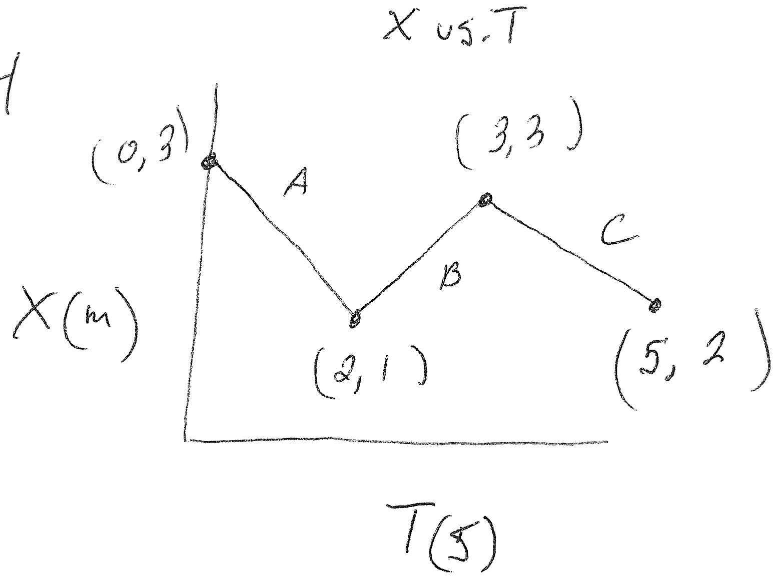
24



Speed = slope in this case

a) B is steepest therefore speed is greatest

b) speed A $= \frac{\Delta x}{\Delta t} = \frac{1m - 3m}{2s - 0s} = \frac{-2m}{2s} = -1\ m/s$

$\boxed{1\ m/s}$ * speed is always positive.

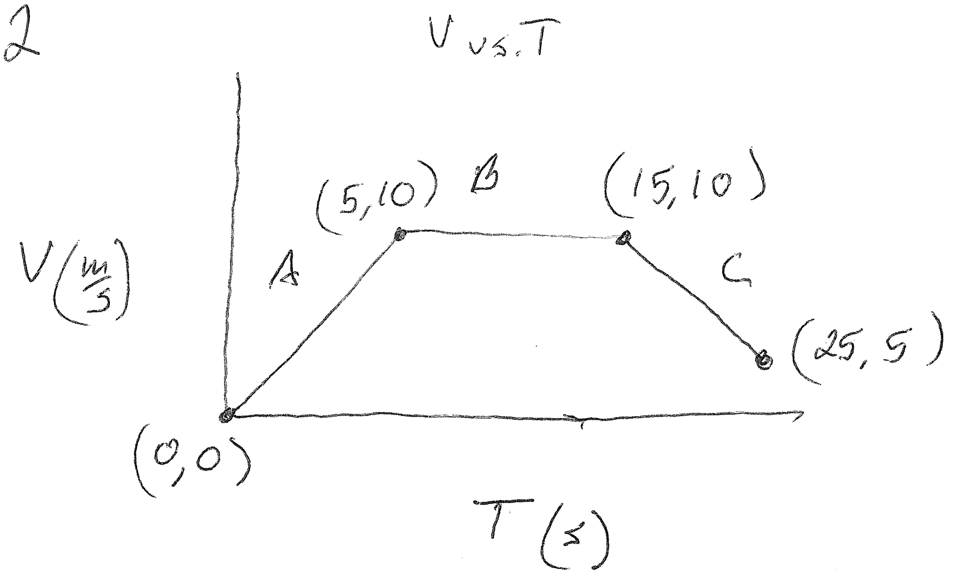
Why?

In this case we are using speed to mean the absolute value, or magnitude of velocity.

c) speed B $= \frac{\Delta x}{\Delta t} = \frac{3m - 1m}{3s - 2s} = \frac{2m}{1s} = \boxed{2\ \frac{m}{s}}$

d) speed C $= \frac{\Delta x}{\Delta t} = \frac{2m - 3m}{5s - 3s} = \frac{-1m}{2s} = -\frac{1}{2}\ \frac{m}{s}$ $\boxed{\frac{1}{2}\ m/s}$

32



* slope of V vs T is always acceleration

a) $\bar{a} = \frac{\Delta V}{\Delta t} = \text{slope} = \frac{10\,m/s - 0\,m/s}{5\,s - 0\,s} = \frac{10\,m/s}{5\,s} = \boxed{2\,m/s^2}$

b) $\bar{a} = \frac{\Delta v}{\Delta t} = \frac{10\,m/s - 10\,m/s}{15\,s - 5\,s} = \frac{0\,m/s}{10\,s} = \boxed{0\,m/s^2}$

c) $\bar{a} = \frac{\Delta v}{\Delta t} = \frac{5\,m/s - 10\,m/s}{25\,s - 15\,s} = \frac{-5\,m/s}{10\,s} = \boxed{-\frac{1}{2}\,m/s^2}$

Now suppose we also are interested in the displacement for each interval.

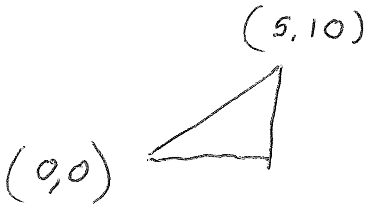
* Area "under the curve" is always displacement for a V vs T graph.

