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Physics Reviewer Stem 12

Instrumentación y Control (John B. Lacson Foundation Maritime University)

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GENERAL PHYSICS

LESSON 1: MEASUREMENTS

- **Measurement**: art of comparing unknown values to a standard set of rules
- **Units of measurement**: standards in which physical quantities are expressed

TWO TYPES OF SYSTEMS OF UNITS

- Metric system: 1900s
- International System of Units (SI): 1960s

PHYSICAL QUANTITIES	
FUNDAMENTAL	***DERIVED***
Independent to one another	Computed using different formulas; combination of fundamental quantities
EX: length, time, mass, temperature, luminous intensity, electric current, amount of substance	EX: speed, acceleration, density, work, energy and etc.

FUNDAMENTAL QUANTITIES AND SI UNITS		
QUANTITY	***SYMBOL***	***UNIT***
Length	l	Meter (m)
Mass	m	Kilogram (kg)
Time	T	Second (s)
Electric current	I	Ampere (A)
Temperature	T	Kelvin (K)
Amount of substance	n	Mole (mol)
Luminous intensity	Subscript v denotes a photometric quantity	Candela (cd)

DERIVED QUANTITIES AND SI UNITS		
QUANTITY	***SYMBOL***	***UNIT***
Area	A	
Volume	V	
Density	ρ	
Speed/velocity	s/v (with arrow at the top)	m/s
Acceleration	a (with arrow at the top)	
Force/weight	F or W (with arrow at the top)	N or kg.
Pressure	P	Pa or N/
Work	W	J or N.m
Power	P	W or N.m/s

SCIENTIFIC NOTATION

- Convenient and widely used method to express large and small numbers
- IN TERMS OF THE EXPONENT: if exponent is **positive**, it means the number is **big** (move the decimal point to the left)**.** If the exponent is **negative**, it means the number is **small** (move the decimal point to the right)**.**

SIGNIFICANT FIGURES

- Digits that are known with certainty plus first uncertainty
- **RULE:** All nonzero digits are significant (1-9)
- **NOTE:** All zeros in between 2 significant digits are significant

To get the significant figures:

1. Locate the decimal place
2. Look for the first nonzero digit from left and count the no. of digit after
   Ex. 0.01030 > 4 significant figures
3. If the decimal point is absent, start from the right
   Ex. 130 010 200 > 7 significant figures

CONVERSION OF UNITS

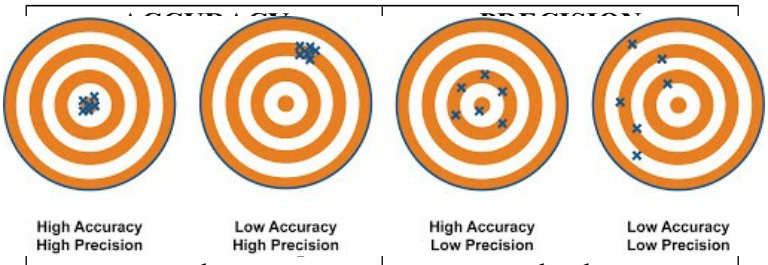
- The process of changing a value expressed in one type of unit to another unit

LENGTH		MASS		
1 km	1000 m	1 kg	1000g	2.21lb
1 m	100 cm	1 g	100 mg	
1 cm	10 mm	1 slug	14.59	
1 in	2.54 cm	1 metric ton	1000 kg	
1 ft	12 in	**AREA**		
1 m	1.094 yd	1	10.76	
1 m	3.28 ft	1	929	
1 m	39.370 in	1 ha	10 000	2.471 acres
1 m	6.214xmi	1 acre	43 560	
1 mi	1.61 km	1	1 000 000	
1 dm	10 m	1	10 000	
1 Hm	10 dm	**VOLUME**		
1 km	10 Hm	1 mL	1 cc or	
1 mm	1000 km	1 L	1000 mL	1.057 qt
1 Gm	1000 mm	1	1000 L	35.31
		1	7.481 gal	28.32 L
		1 gal	3.785 L	
		1 L	1	

