measurement

1.1 Physical Quantities

- **physical quantity** → quantity that can be measured
- **derived quantity** → physical quantity derived by combining base quantities thru multiplication / division / both

physical quantity

base quantities

- time
- length
- electric current
- thermodynamic temperature
- luminous intensity
- amount of substance

derived quantities

- volume
- area
- velocity
- acceleration
- density
- momentum
- charge
- power
- force
- energy
- work
- pressure

Base quantities & Derived quantities

↳ physical quantity which cannot be derived from another physical quantity

Base quantity	symbol
Length	l
Mass	m
Time	t
Thermodynamic temperature	T
Electric current	I
Luminous intensity	I_v
Amount of substance	n

S.I. unit	symbol
metre	m
kilogram	kg
second	s
kelvin	K
ampere	A
candela	cd
mole	mol

Amount of substance

- used in chemistry
- refers to the quantity of an element / a compound

Derived quantity	symbol	Formula
Volume	V	$V = l^3$
Density	ρ	$\rho = \frac{m}{V}$
Velocity	v	$v = \frac{l}{t}$
Charge	Q	$Q = I \times t$

Prefixes

Prefixes	value	Standard form	Symbol
Tera	1 000 000 000 000	10^{12}	T
Giga	1 000 000 000	10^{9}	G
Mega	1 000 000	10^{6}	M
Kilo	1 000	10^{3}	k
deci	0.1	10^{-1}	d
~~milli~~ centi	0.01	10^{-2}	c
milli	0.001	10^{-3}	m
micro	0.000 001	10^{-6}	M
nano	0.000 000 001	10^{-9}	n
pico	0.000 000 000 001	10^{-12}	p

Units for Area + Volume

$1\ m = 10^{2}\ cm$ $\quad$ $1\ cm = 10^{-2}\ m$

$1\ m^{2} = (10^{2})^{2}\ cm^{2}$ $\quad$ $1\ cm^{2} = (10^{-2})^{2}\ m^{2}$

$1\ m^{3} = (10^{2})^{3}\ cm^{3}$ $\quad$ $1\ cm^{3} = (10^{-2})^{3}\ m^{3}$

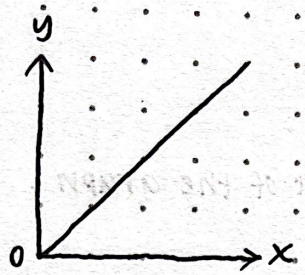
scalar + vector quantities

scalar quantity	vector quantity
physical quantity that has only magnitude	physical quantity that has both magnitude and direction
Examples: - Distance - mass - speed - energy - time	Examples: - displacement - force - velocity - acceleration - weight

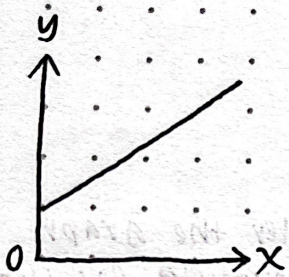
Measurement

1.2 Scientific Investigation

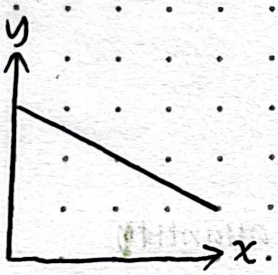
Interpretation of Graphs of Different Shapes

① 

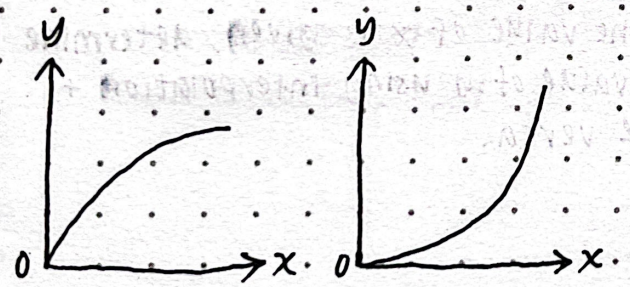
Type of graph : A straight line that passes through the origin
Relationship : y is directly proportional to x
Linear equation : $y = mx$ ↳ $y \propto x$
↳ $c = 0$

② 

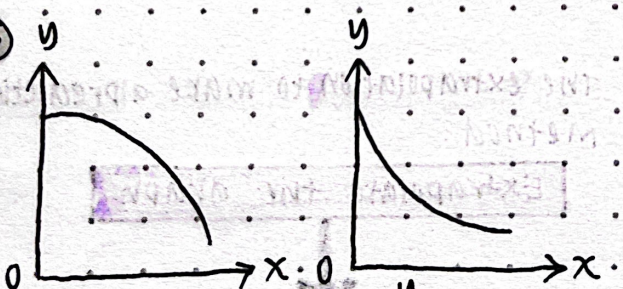
Type of graph : A straight line w/ a positive gradient that x pass thru the origin
Relationship : y increases linearly w/ x
Linear equation : $y = mx + c$