32 cont.

Area under the curve means area between graph and t-axis.

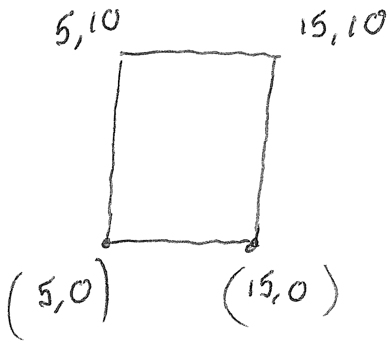
- Areas above the t-axis are positive.
- Areas below the t-axis are negative.

Displacement A



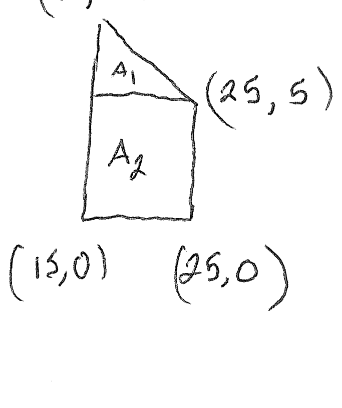
$A = \frac{1}{2}bh = \frac{1}{2}(5s)(10\,m/s) = \boxed{25\,m}$

Displacement B



$A = bh = (10s)(10\,m/s) = \boxed{100\,m}$

Displacement C



$A_1 = \frac{1}{2}bh = \frac{1}{2}(10s)(5\,m/s) = 25m$

$A_2 = bh = (10s)(5\,m/s) = 50m$

$A = A_1 + A_2 = \boxed{75\,m}$

A certain sports car can accelerate from 0 to 60 mph ($\sim 100 \frac{km}{h}$) in 4.9 s. At this rate how fast will the car be traveling after 11 s?

Given Information:

motion 1

$V_0 = 0\ m/s$

$a = ?$

$V = 100 \frac{km}{h}$

$\Delta t = 4.9\ s$

motion 2

$V_0 = 0\ m/s$

$a =$

$V = ?$

$\Delta t = 11\ s$

Use motion 1 to find a for motion 2

<u>motion 1 - finding a</u>

$$V = V_0 + a\Delta t$$

V in m/s

$$a = \frac{V - V_0}{\Delta t} = \frac{\overbrace{100 \frac{km}{h}\left(\frac{1000\ m}{1\ km}\right)\left(\frac{1\ h}{3600\ s}\right)}^{V \text{ in } m/s} - 0\ \frac{m}{s}}{4.9\ s}$$

$a = 5.669\ m/s^2$

motion 2 - finding v @ $t = 11s$

$v = v_0 + a\Delta t$

$= 0\,m/s + (5.669\,m/s^2)\,11s$

$= 62.36\,m/s$

$\boxed{62\ m/s}$ or $62\,\frac{m}{s}\left(\frac{3600s}{1h}\right)\frac{1km}{1000m}$

$223\ \frac{km}{h}$

60

Friend

$V = 3.5 \, m/s$

$X_0 = 0 \, m$ passing you

$a = 0 \, m/s$

You

$V_0 = 0 \, m/s$

$X_0 = 0 \, m$

$a = 2.4 \, m/s^2$

$\Delta t = 2.0 \, s$ - time traveled while you get on after repair

---

X_0 when you start

Part b

$X = \cancel{X_0}^{\,0} + v\Delta t$

$= (3.5 \, m/s)(2.0 \, s) = 7.0 \, m$

X_0 when you start $= 7.0 \, m$

Equation of motion

$$x = x_0 + v_0 \Delta t + \tfrac{1}{2} a \Delta t^2$$

Friend

$X = 7.0 \, m + 3.5 \, m/s \, \Delta t$

* no Δt^2 term because your friend is not accelerating

You

$x = \tfrac{1}{2}(2.4 \, m/s^2) \Delta t^2$

* $x_0 = 0$ and $v_0 = 0$ for you

60 cont.

Point of intersection will yield the time to reach your friend.

$$7.0\,m + 3.5\,m/s\;\Delta t = \tfrac{1}{2}(2.4\,m/s^2)\,\Delta t^2$$

why? When you meet you are at the same position, so set the two equations equal to each other

$$-\underbrace{(1.2\,m/s)}_{a}\Delta t^2 + \underbrace{(3.5\,m/s)}_{b}\Delta t + \underbrace{7.0\,m}_{c} = 0$$

$$\Delta t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-3.5 \pm \sqrt{3.5^2 - 4(-1.2)(7.0)}}{2(-1.2)}$$

$$= \frac{-3.5 \pm 6.771}{\sout{9.80}\ -2.4}$$

= + → $-1.36\,s$ does not make physical sense

− → $4.28\,s$

4.3 s

60 cont.

c) Speed when the two meet?

$V = V_0 + a\Delta t$

$\Delta t = 4.3\,s$

$V_0 = 0\,m/s$

$a = 2.4\,m/s^2$

$V = 2.4\,m/s^2\,(4.3\,s)$

$= 10.32\,m/s$

10. m/s