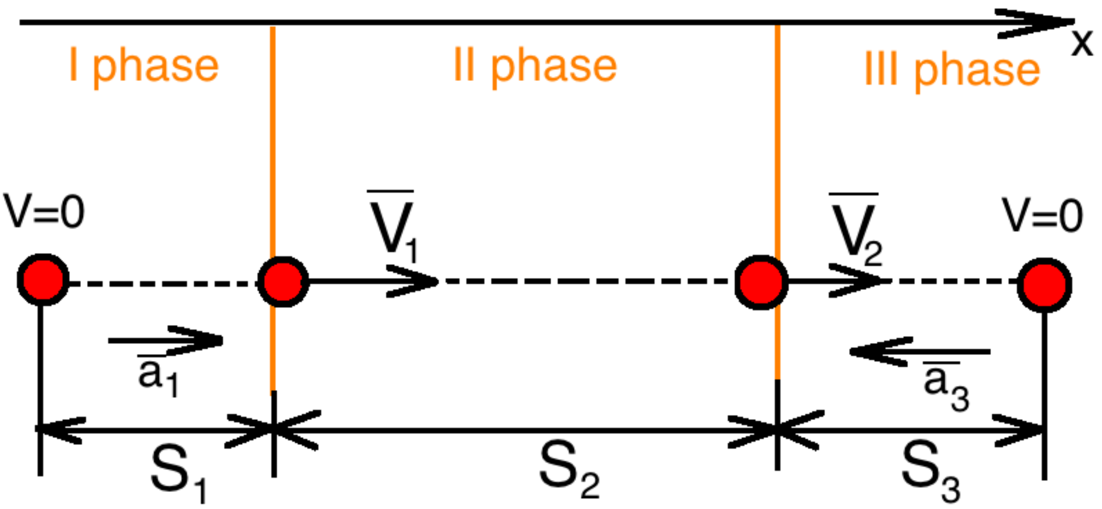
A truck on a straight road starts from rest and accelerates at 2.0 m/s2 until it reaches a speed of 20 m/s. Then the truck travels for 20 s at a constant speed until the brakes are applied, stopping the car in a uniform manner in an additional 5.0 s. How long is the truck in motion and what is its average velocity during the motion?

**Solution**




Assumption: to find the average speed we can break all path up into three phases: accelerating $\rightarrow$ coasting $\rightarrow$ decelerating.

**First phase (accelerating)**

Rate equation for the acceleration phase:

$$V_1 = a_1 t_1$$

$$t_1 = \frac{V_1}{a_1} = \frac{20\frac{m}{s}}{2.0\frac{m}{s^2}} = 10\ s$$

It means thet accelerating will stop after 10 seconds because then the truck will reach velocity 20 m/s.

Equation of motion for the acceleration phase:

$$S_1 = \frac{a_1 {t_1}^2}{2} = \frac{2.0\frac{m}{s^2}\cdot(10\ s)^2}{2} = 100\ m$$

**Second phase (coasting):**

Truck travels path at 20 m/s for 20 s:

$$S_2 = V_2 t_2 = 20\frac{m}{s}\cdot 20s = 400\ m$$

**Third phase (decelerating):**

Rate equation for the acceleration phase:

$$0 = V_2 - a_3 t_3$$

$$a_3 = \frac{V_2}{t_3} = \frac{20\,\frac{\mathrm{m}}{\mathrm{s}}}{5\ \mathrm{s}} = 4\ \frac{\mathrm{m}}{\mathrm{s}^2}$$

It means thet accelerating will stop after 10 seconds because then the truck will reach velocity 20 m/s.

Equation of motion for the deceleration phase:

$$S_3 = \frac{a_3 {t_3}^2}{2} = \frac{4\ \frac{\mathrm{m}}{\mathrm{s}^2} \cdot (5\ \mathrm{s})^2}{2} = 50\ \mathrm{m}$$

$$\text{Average velocity} = \frac{\text{all distance}}{\text{all time}} = \frac{S_1 + S_2 + S_3}{t_1 + t_2 + t_3} = \frac{100\mathrm{m} + 400\mathrm{m} + 50\mathrm{m}}{10\mathrm{s} + 20\mathrm{s} + 5\mathrm{s}} = \\ = 15.7\frac{\mathrm{m}}{\mathrm{s}}$$

Time of the travel is $T = 10\mathrm{s} + 20\mathrm{s} + 5\mathrm{s} = 35\mathrm{s}$.

**Answer:** average velocity during the motion is $15.7\frac{\mathrm{m}}{\mathrm{s}}$, truck was in motion during 35s.