"What one man calls God, another calls the laws of physics."

-Nikola Tesla

TOPIC 1: MEASUREMENTS

THE ABOUT

CHAPTER ANALYSIS

TIME

- Relatively easy chapter
- 2 **basic** concepts, 2 **key** concepts
- **Basic:** SI Units & Pre-fixes, Scalar & Vector

  Key: Vernier Caliper, Micrometer screw gauge

EXAM

- Usually tested in MCQs
- Fundamental for understanding physics units and calculations

WEIGHTAGE

- Light overall weightage
- Constitute to **0.5%** of marks for past 5 year papers

BASICS

SI UNITS

Base Quantity	Symbol	SI Unit	Symbol for SI Unit
Length	l	metre	m
Mass	m	kilogram	kg
Time	t	second	s
Temperature	T	Kelvin	K
Electric current	I	ampere	A
Amount of substance	n	mole	mol

K → Capital 'K'*

More for chemistry (Amount of substance)

*Small 'k' is prefix for kilo

Standard form: $a \times 10^n$
For eg, 73000 = 7.3×10^4

BASICS

PREFIXES

How to 'remember'	Base Quantity	Symbol	Magnitude	Numerical
Game apps are 'GB'	**G**iga	G	10^9	1 000 000 000
Pictures are in 'MB'	**M**ega	M	10^6	1 000 000
Rice is in 'kg'	**k**ilo	k (small 'k')	10^3	1 000
1 'deci'mal point	**d**eci	d	10^{-1}	÷ 10
1**c**m = ÷100 of 1m	**c**enti	c	10^{-2}	÷ 100
1**m**m = ÷10 of 1cm	**m**illi	m	10^{-3}	÷ 1 000
'micro'scope (small particle)	micro	μ (not u)	10^{-6}	÷ 1 000 000
Ironman suit is 'nano'-tech, really tiny particles	**n**ano	n	10^{-9}	÷ 1 000 000 000

*Tip: Increase by ^3

KEY CONCEPT

Not a difficult concept, but an important one.

But can you even name 5 of each?=)

TWO PHYSICAL QUANTITIES
SCALAR QUANTITIES
VECTOR QUANTITIES

SCALAR QUANTITY

A scalar is a physical quantity that has magnitude only.

Examples:
Distance
Speed
Time
Mass
Volume
Density
Energy
Pressure

VECTOR QUANTITY

A vector quantity is a physical quantity that have both **magnitude & direction.**

Examples:
Displacement
Velocity
Acceleration
Weight
Force

*To learn more in next chapter, 'Kinematics'

VECTOR QUANTITY

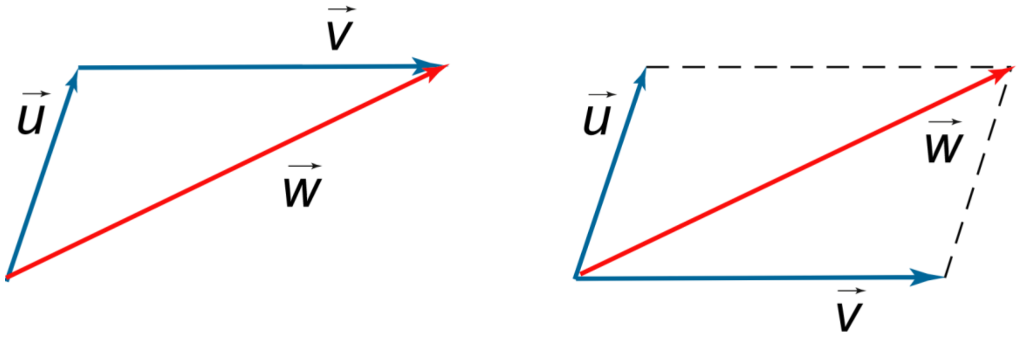
A vector quantity is a physical quantity that have both **magnitude & direction.**

