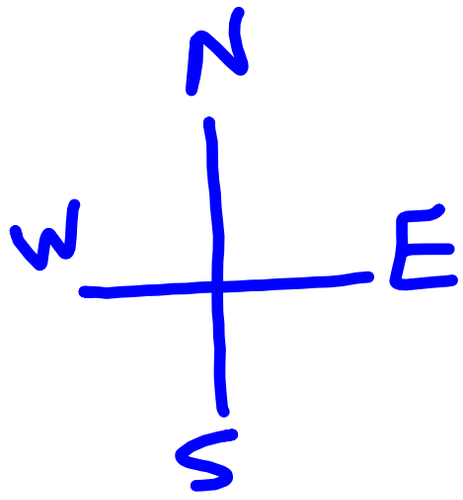
Motion

Kinematics~ the study of motion

Dynamics~ the causes of motion

} **Mechanics**



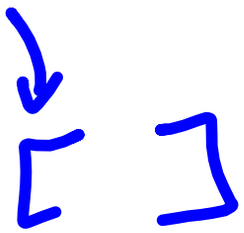
Vectors and Scalars

Scalar Quantities ~ have magnitude only (direction is not important).

i.e. time, mass, density, area, volume, speed, distance

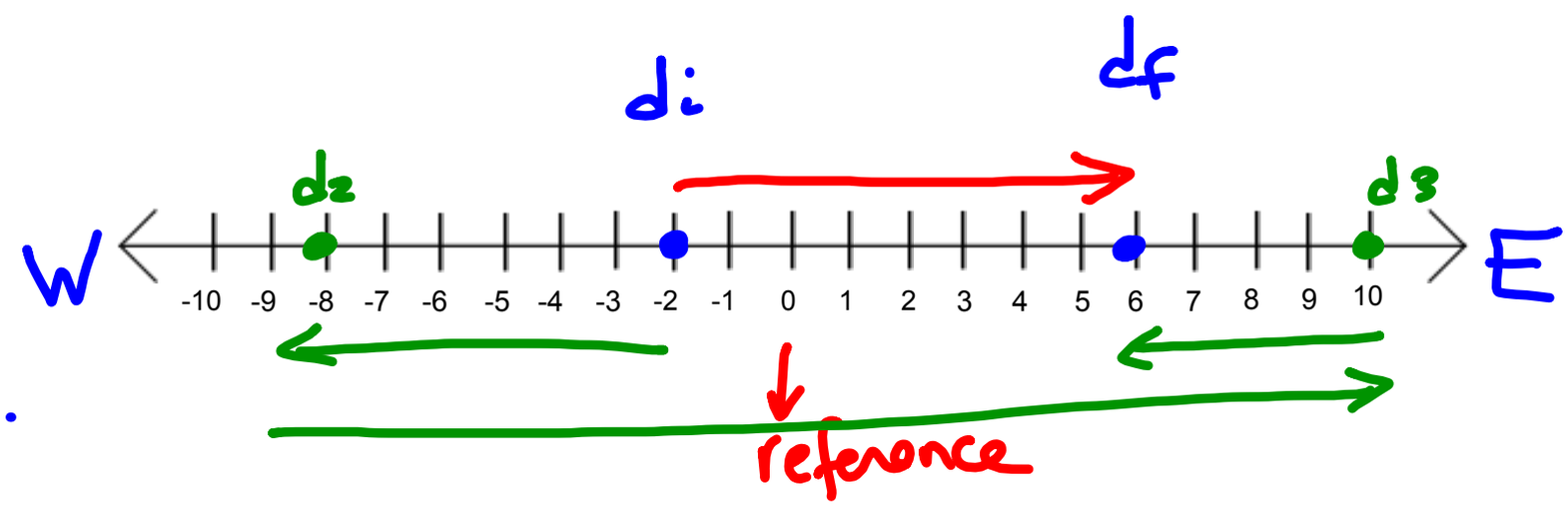
Vector Quantities ~ have both a magnitude and direction

i.e. displacement, velocity, force, acceleration



Position and Displacement

1. Position is a vector quantity describing location



Example: Initial position 2 blocks west, final position 6 blocks east.

2. Displacement is the straight line distance from the starting position to the final position in that direction.

Example: $\vec{\Delta d} = \vec{d}_f - \vec{d}_i = 6 - (-2) = 8$ blocks [E]

(change in)

N.B ~ The distance would be the total length of the trip.

Example: d = 28 blocks

Uniform Motion (or constant velocity)

Motion that occurs at a constant speed in one direction.

Example: A car travelling at 80 km/h [E]

cruise control
light travelling in one medium

Non-Uniform Motion (acceleration)

Motion where the speed and/or direction are changing.