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ACCURACY AND PRECISION



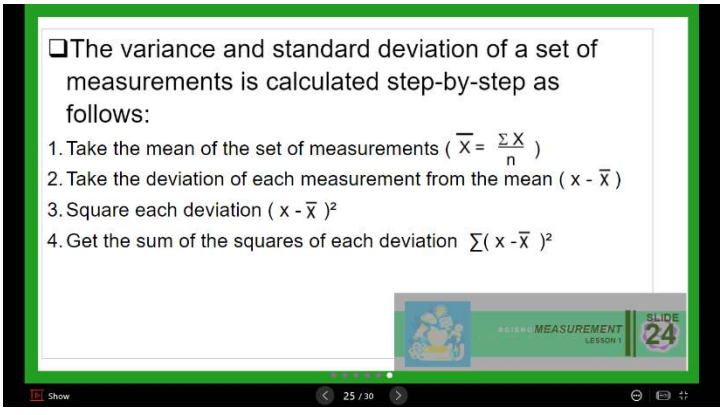
ACCURACY	PRECISION
value	each other

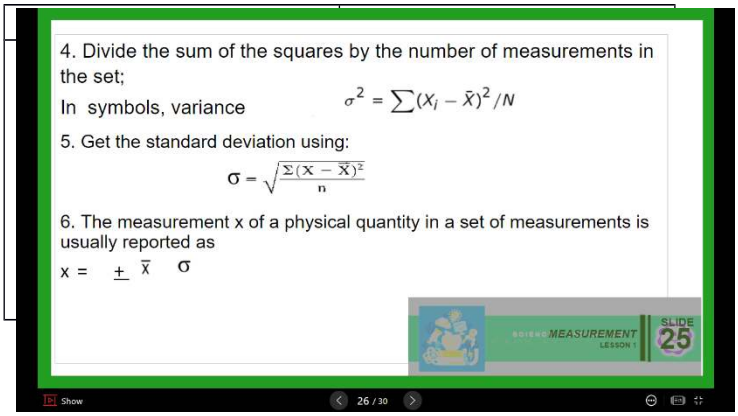
- **Errors:** are deviation of measured value from the expected true value. Also the difference between the actual value and calculated value of any physical quantity.

RANDOM ERRORS	SYSTEMATIC ERRORS
Results from unpredictable changes during data measurement	Comes from measuring instruments in the design of experiment itself or incorrect handling of instruments
*can occur in **measuring instruments** or **environmental conditions**	*when there is **something wrong about the instrument** or because the **instrument was wrongly used**
Unavoidable in an experiment, almost natural	One that can be lessened

ESTIMATING ERRORS USING VARIANCE

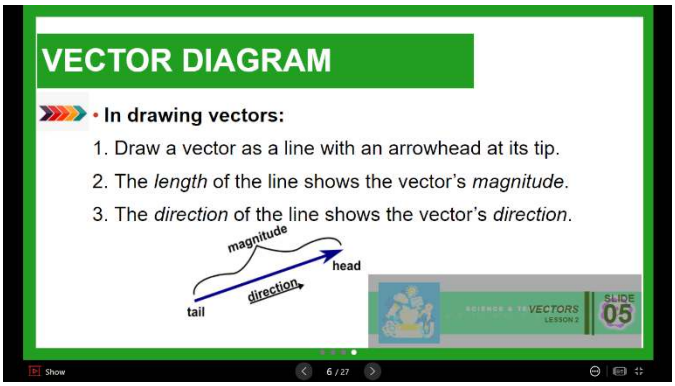
- **Variance:** measures the squared deviation of each number in the set of a mean
- **Standard deviation:** how diverse or spread out are a set of measurements from their average

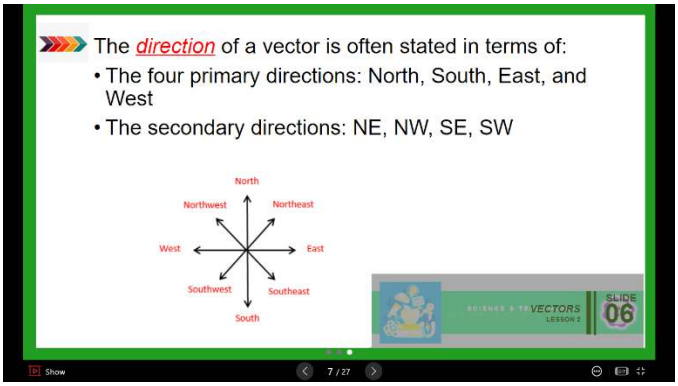




VECTOR DIAGRAM

- A vector is represented by an arrow
- **Length of the arrow:** magnitude
- **Head of the arrow:** direction

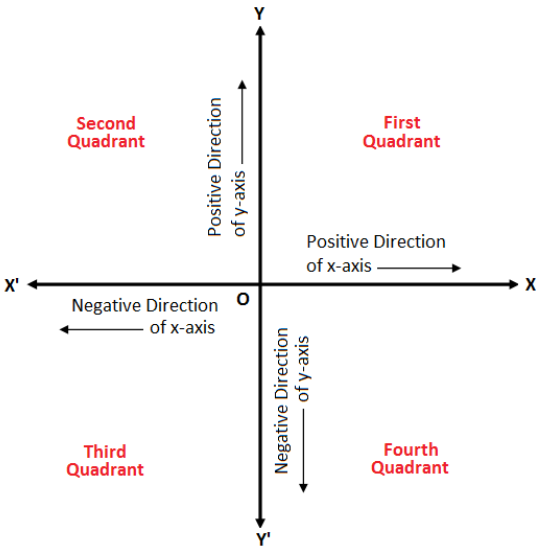




LESSON 2: VECTORS

SCALAR	VECTOR
Don't need directions, only described by their	Described by both magnitude and directions