Examples:
Displacement
Velocity
Acceleration
Weight
Force

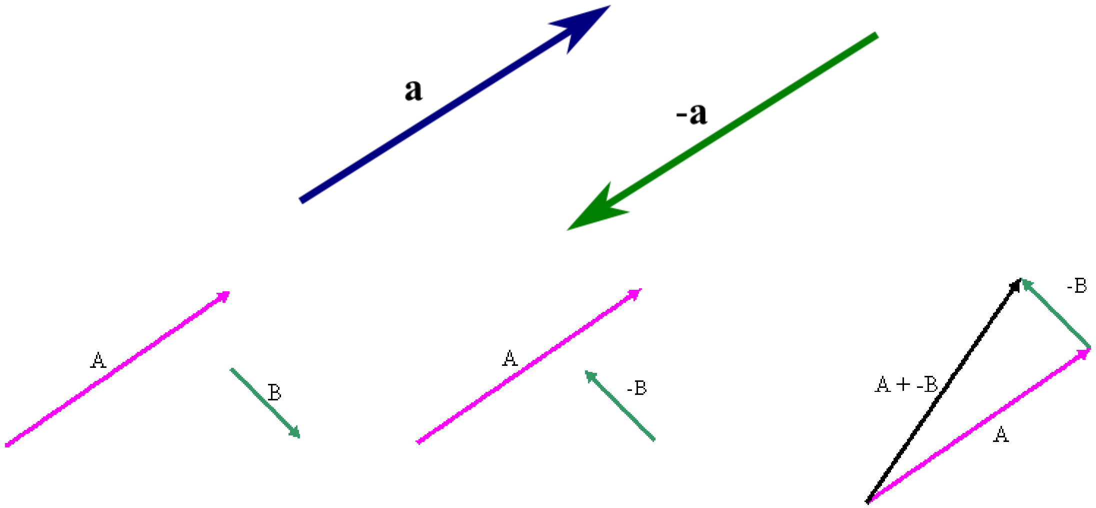
Drawing of vectors

A **vector** quantity can also be represented in a graphical form.

Addition:



Subtraction:

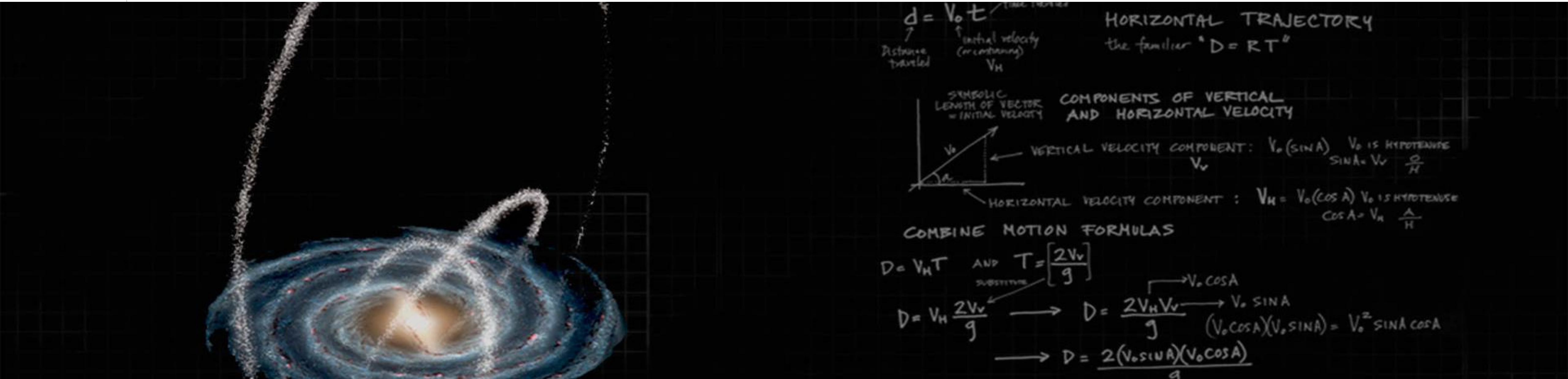


Don't worry too much, you will have a E-math chapter dedicated to this!