③ 

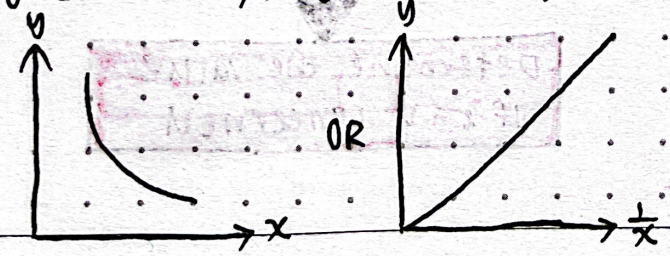
Type of graph : straight line w/ a -tive gradient that x pass thru the origin
Relationship : y decreases linearly w/ x
Linear equation : $y = mx + c$

④ 

Type of graph : A curve w/ a +tive gradient that pases thru the origin
Relationship : y increases w/ x

⑤ 

Type of graph : A curve w/ a -tive gradient that x pass thru the origin ~~both axes~~
Relationship : y decreases w/ x

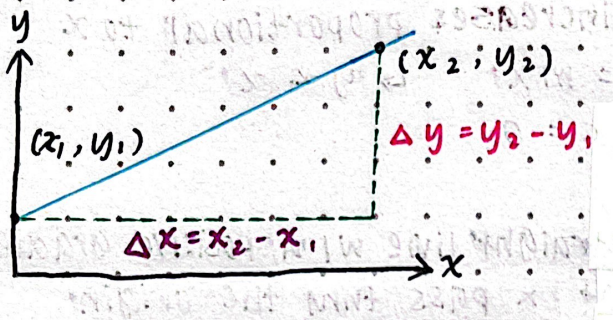
⑥ 

Type of graph : (i) A curve w/ a -tive gradient that x cut both axes
(ii) A straight line y against $\frac{1}{x}$ w/ a +tive gradient thru the origin
Relationship : (i) y is inversely proportional to x
(ii) y is directly proportional to $\frac{1}{x}$.

Analysing Graphs to Summarise an Investigation

① The relationship between two variables.
- Method: Interpret the shape of graph obtained

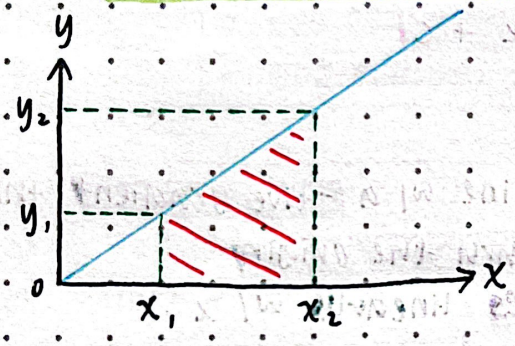
② The gradient of the graph.



Method:
Calculate the gradient of the graph,

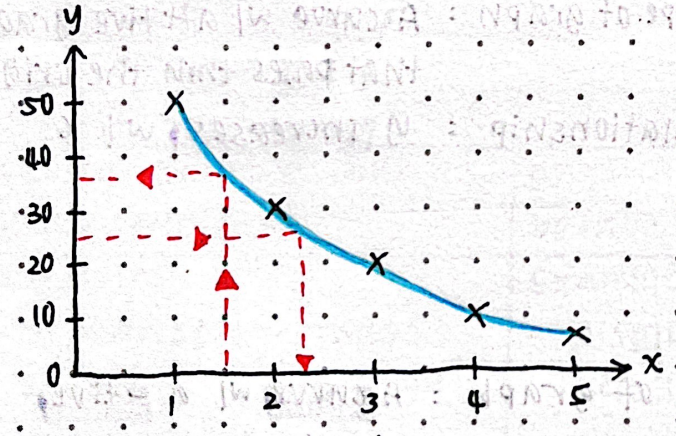
$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

③ The area under the graph



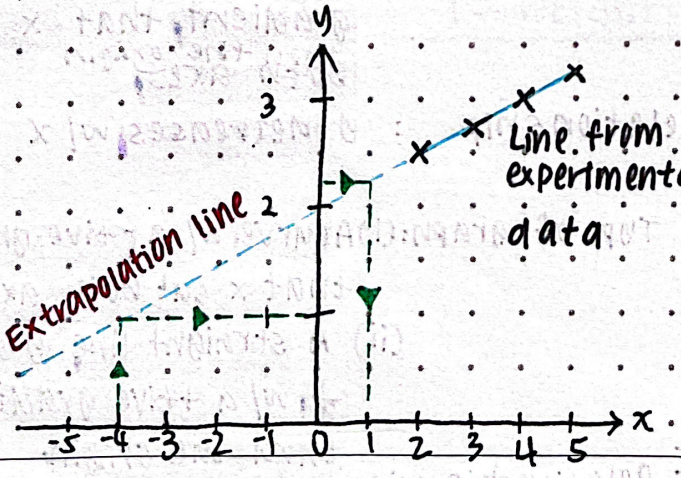
Method:
Calculate the area under the graph using the relevant formula for the area.

④ The interpolation to determine the value of a physical quantity



Method:
If the value of x is given, determine the value of y using interpolation + vice versa.

⑤ The extrapolation to make a prediction



Method:

Extrapolate the graph

↓

Determine the value of x + y concerned