Displacement & Acceleration

Constant Velocity $\Rightarrow$ $v = \frac{\Delta d}{\Delta t}$

Constant Acceleration $\Rightarrow$ $a = \frac{\Delta v}{\Delta t}$ $\quad (\Delta v = v_2 - v_1)$

$v_{ave} = \frac{\Delta d}{\Delta t}$ $\quad \left(v_{ave} = \frac{v_1 + v_2}{2}\right)$

Maybe Useful:

① $\Delta d = v_1 \Delta t + \frac{1}{2} a (\Delta t)^2$

② $\Delta d = v_2 \Delta t - \frac{1}{2} a (\Delta t)^2$

③ $v_2^2 = v_1^2 + 2a\Delta d$

MP 87

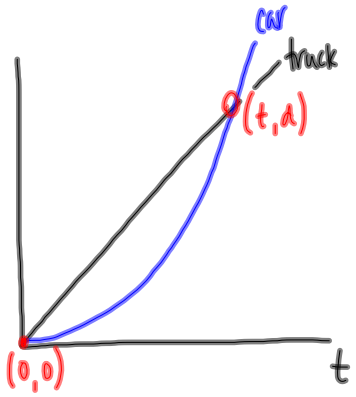
Truck

$\vec{v} = 22\,m/s\,[N]$ (constant) $\quad \Delta d = ?$ $\quad \Delta t = ?$

Car

$\vec{a} = 4.8\,m/s^2\,[N]$ $\quad \Delta d = ?$ $\quad \Delta t = ?$

$v_1 = 0$



Truck (constant velocity)

$$v = \frac{\Delta d}{\Delta t}$$

$$v = \frac{d - 0}{t - 0}$$

$$v = \frac{d}{t}$$

$$d = vt$$

$$\boxed{d = (22\,m/s)t}$$

Car (constant acc)

$$\Delta d = \cancel{v_0 \Delta t} + \frac{1}{2}a(\Delta t)^2$$

$$d = \frac{1}{2}at^2$$

$$d = \frac{1}{2}(4.8\,m/s^2)t^2$$

$$\boxed{d = (2.4\,m/s^2)t^2}$$

$$22t = 2.4t^2$$

$$0 = 2.4t^2 - 22t$$

$$0 = t(2.4t - 22)$$

Set each factor equal to zero:

$t \neq 0$ and $2.4t - 22 = 0$

$$2.4t = 22$$

$$t = \frac{22\,m/s}{2.4\,m/s^2}$$

$$\boxed{t = 9.2\,s}$$

$$d = (22\,m/s)t$$

$$d = (22\,m/s)(9.2\,s)$$

$$d = 201.7\,m$$

$$\boxed{\vec{d} = 2.0 \times 10^2\,m\,[N]}$$

Example

An airplane must reach a velocity of 71 m/s for takeoff. If the runway is 1.0 km long, what must the constant acceleration be?

$V_1 = 0$ m/s

$V_2 = 71$ m/s

$\Delta d = 1.0$ km

$a = ?$

$$V_2^2 = V_1^2 + 2a\Delta d$$

$$\frac{V_2^2 - V_1^2}{2\Delta d} = \frac{2a\cancel{\Delta d}}{\cancel{2\Delta d}}$$

$$a = \frac{V_2^2 - V_1^2}{(2\Delta d)}$$

$$a = \frac{(71\text{ m/s})^2 - 0^2}{2(1.0\times10^3\text{ m})}$$

$$a \doteq 2.5\text{ m/s}^2$$

- PP 80 (All)
- Calculator Pad (1-15) (finish)