EPISODE GUIDE | EPISODE 1

HOW DO THINGS MOVE?

CONCEPTS
Distance and speed; displacement & velocity; acceleration, free fall, equations describing motion

CURRICULUM CODES
S3FE-IIIa-b-1, S4FE-IIIa-1, S5FE-IIIa-1, S7FE-IIIa-1

#1 VARIABLES OF MOTION

DISTANCE, DISPLACEMENT, SPEED & VELOCITY

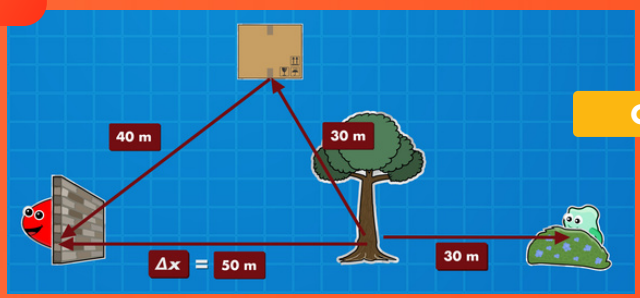
SI system - The international standard for measurement in science

"These are the base SI units we will use in Mind S-Cool Online Season 3"

QUANTITY MEASURED	Base Unit	SI abbreviation
Length	meter	m
Time	second	s
Mass	kilogram	kg
Temperature	kelvin	K
Electric current	ampere	A or amp

"The other SI units are built from these base units."

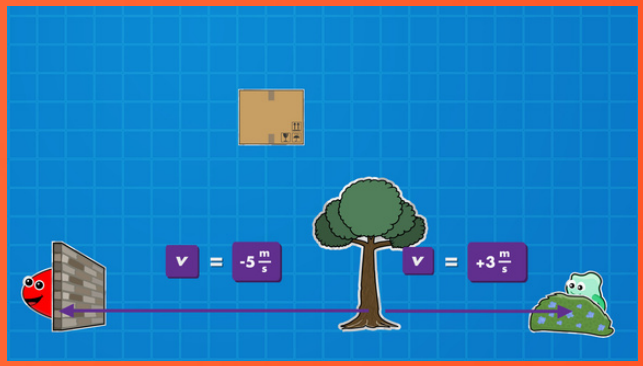
"For example, 1 newton = 1 kg m/s^2. Newton is the SI unit for force."



CALCULATING SPEED & VELOCITY

SI unit for distance and displacement: meter (m)

Displacement includes direction sometimes written using the symbols Δx (pronounced as "delta x") when horizontal or Δy ("delta y") when vertical



SI unit for speed and velocity:
- m/s (meter/s per second/s)
- Velocity (v) includes direction

GIVEN

- Bouncy's distance travelled = 30 m
- Bouncy's displacement = 30 m to the right
- Speedy's distance travelled = 70 m
- Speedy's displacement = 50 m to the left
- Time = 10 s

ASKED

- Speed and velocity

FORMULAS

$$s = \frac{d \text{ in m}}{t \text{ in s}} \qquad v = \frac{\Delta x \text{ in m}}{t \text{ in s}}$$

SOLUTIONS

BOUNCY

$$s = \frac{30\text{m}}{10\text{s}} = 3\text{m/s}$$

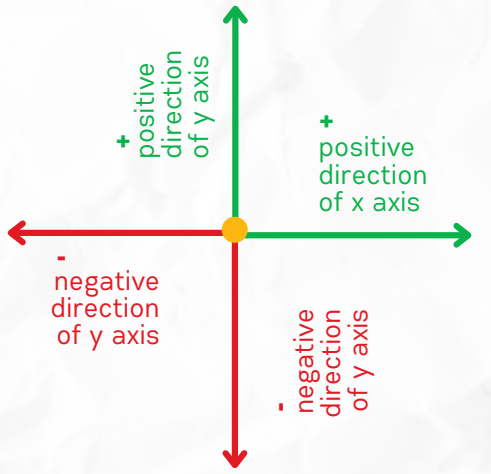
$$v = \frac{30\text{m to the right}}{10\text{s}} = 3\text{m/s to the right}$$