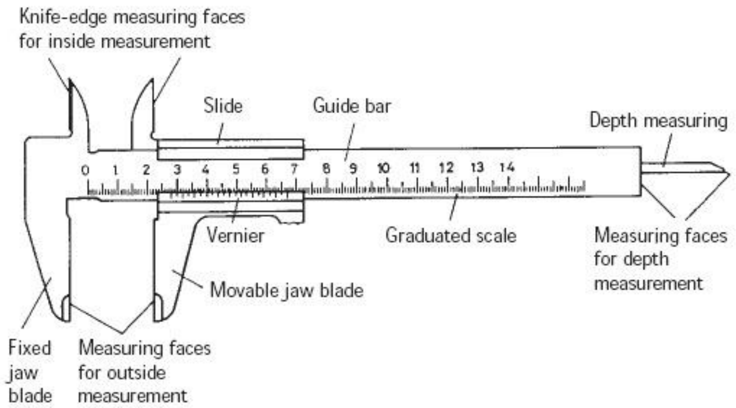
KEY CONCEPT

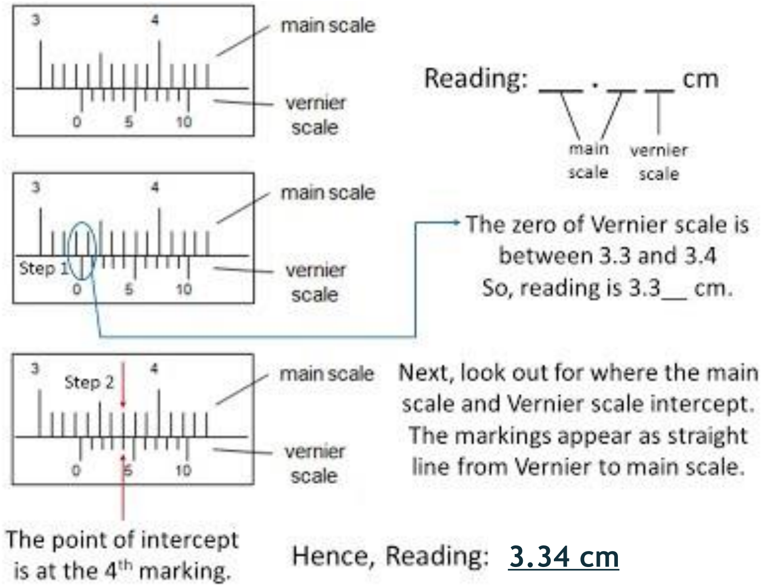
TWO INSTRUMENTS
VERNIER CALIPER
MICROMETER SCREW GAUGE

Two new instruments.
Know the difference.
Zero errors, simple math.



VERNIER CALIPER

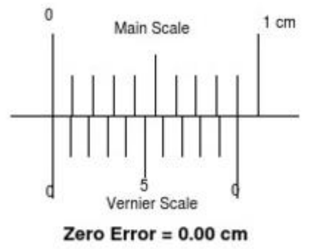
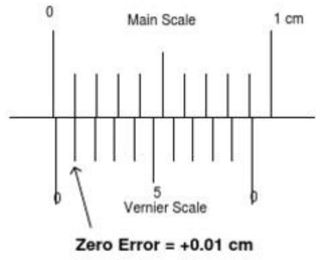
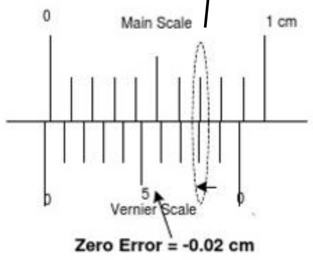




Zero error

For negative zero error, read from the back.

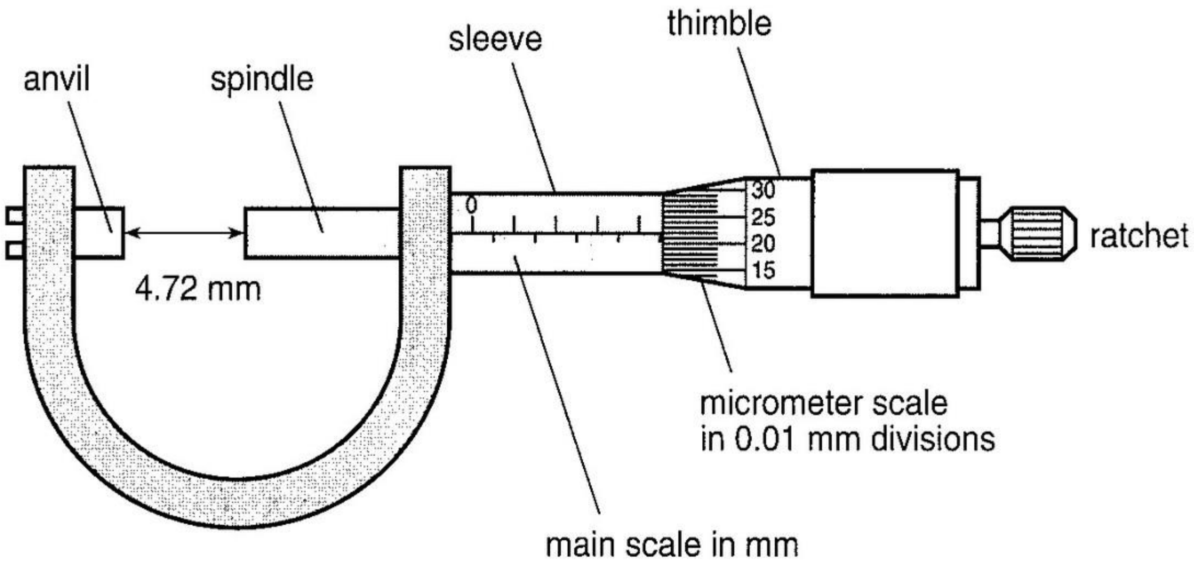
Zero error here is not 0.08cm, but **-0.02cm.**

