ملخص الوحدة الأولى Toolkit Physics منهج انسباير

Chapter 1

PHYSICS TOOLKIT

Section 1 : Methods of Science

What is physics?

Physics is a branch of science that study physical world: energy, matter and how they are related.

Scientific Methods

The pattern of investigation procedures.

1-The problem the question of "why" ,"what" or "how"

2- **Gather information** by Researching

3- Hypothesis /is a possible explanation for a problem using what you know and have observed

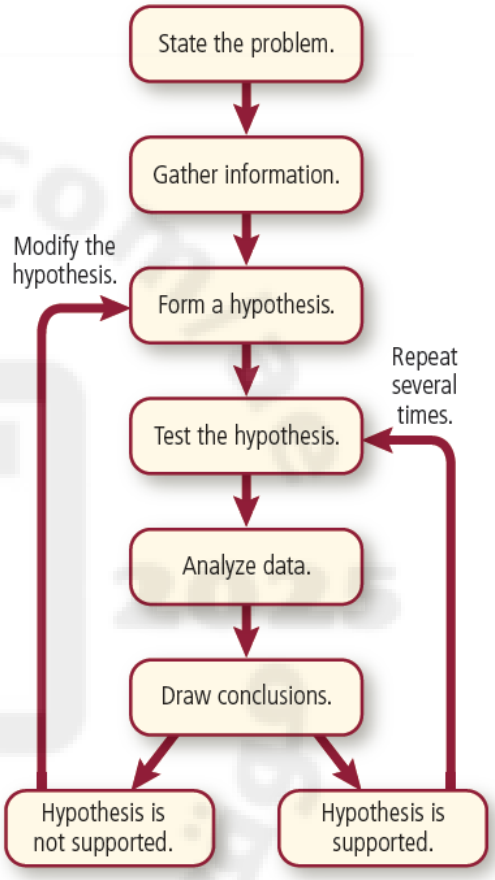
4- **Test hypothesis**: A hypothesis is a possible explanation for a problem using what you know and have observed.

- Hypotheses can be tested by different means:
  - Observations
  - Models
  - Experiments (investigation)

5- **Analyze the data** includes recording observations and organizing data into easy-to-read tables and graphs

6- **Conclusion** to decide whether the hypothesis is supported.

If the experiment does not support the hypothesis, the hypothesis must be reconsidered.



Models

A **model** is a representation of an idea, event, structure, or object that helps people better understand it.
Ex. Earth model, engine, bridge, and high-tech models (computer simulation)

Scientific Theories and Laws

A **scientific theory** is an explanation of things or events based on knowledge gained from many observations and investigations. but they don't explain why or how something happens.
A **scientific law** is a statement about what happens in nature and seems to be true all the time.

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The Limitations of Science

- Science cannot explain or solve every question.
- Questions about opinions, values or emotions are not scientific because they cannot be tested.

Section2 – Mathematics and Physics

We use math to express concepts in physics

The **SI (Systeme International d'Unites or SI.)** system of measurement uses seven base quantities.

The **base quantities** were originally defined in terms of direct measurements.

Other units, called **derived units**, are created by combining the base units in various ways .

Ex: velocity: **m/s** density: **Kg/m^3** force **N= kg.m/s^2**.

Base Quantity	Base Unit	Symbol
Length	meter	m
Mass	Kilogram	kg
Time	second	s
Temperature	Kelvin	K
Amount of substance	Mole	mol
Electric current	Ampere	A
Luminous intensity	candela	cd

Prefixes are used to change SI base units to powers of 10

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Prefixes Used with SI Units				
Prefix	**Symbol**	**Multiplier**	**Scientific Notation**	**Example**
femto-	f	0.000000000000001	10^{-15}	femtosecond (fs)
pico-	p	0.000000000001	10^{-12}	picometer (pm)
nano-	n	0.000000001	10^{-9}	nanometer (nm)
micro-	μ	0.000001	10^{-6}	microgram (μg)
milli-	m	0.001	10^{-3}	milliamps (mA)
centi-	c	0.01	10^{-2}	centimeter (cm)
deci-	d	0.1	10^{-1}	deciliter (dL)
kilo-	k	1000	10^{3}	kilometer (km)
mega-	M	1,000,000	10^{6}	megagram (Mg)
giga-	G	1,000,000,000	10^{9}	gigameter (Gm)
tera-	T	1,000,000,000,000	10^{12}	terahertz (THz)

Dimensional Analysis

You will often need to use different versions of a formula, or use a string of formulas, to solve a physics problem, This method of treating the units as algebraic quantities, which can be cancelled, is called **dimensional analysis**.

We use dimensional analysis for ….