SPEEDY

$$s = \frac{70\text{m}}{10\text{s}} = 7\text{m/s}$$

$$v = \frac{50\text{m to the left}}{10\text{s}} = 5\text{m/s to the left}$$

SCALARS AND VECTORS



Sign of vector for common directions

EXAMPLES

3m

3m/s to the right

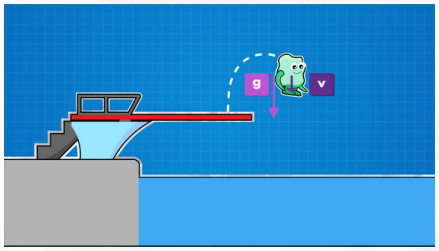
+3m/s

5m

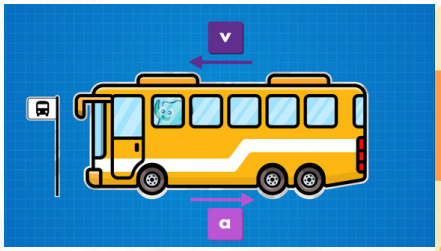
5m/s to the left

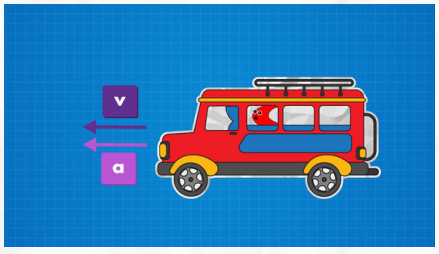
-5m/s

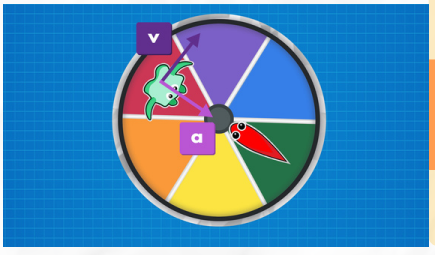
EXAMPLES OF ACCELERATION



Acceleration due to gravity







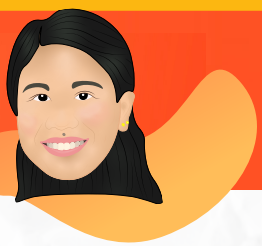
"Speeding up is an example of acceleration!"

"Slowing down is acceleration, too! And so is changing the direction of motion!"

"Δ is the Greek letter delta. It means change, so Δv is change in velocity."

FORMULA

$$a = \frac{\Delta v \text{ in m/s}}{t \text{ in s}} = \frac{\frac{m}{s}}{s} = \frac{m}{s} \times \frac{1}{s}$$



Acceleration includes direction.
SI unit: meters per second squared (m/s^2)

#2 EQUATIONS OF MOTION

$$v_f = v_i + a\,t$$

$$\Delta x = \frac{1}{2}(v_f + v_i)\,t$$

$$v_f^2 = v_i^2 + 2\,a\,\Delta x$$

$$\Delta x = v_i\,t + \frac{1}{2}\,a\,t^2$$

Use these formulas when something moves with constant acceleration!

GIVEN

- $\Delta x = 16.0$ m
- $V_i = 0$ m/s
- $a = +2.00\ m/s^2$

ASKED

- t

FORMULA

$$\Delta x = v_i\,t + \tfrac{1}{2}\,a\,t^2$$

Variable not involved: v

SOLUTION

$$\Delta x = v_i\,t + \tfrac{1}{2}\,a\,t^2$$

$$16m = 0m/s\ t + \tfrac{1}{2}\ 2m/s^2\ t^2$$

$$= 0 + \tfrac{1}{2}\ 2m/s^2\ t^2$$

$$= \tfrac{1}{2}\ 2m/s^2\ t^2$$

$$t^2 = \frac{2\ 16m}{2m/s}$$

$$\sqrt{t^2} = \sqrt{16m}$$

$$t = 4m$$

#3 FREE FALL

"If air resistance can be ignored, then I am moving only due to gravity. I am in free fall!

"I have acceleration due to gravity equal to 9.81 m/s ^{2} downward."

Use these formulas for things in free fall. Δy is the vertical displacement. g is the acceleration due to gravity of 9.81 m/s2.

FORMULAS	QUANTITY NOT INVOLVED
$v_f = v_i - g\,t$	Δx
$\Delta y = \frac{1}{2}(v + v)\,t$	------
$v_f^2 = v_i^2 - 2\,g\,\Delta x$	t^2
$\Delta y = v_i\,t - \frac{1}{2}\,g\,t^2$	v_f

Use the above equation if you use the convention g = 9.81 m/s ^{2}.

If you use g = -9.81 m//s ^{2}; use the original four equations but replace a = g.

Do not worry, your answer will be the same either way. Just make sure to be consistent with the convention you choose.