Example: A pendulum swinging, car rolling down a hill

Speed and Velocity

speed = $\frac{\text{distance}}{\text{time}}$ velocity = $\frac{\text{displacement}}{\text{time}}$

$v = d/t$ $\bar{v} = \frac{\Delta \bar{d}}{t} = \frac{\bar{d}_f - \bar{d}_i}{t}$

Units: m/s km/h, cm/min

Example If I ran around a 400m track in 40s what is my speed and velocity?

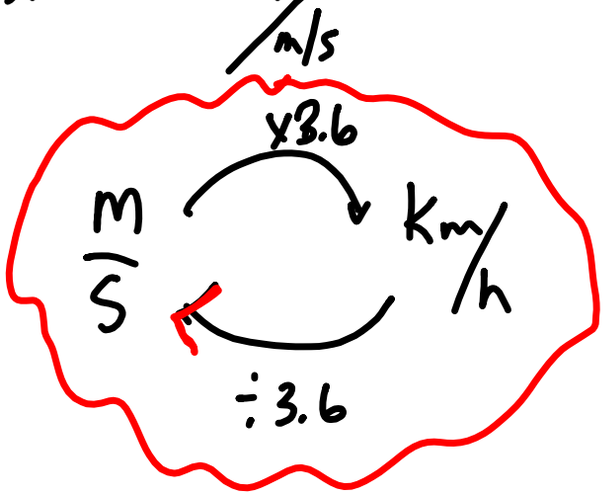
$V = \frac{d}{t}$ $\bar{V} = 0\,m/s$

$= 400/40 = 10\,m/s$

What is my speed in km/h?

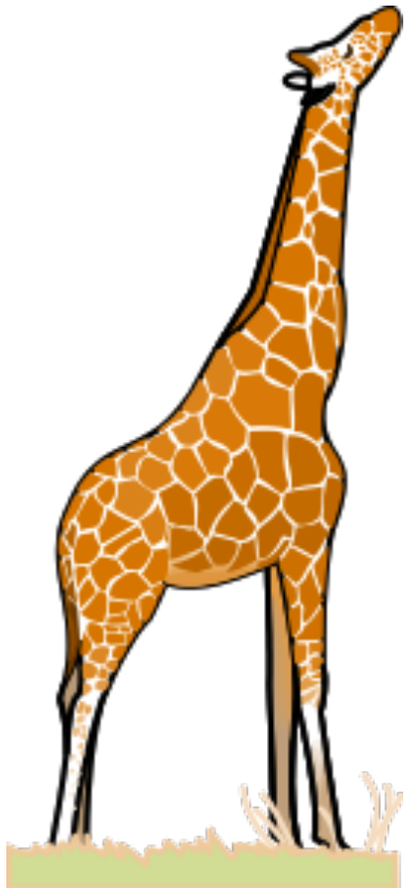
$10\,\frac{m}{s} \times \frac{1\,km}{1000\,m} \times \frac{3600\,s}{h} = 36\,km/h$

$10\,m/s \times 3.6\,km/h/m/s = 36\,km/h$



Example: a) Find the speed of a bullet travelling with uniform motion over a distance of 500.0 m in a time of 2.3 s.
b) convert the value to km/h

Example: Find the distance travelled by a giraffe that runs uniformly for 2.0 h at a speed of 12 m/s.



Givens

$V = 12\ m/s \times 3.6$

$= 43.2\ km/h$

$d = ?$

$t = 2.0\ h$

Formula

$V = \frac{d}{t}$

$d = vt$

$d = 43.2 \times 2.0$

$= 86.4\ km$

$\simeq 86\ km$

OR

$V = 12\ m/s$

$d = ?$

$t = 2.0 \times 3600$

$= 7200\ s$

$d = 12 \times 7200$

$\simeq 86400\ m$

$= 86000\ m$

Example: Mr Orange drives his car for 2.5 h at an average speed of 20.0 m/s. Mrs. Orange takes over driving for 1.5 h at an average speed of 28 m/s. Find the average speed of the trip. in m/s.

Mr O.	Mrs O
$t = 2.5\,h$	$t = 1.5\,h$
$v = 20.0\,m/s$	$v = 28\,m/s$
$= 72\,km/h$	$= 100.8\,km/h$
$d = 72 \times 2.5$	$d = 100.8 \times 1.5$
$= 180\,km$	$= 151.2$

$$V = \frac{180 + 151.2}{2.5 + 1.5}$$

$$= 82.8\,km/h$$

$$\div 3.6$$

$$= 23\,m/s$$

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