1- Checking if the equation using for solving problems wright or wrong (the wright equation will have the same dimensions on its left and right sides) Ex. $x = v\,t + x_o$

- (m) = (m/s) (s) + (m) ➔ (m) =(m)

2- converting between SI units using conversion factor :A conversion factor is a multiplier equal to 1. For example, because 1 kg = 1000 g,

you can construct the following conversion factors:($1 = \frac{1kg}{1000g}$) or ($1=\frac{1000g}{1kg}$)

- Choose a conversion factor that will make the units cancel, leaving the answer in the correct units.For example, to convert 1.34 kg of iron ore to grams, do as shown below:

  $1.34kg\ X(\frac{1000g}{1kg}) = 1340g$,

  convert 800 g =……kg

- Convert 90 km/h into ……. m/s

  $\frac{90km}{1h} X(\frac{1000m}{1km})X(\frac{1h}{60min})X(\frac{1min}{60s}) = 25\ m/s$

Significant Figures.

- The measurement as 138.2mm, This measurement has four valid digits: three you are sure of, and one you estimated.
- The valid digits in a measurement are called **significant figures**.
- However, the last digit given for any measurement is the uncertain digit.
- All ***nonzero*** digits in a measurement **are significant**, but not all ***zeros*** are significant.

number	123	400	50001	0.0056	3.000	0.01230	9.0053	$4X10^2$	$1.2X10^{-4}$
significant figures	3	1	5	2	4	4	5	1	2

Arithmetic with significant figures: To **add** or **subtract** measurements: First perform the operation, then round off the result to correspond to the least-precise value involved.

3.86m + 2.4m =6.2~~6~~ m ~round~ **6.3**m

2.813 m +2.14 m = 4.95~~3~~ m -round– 4.95m

To **multiply** or **divide** measurements: Perform the calculation and then round to the same number of significant digits as the least-precise measurement.

- **Ex.** 409.2kg / **11.4L** = 35.8~~947368~~ ~round ~→ **35.9**kg/L

42.2 kg ÷ 5.5 L = 7.6~~72727~~ kg/L ~round~ → 7.7 kg/L

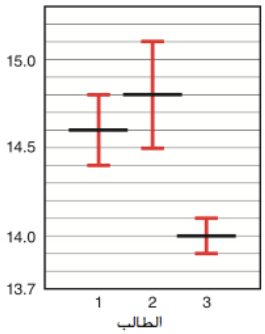
666 m X 3.2m = 21~~31.2~~ m^2 ~round ~ → 2100m^2

Section 3 - Measurement.

measurement is a comparison between an unknown quantity and a standard.

Measurement usually reported as **(12.3±0.05)**cm.

Ex. In an experiment done by 3 students



- Student1. (14.4cm ,14.8cm) average=14.6cm.

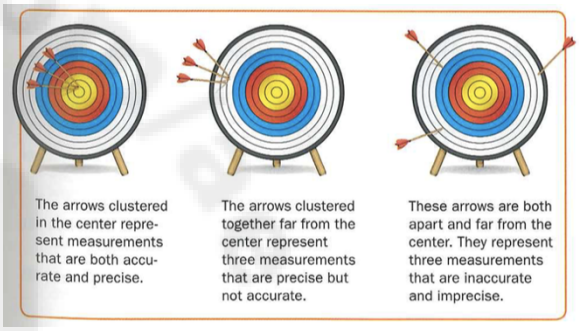
  →Result1:(14.6 ± 0.2)cm

- Student2 : →Result2:(14.8 ± 0.3)cm
- Student3 : →Result4:(14.0 ± 0.1)cm

Student1, and 2 are less precise because they have large uncertainty (0.2 , 0.3),but student3 is the most precise.

Precision is the degree of exactness of measurement.

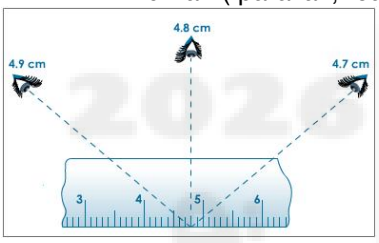
Accuracy describe how well results of measurement agree with the real value.



Error in measurement comes from

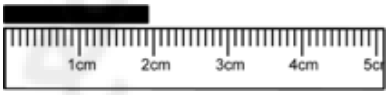
1- instrument (zero ,scales, not working well ..)

2- Human (parallax, reading, reporting, way of measuring)



Generally, the device with the finest division on its scale produces the most precise measurement.
The precision of a measurement is one-half (0.5) of the smallest division of the instrument.

