Chapter 2 - Kinematics

Description of HOW things move

Distance (d) - **how far an object moves if add up all segments, no direction**

Displacement (x) - **how far an object moves between start and end, direction matters.**

Speed (u)	Velocity (v)
Total distance per time	Displacement per time
no direction	one direction
scaler	vector
units = m/s	units = m/s
ex = 5 m/s	ex = 5 m/s south

1 What's the average speed of an object making a complete circle with a radius of 2 m in 5 seconds?

Given
Find
Equation
Math
Answer

m

G: $r = 2m, t = 5s$

F: $\bar{u} = ?$

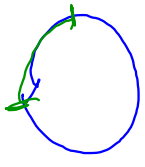
E: $\bar{u} = d/t$, $d = 2\pi r$

M: $\bar{u} = \frac{2\pi r}{t}$

$\bar{u} = \frac{2\pi(2m)}{5s}$

A: $\frac{4\pi}{5}$ m/s

2 What's the average VELOCITY of an object making a complete circle with a radius of 2 m in 5 seconds?



$X = 0$

$\bar{V} = \frac{X}{t} = 0$

Runner vs Sprinter or Moving Man (2 m/s vs 2 m/s²)

Acceleration = CHANGE in VELOCITY per time

3 ways to accelerate:

1) Increase speed
2) Decrease speed
3) Change direction

Free Fall

- Falling due to gravity only
- Acceleration due to gravity = $-10\ m/s^2$
- What does that mean??? $\frac{10\ m/s}{s} = \frac{\Delta v}{t}$

Big 5 Kinematic Equations

1) $\bar{v} = x/t$ (note this is AVERAGE v)
2) $x = 1/2\ (v_o + v_f)t$
3) $a = \Delta v/t = (v_f - v_o)/t$

change → straight = 0

Suppose we had a man fall off a building with no parachute...how far would he fall every second and how fast would he fall?

$v=0, t=0, x=0, a=-10 m/s^2$

$t=1s, v=-10 m/s, a=-10 m/s^2$
$x=-5m$

$t=2s, v=-20 m/s, a=-10 m/s^2$
$x=-20m$

$\bar{v} = \frac{0+30}{2} = 15 m/s$

$x = vt = 15 \times 3 = 45 m/s$

$t=3s, v=-30 m/s, a=-10 m/s^2$
$x=-45m$

How could we do this with math?

Start with....

$x = 1/2(v_o + v_f)t$ and $a = (v_f - v_o)/t$

$v_o + at = v_f$

$x = v_o t + \frac{1}{2}at^2 + x_o$

OR we could get rid of t

$x = \frac{1}{2}(v_o + v_f)t$ $\quad a = (v_f - v_o)/t$

$t = \frac{2x}{v_o + v_f} = \frac{v_f - v_o}{a}$ $\quad t = \frac{v_f - v_o}{a}$

$2ax = (v_f - v_o)(v_f + v_o)$

$2ax = v_f^2 - v_o^2$

Now we have the BIG 5

Equations	x	$\bar{v}$	v_o	v_f	t	a	
$\bar{v} = x/t$	✓	✓			✓		only $\bar{v}$
$x=1/2(v_o + v_f)t$	✓		✓	✓	✓		no a
$v_f = at + v_o$			✓	✓	✓	✓	no x
$x = 1/2at^2 + v_o t$ (+ x_o)	✓		✓		✓	✓	no v_f
$v_f^2 = 2ax + v_o^2$	✓		✓	✓		✓	no t

3 A ball is thrown up in the air at 25 m/s. How long does it take to reach the top?

G: $v_o = 25\ m/s$, $v_f = 0$

$a = -10\ m/s^2$

F: $t = ?$

E: $v_f = at + v_o$

M: $t = \frac{v_f - v_o}{a}$

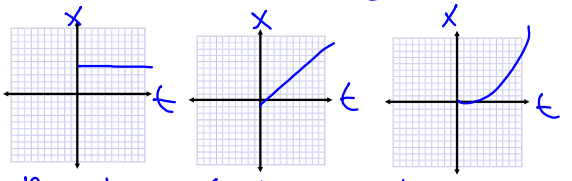
$t = \frac{0 - 25\ m/s}{-10\ m/s^2}$

$= 2.5\ s$

Graphs - Matching graphs

Position Graph

Slope = $\frac{\Delta x}{\Delta t}$ = v



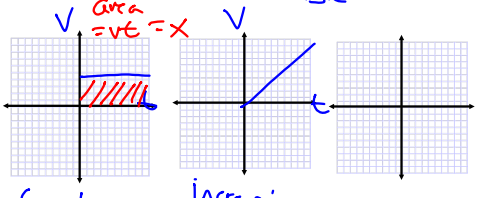
no motion

Const v

increasing v
Const a

Velocity Graph

Slope = $\frac{\Delta v}{\Delta t}$ = a

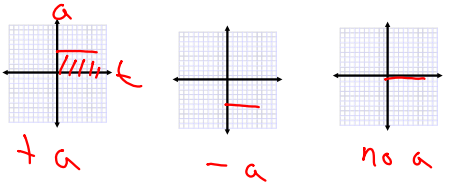


Const v

increasing v
Const a

Acceleration Graph

Area = at = v



+ a

− a

no a