Acceleration & Displacement

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

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

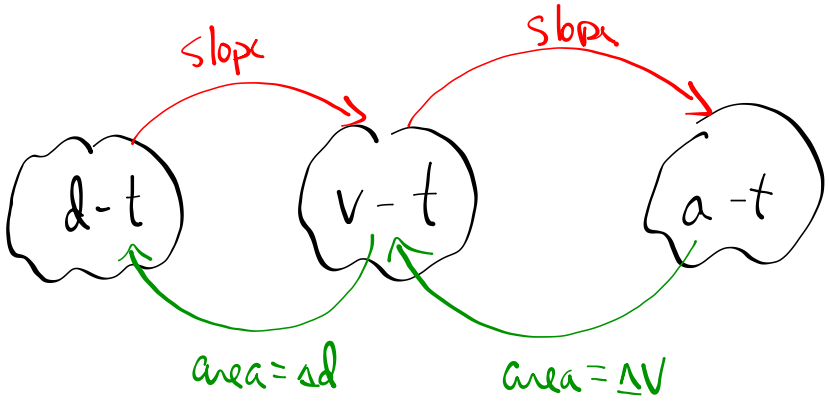
$v_{ave} = \frac{\Delta d}{\Delta t}$ $\left(v_{ave} = \frac{v_1 + v_2}{2}\right)$

Maybe Useful Equations

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 $v_2^2 = v_1^2 + 2a\Delta d$



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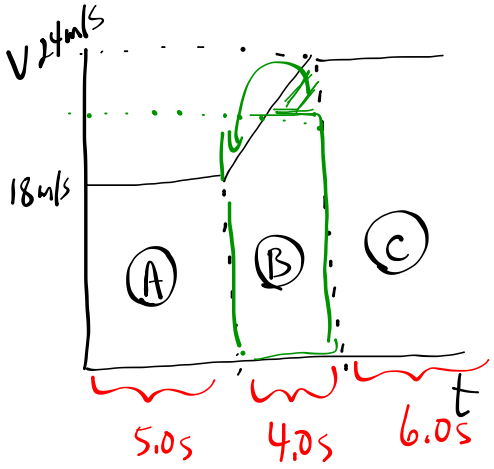

Section A (constant velocity)

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

$\Delta d = v \Delta t$

$\Delta d = (18 m/s)(5.0 s)$

$\Delta d = 90 m$

Section B (constant acc)

$V_1 = 18 m/s$

$V_2 = 24 m/s$

$\Delta t = 4.0 s$

$\Delta d = ?$

$V_{ave} = \frac{\Delta d}{\Delta t}$

$\Delta d = V_{ave} \Delta t$

$\Delta d = \left(\frac{V_1 + V_2}{2}\right) \Delta t$

$\Delta d = \left(\frac{18 m/s + 24 m/s}{2}\right)(4.0 s)$

$\Delta d = (21 m/s)(4.0 s)$

$\Delta d = 84 m$

Section C (constant velocity)

$\Delta d = v \Delta t$

$\Delta d = (24 m/s)(6.0 s)$

$\Delta d = 144 m$

TOTAL:

A = 90 m

B = 84 m

C = 144 m

318 m

$\vec{\Delta d} = 3.2 \times 10^2 m \; [E]$

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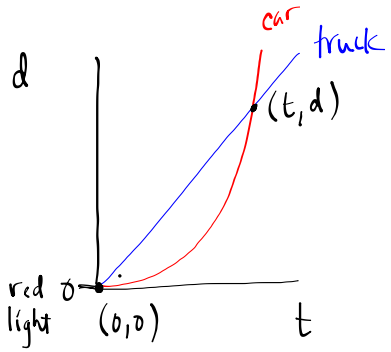


Truck (constant velocity)

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

$\Delta d = v \Delta t$

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

$d = (22 m/s)t$

$(y = mx + b)$

Car (constant acceleration)

$V_1 = 0$

$a = 4.8 m/s^2$

$\Delta d = ?$

$\Delta t = ?$

$\Delta d = V_1 \Delta t + \frac{1}{2} a (\Delta t)^2$

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

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

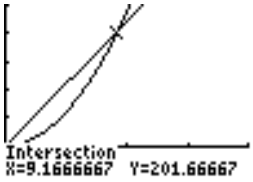
Graph: $y_1 = 22x$, $y_2 = 2.4x^2$

Setting the two equations equal to one another:

$22t = 2.4t^2$

$0 = 2.4t^2 - 22t$

$0 = t(2.4t - 22)$



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

$2.4t = 22$

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

$t = 9.2 s$

where:

$d = (22 m/s)t$

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

$d = 201.7 m$

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

TO DO

① PP|89

② Calculator Pad (1-15) + more . . . . . .

One more 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?

$V_1 = 0$

$V_2 = 71\ m/s$

$\Delta d = 1.0 \times 10^3\ m$

$a = ?$

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

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

$$a = \frac{V_2^2 - V_1^2}{2\Delta d} \quad (V_1 = 0)$$

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

$$a = 2.5\ m/s^2$$