(1.8±0.05)cm or (18±0.5)mm



Section 4 - Graphing Data

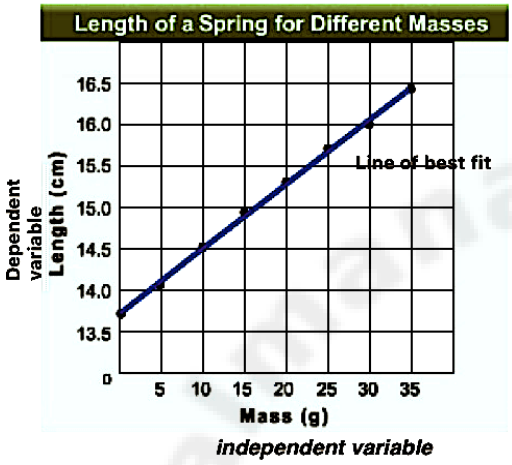
Identifying Variables.

- **Independent variables**: the factor that is changed or manipulated during the experiment.
- **Dependent variable** is the factor that depends on the independent variable.

- Scatter plots of data may take many different shapes, suggesting different relationships.

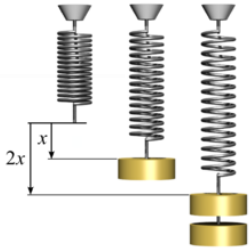
Three of the most common relationships include linear relationships, quadratic relationships and inverse relationships.

A- Liner releationships:



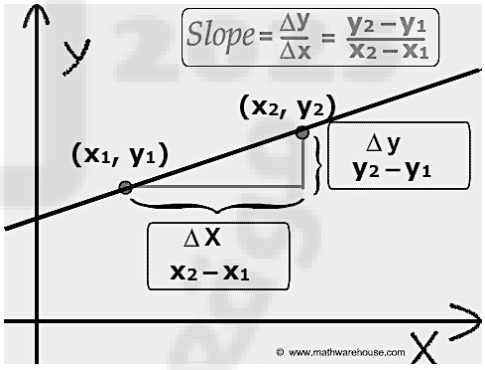
Length of a Spring for Different Masses

Mass Attached to Spring (g)	Length of Spring (cm)
0	13.7
5	14.1
10	14.5
15	14.9
20	15.3
25	15.7
30	16.0
35	16.4



The equation represinting **y=mx+b**

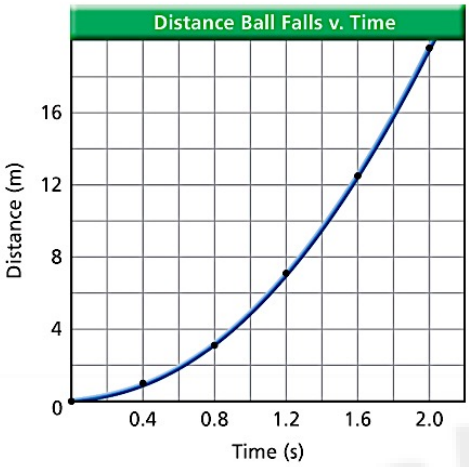
The **slope** **m=**$\frac{\Delta y}{\Delta x} = \frac{y2-y1}{x2-x1}$



B- Nonlinear Relationships

B1-quadratic relationship exists when one variable depends on the square of another

- .**$y=ax^2+bx+c$**



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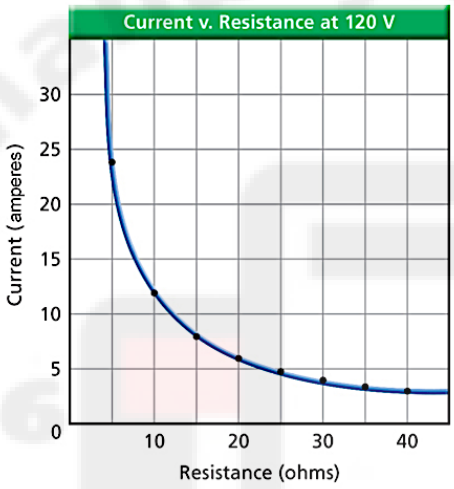
B2- inverse relationship, a hyperbola results when one variable depends on the inverse of the other



$$y=\frac{a}{x}$$

1. What is science?

……..……
……..

2. What is physics?

……..
……..

3. What are the steps of the scientific method?

……..
……..
……..
……..
……..
……..
……..

4. What scientist do if his hypothesis is not supported in the investigation?

……..
……..

5. Why scientists use models?

……..
……..

6. What is the difference between scientific theory and scientific law?

……..
……..

7- complete the table

base quantities	time			temperature	electric current	limns intensity	amount of substance
unit		kg	m				

8- what is the unit of velocity ? **velocity= displacement ÷ time**

9- What is the unit of density ? density= mass ÷ volume

10- convert units

- 30 Km =..... m
- 50 cm = ...m
- 50000 g = ...mg = ...µg
- 500 mA = ...A
- 100ms = ...s
- 4 Mm = ...m

11- How many significant figures are in each figure?