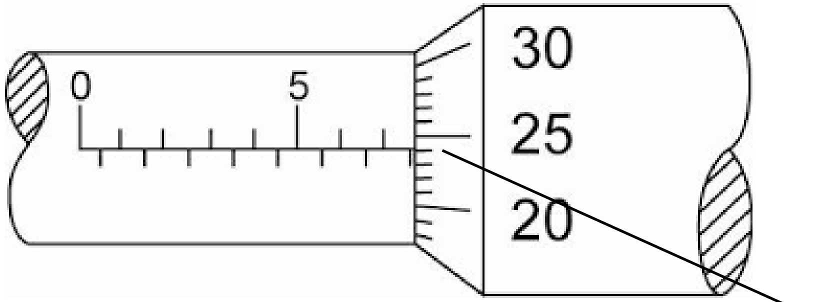
How to correct zero error		
		
No zero error if the '0' on both the main scale and the vernier scale is aligned.	When the vernier caliper is fully closed, there is an excess of +0.01cm. Hence, this a **positive zero error.**	When the vernier caliper is fully closed, there is a negative value of -0.02cm. Hence, this a **negative zero error**.
To rectify any zero error, **Measurement – (zero error) = actual value**		

Positive zero error:
Haven't even measure, there's already a reading.
Subtract that extra value away.

Negative zero error:
Haven't even measure, negative value already?
Plus in the necessary value to make up for it.

MICROMETER SCREW GAUGE

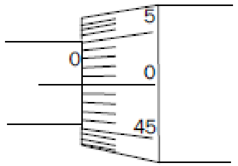
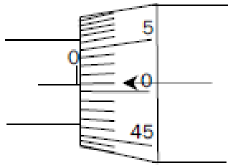
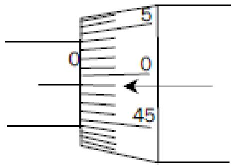




Correct reading is: **7.74 mm**

*Micrometer = _.__ **mm (answer in millimeter)**

What is more important is your ability to **identify** zero errors and knowing how to **rectify** it.

To correct for zero error (end error)		
1 Close the micrometer with nothing in between the anvil and the spindle.		
No zero error if '0' on both the main scale and circular scale are exactly in line 	zero error = +0.01 mm 	zero error = −0.01 mm 
2 Correct reading = scale reading − zero error		

For negative zero error, read from the back.

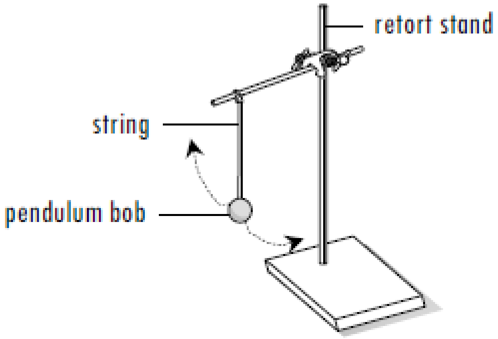
Zero error here is not 0.49mm, but **-0.01mm.**

USE LOGIC.

Positive zero error:
Haven't even measure, there's already a reading.
Subtract that extra value away.

Negative zero error:
Haven't even measure, negative value already?
Plus in the necessary value to make up for it.

PENDULUM BOB EXPERIMENT



Commonly tested question

1) **Why do we have to take reading for 20 oscillations and do it multiple times?**

During the starting and the stopping of the stopwatch, there is **human reaction time**. By increasing the number of oscillations and taking the average of the readings, we **reduce** the significance of that **random error** and obtain a more accurate value as a result.

The pendulum bob also starts to sway after 20 oscillations, hence 20 oscillations is an ideal number.

2) Does increasing the mass of the pendulum bob/ angle of swing affect the oscillation time?

No, the mass of the pendulum bob does not affect the time taken for the oscillation. Only the **length** of the string affects the time taken for the oscillation.

Similarly, the angle of swing of the pendulum has no effect on the time as well. *(Ideally, an angle of 5 degree is optimal for stability.)*

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