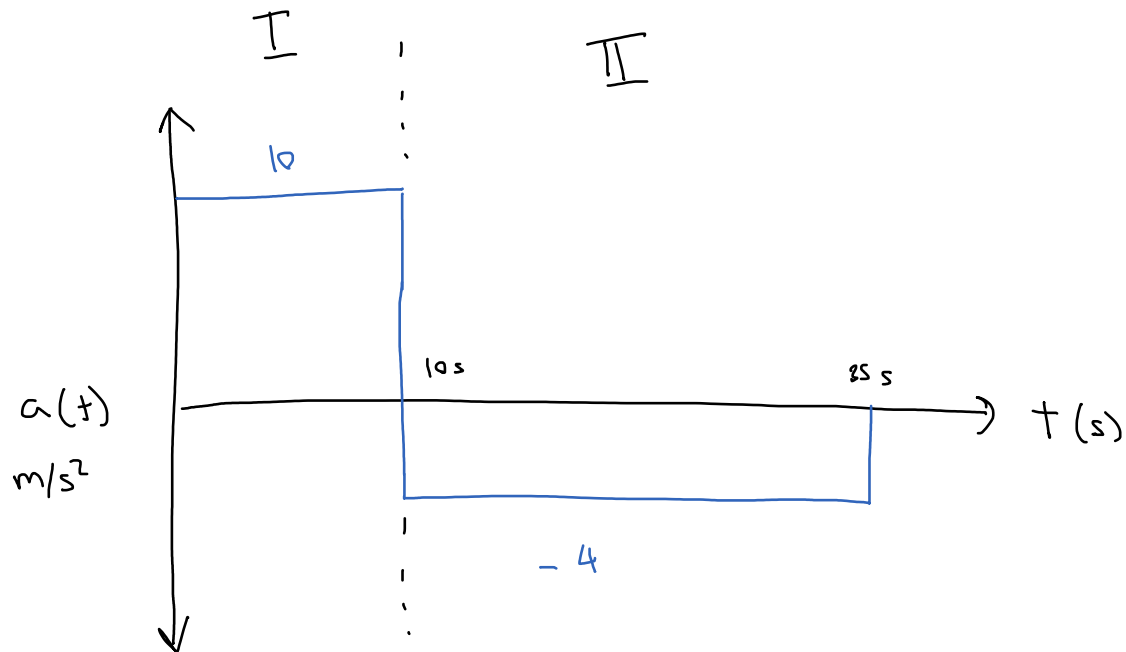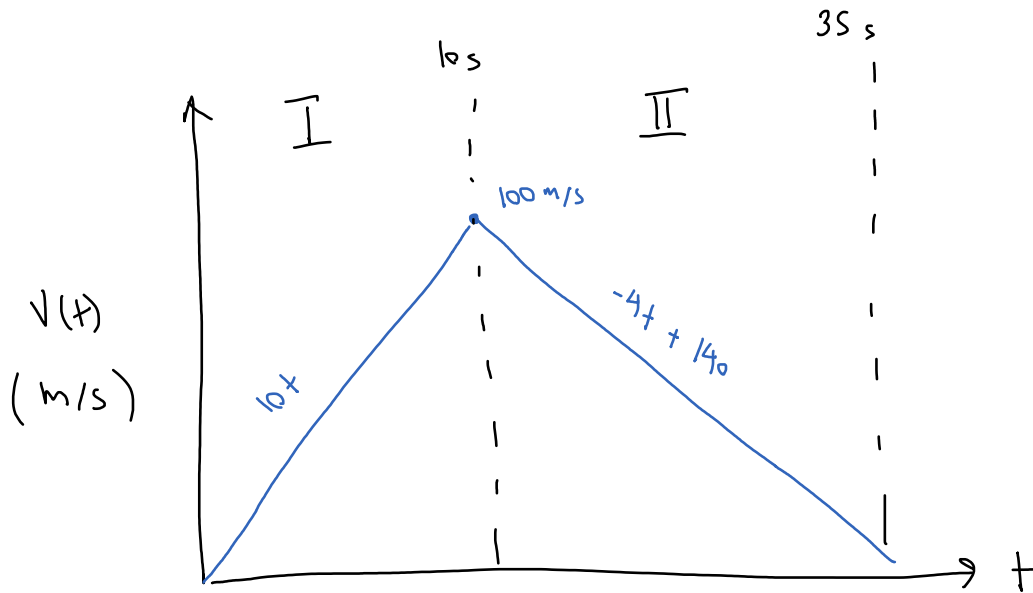# Question 1:

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

10

10 s
25 s

$a(t)$
m/s^2

-4

$t (s)$

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

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

$V(10) = 100$

II $V(t) = \int a(t) = \int -4$ when $t = 10$

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

$C = 140$

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

The graph shows $X(t)$ (m) versus t (s), with region I before $t = 10\text{s}$ and region II between 10s and 35s. In region I the curve is labeled $5t^2$; in region II the curve is labeled $-2t^2 + 140t - 700$. Marked points: 500 m at $t = 10\text{s}$ and 1750 m at $t = 35\text{s}$.
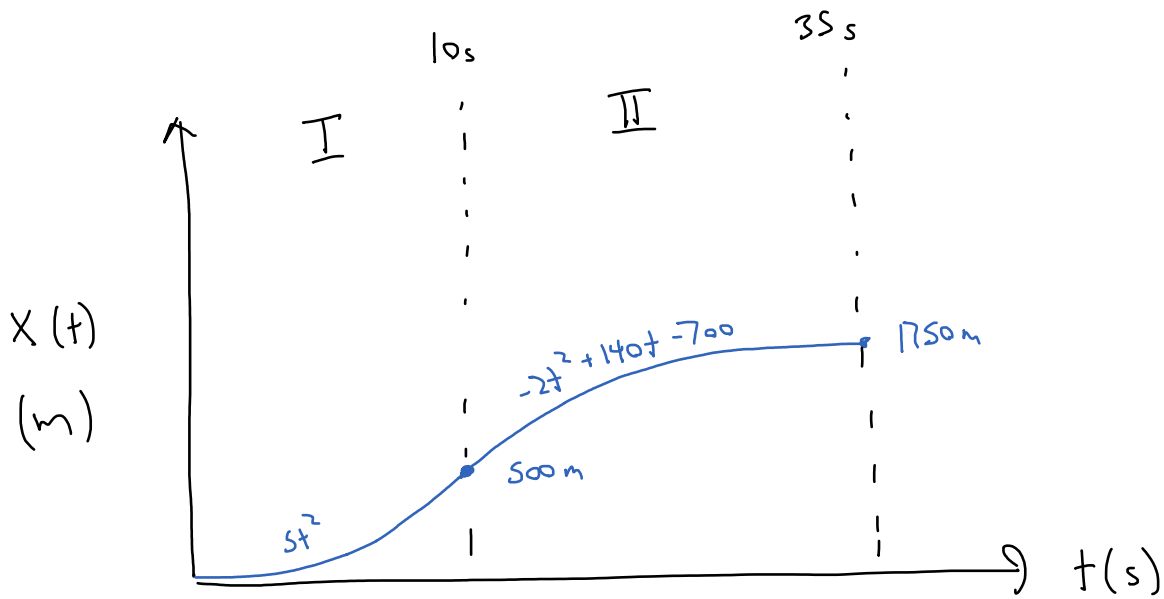
I

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

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

$$X(10) = 500$$

II

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

$$X(t) = -2t^2 + 140t + C \quad \leftarrow \quad \begin{array}{l}\text{when } t = 10 \\ X(t) = 500\end{array}$$

$$C = -700$$

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