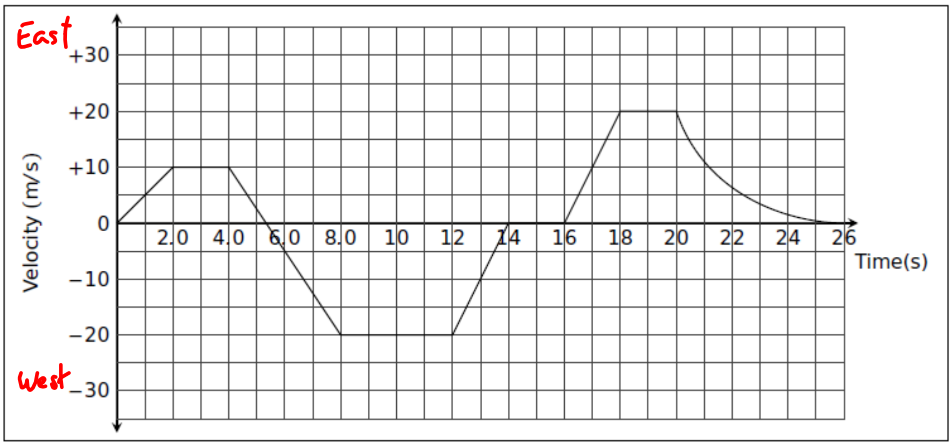
Motion Graph #7 - The following graph indicates the motion of an object along an East-West path.



1. During what time intervals did the object have:

a. constant velocity? slope = 0 — 2-4, 8-12, 14-16, 18-20 s (25.5-26 s)

b. greatest positive acceleration? — 12-14 s, 16-18 s

c. uniform negative acceleration? — 4-8 s

d. non-uniform negative acceleration? — 20-26 s (1st)

e. zero acceleration — same as (a)

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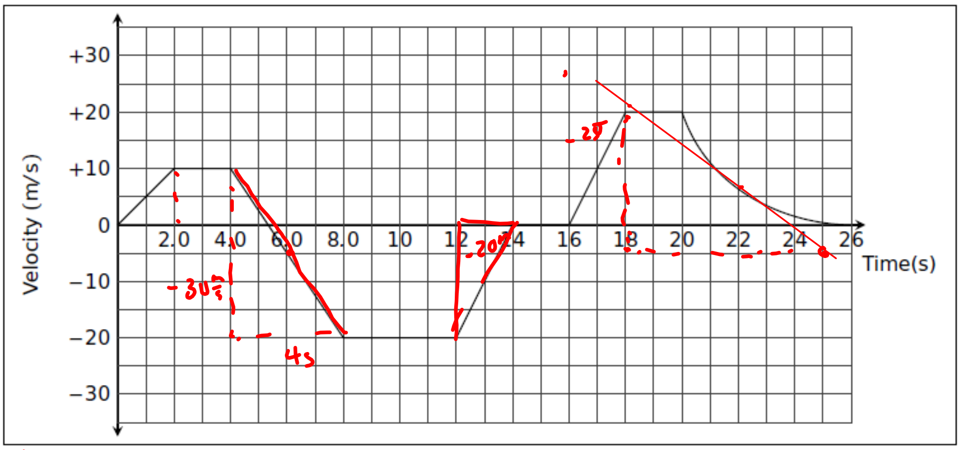


2. What was the object's acceleration in the first 2 seconds? $\vec{a} = \frac{\Delta \vec{v}}{t} = \frac{+10\,m/s - 0}{2.0\,s} = +5\,m/s^2$

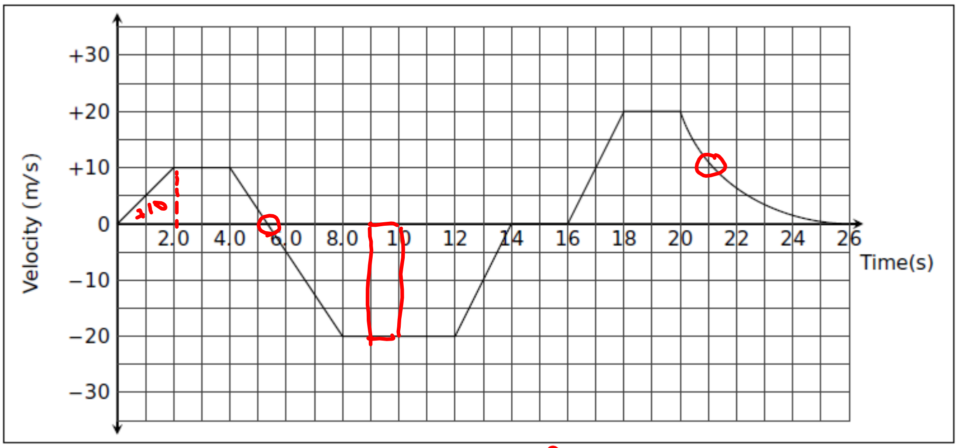
3. What was the average acceleration in the first 4 seconds? $\frac{+10\,m/s}{4.0\,s} = +2.5\,m/s^2$