2000	1.9002	0.0055	8.00	321	$1.2X10^{3}$	$1.33 X10^{-6}$
…….	…….	……	…….	……	…….	……

12- Do arithmetic operation on significant figures

2.111 + 3.11 =…….

24.2 - 10.111=…….

1.22 X 3.2 =……

800 ÷ 4.2=…….

13- Which is <u>Accuracy</u>, and which is <u>Precision</u>?

..... refers to the closeness of a measured value to a standard or actual (true) value.

.....refers to the closeness of two or more measurements to each other

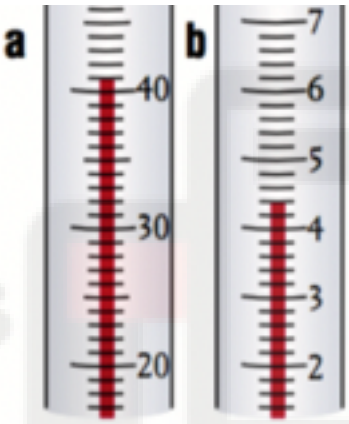
accuracy

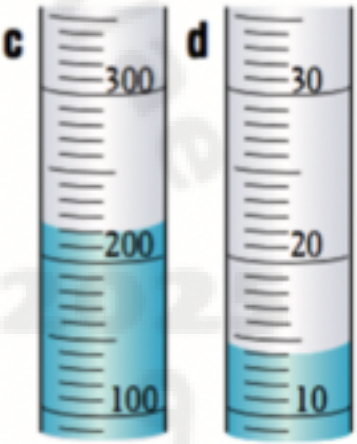
precision

14-A book length is 20.0 cm ,it had been measured by students . which group is accurate and which is precise?

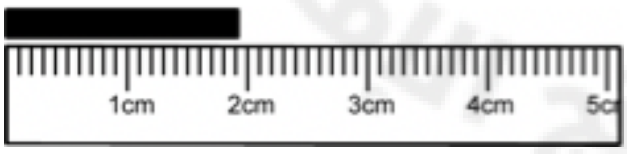
group A	***group B***	***group C***
19.7 cm	21.0 cm	20.4 cm
21.2 cm	21.1 cm	20.1 cm
20.6 cm	21.2 cm	19.8 cm

15- Look at the pictures and write the measurements.





3.6+0.1A

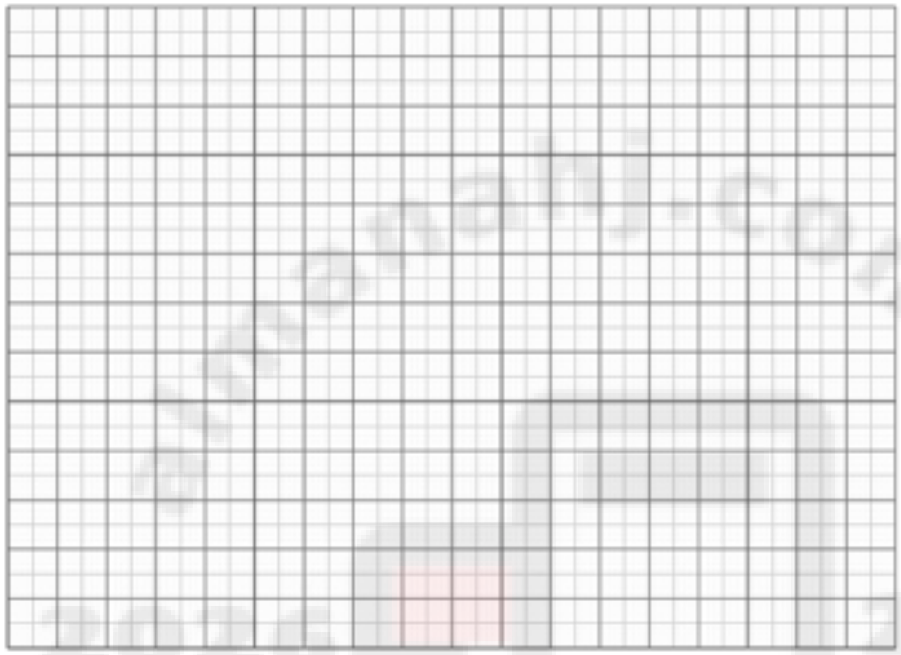


section4 - Graphing data

16- graph the following data .time is the independent variable .

time(s)	0	5	10	15	20	25	30	35	
velocity(m/s)	12	10	8	6	4	2	2	2	

Describe the graph.....



17-What is the slope of the graph?

A .0.25 m/s^2 B. 0.4m/s^2 C. 2.5m/s^2 D. 4.0 m/s^2