Acceleration + Displacement

Displacement is the area under v-t graph.

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

Constant Acceleration: $v_{ave} = \frac{\Delta d}{\Delta t}$ $a = \frac{\Delta v}{\Delta t}$

$v_{ave} = \frac{v_1 + v_2}{2}$ $\Delta v = v_2 - v_1$

maybe useful equations

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

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

$v_2^2 = v_1^2 + 2ad$

exact

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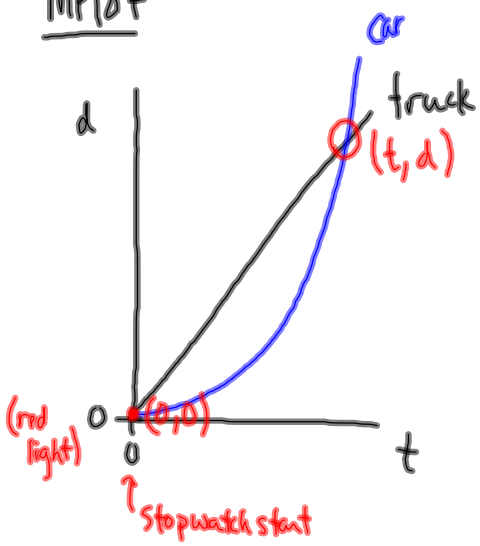
MP 8.7



Truck - constant velocity

$v = 22\ m/s$

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

$\Delta d = v\,\Delta t$

$d - 0 = (22\ m/s)(t - 0)$

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

Car - constant acceleration

$v_1 = 0$

$a = 4.8\ m/s^2$

$\Delta d = ?$

$\Delta t = ?$

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

$d = 0(t) + \frac{1}{2}(4.8\ m/s^2)t^2$

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

$d = (2.4\ m/s^2)t^2$

$(22\ m/s)t = (2.4\ m/s^2)t^2$

$0 = 2.4t^2 - 22t$

$0 = t(2.4t - 22)$

Set each factor equal to zero:

~~$t = 0$~~ and $2.4t - 22 = 0$

$2.4t = 22$

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

$t = 9.2\ s$

$\frac{m/s}{m/s^2} = \frac{m}{s} \div \frac{m}{s^2}$

$= \frac{m}{s} \cdot \frac{s^2}{m}$

$= s$

It will take the car 9.2 s to catch up with the truck

How far have they travelled?

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

$d = 2.0 \times 10^2\ m$

They have travelled 2.0×10^2 m from the traffic light.

(The displacement was 2.0×10^2 m [N])

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Example

An airplane must reach a velocity of 71 m/s (V_2) for takeoff. If the runway is 1.0 km (Δd) long, what must the acceleration (a) be?

$V_1 = 0$

$V_1 = 0$ m/s

$V_2 = 71$ m/s

$\Delta d = 1.0\text{ km} = 1.0 \times 10^3$ m

$a = ?$

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

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

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

$$a = \frac{(71\text{ m/s})^2 - 0^2}{2(1.0 \times 10^3\text{ m})}$$

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

$$\frac{m^2/s^2}{m} = \frac{m^2}{s^2} \div m$$

$$= \frac{m^2}{s^2} \times \frac{1}{m}$$

$$= \frac{m}{s^2}$$

To DO:

1. pp 89
2. CalculatorPad | kinematics
   1 - 15