4. What was the instantaneous acceleration at 6.0 s? $\frac{-30\,m/s}{4\,s} = -7.5\,m/s^2$

5. What was the instantaneous acceleration at 22 s? $\frac{-25\,m/s}{7\,s} = -3.6\,m/s^2$

6. What was the average velocity between 12 and 14 s? $\frac{\vec{d}}{t} = \frac{-20\,m}{2\,s} = -10\,m/s$

Motion Graph #7 - The following graph indicates the motion of an object along an East-West path.



7. When did the object first start to move west? $-\vec{v}$ 5.3 s (ish)

8. What was the object's instantaneous velocity at 21 s? + 11 m/s

9. What was the object's displacement in the first 2 seconds? + 10 m

10. What was its displacement in the tenth second? (9-10s) - 20 m

	$\vec{d}-t$	$\vec{v}-t$
t	x-axis	x-axis
$\vec{d}$	y-axis	Σ area
d	$\Sigma\lvert\Delta$ y-axis$\rvert$	$\Sigma\lvert$area$\rvert$
$\vec{v}$	slope	y-axis
v	$\lvert$slope$\rvert$	$\lvert$y-axis$\rvert$
$\vec{v}_{ave}$	$\vec{d}/t$	$\vec{d}/t$
v_{ave}	d/t	d/t
$\vec{a}$		slope
$\vec{a}_{ave}$	$\Delta\vec{v}/t$	$\Delta\vec{v}/t$

The Mathematical Tool Kit for Kinematics

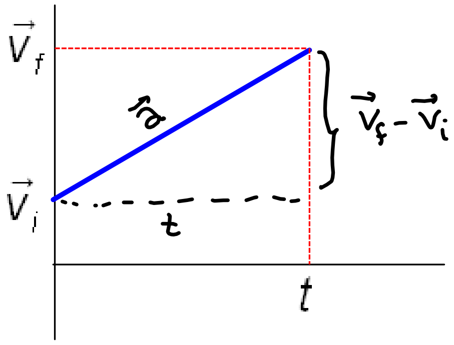
So far, we have two vector equations that we use

$$\vec{v}_{ave} = \frac{\vec{d}}{t}$$

$$\vec{a}_{ave} = \frac{\Delta\vec{v}}{t}$$

Both of which come from the slope equation - the first for a displacement-time graph, the second for a velocity-time graph.

If we look at a velocity-time graph as follows, we can learn a lot about equations of motion.



$\vec{V}_i$ = initial velocity

$\vec{V}_f$ = final velocity

t = time (time interval)

$\vec{a}$ = acceleration

$$\vec{a} = \text{slope} = \frac{\vec{v}_f - \vec{v}_i}{t}$$

$$\vec{a} \times t = \frac{\vec{v}_f - \vec{v}_i}{t} \times t$$

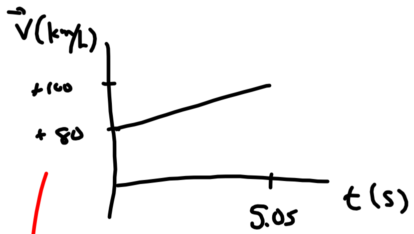
$$\vec{v}_i + \vec{a}t = \vec{v}_f - \vec{v}_i + \vec{v}_i$$

$$\boxed{\vec{v}_f = \vec{v}_i + \vec{a}t}$$

→ true for a single straight line on a $\vec{v}$ - t graph (constant $\vec{a}$)

Example

A car accelerates from +80 km/h to +100 km/h to pass another vehicle. This acceleration takes 5.0 s. What is the rate of acceleration of the car.

① 

→ m/s

$\vec{v}_f = +100 \frac{km}{h} = +100 \times \frac{1000 m}{60 \times 60 s}$

$= +27.8 \frac{m}{s}$

$\vec{v}_i = +80 \frac{km}{h} = +80 \times \frac{1000 m}{3600 s}$

$= +22.2 \frac{m}{s}$

② $\vec{v}_f = \vec{v}_i + \vec{a}t$

③ $+27.8 \frac{m}{s} = +22.2 \frac{m}{s} + \vec{a}(5.0 s)$

$\frac{+5.6 \frac{m}{s}}{5.0 s} = \frac{(5.0 s)\vec{a}}{5.0 s}$

④ $\vec{a} = +1.1 \, m/s^2$

① Diagram
② Equation
③ Substitution
④ Answer

Minimum requirements for a problem

No DIAGRAM = No MARKS

Homework: Finish Graph # 8 for Friday - it WILL be marked.
Quest - Monday - 1 displacement-time graph, 1 velocity-time graph