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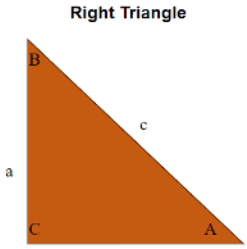


VECTOR ADDITION

- The process of finding a single vector which will produce the same effect produced by the given vectors.
- **Resultant:** single vector
- **Two ways to solve:** graphical and analytical

GRAPHICAL
Also known as polygon or head-to-tail method
Where vectors are connected until the resultant vector is determined
***scale** is used to show greater value
STEPS: - Draw the first vector - Connect the second vector's arrowhead to the tail of the first vector - Add their magnitudes if they are at the same direction - Subtract their magnitudes if they are at the opposite directions - Use protractor to determine the direction of the resultant
***Note: resultant is always drawn at the tail first up to the arrowhead of the last vector**

ANALYTICAL	
The inverse of graphical method	
Requires the concept of trigonometry as well as its idea of the components.	
***trigonometry:** observes the relationship of sides of and angles of triangles	
Sine	
Cosine	
Tangent	



It has sides a, b, and hypotenuse c. With reference to angle ɵ A, side ***b*** is called ***adjacent side*** and ***a*** as ***opposite side.***

$\sin \theta = o/h = a/c$

$\cos \theta = a/h = b/c$

$\tan \theta = o/a = a/b$

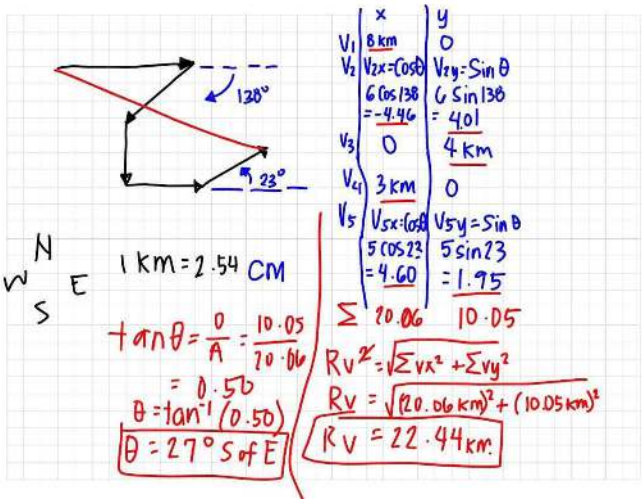
The **hypotenuse (c)** can be determined if the sides (a) and (b) are given using the Pythagorean theorem. From elementary geometry, the hypotenuse is found as:

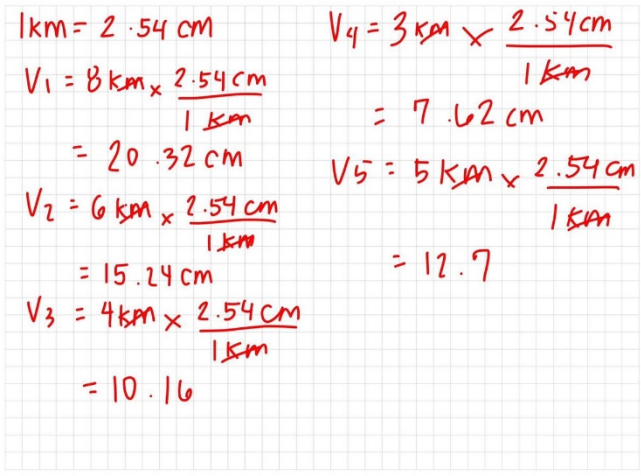
$$c^2 = a^2 + b^2$$

The **angle (ɵ)** is found from the definition of the tangent function:

tan ɵ = o/a = a/b , ɵ = tan^-1 a/b

SOLVING USING ANALYTICAL METHOD





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LESSON 3: KINEMATICS

Kinematics

- The motion of objects without references to forces
- Study of motion without delving into what caused the motion
- Science that describes motion using words, diagrams, numbers

Motion

- Change in position with respect to reference point
- Always relative
- **Reference frame:** a physical entity to which the position and motion of an object is relative
- **Translational:** motion along a line or a curve
- **Rotational:** motion that changes the orientation of a body; when an object spins

KINEMATIC QUANTITIES

Time	Change or interval over which change occurs
	SI unit: second (s)
Distance	Length of an actual path taken to go from source to destination
	SI unit: meter (m)
	= + …
	d = s * t
Displacement	Length of the **straight line** joining the source to the destination
	Use of Pythagorean theorem
	SI unit: meter (m)
Speed	Distance covered by an object in a given time
	S = d/t
	SI unit: m/s
Velocity	Rate of an object's displacement over time
	V (with arrow at the top) = d (with arrow at the top)/time
	SI unit: m/s
Acceleration	Rate of change in velocity
	SI unit:
	*when a moving body changes its velocity, the body is said to be moving with constant acceleration

FREE FALL

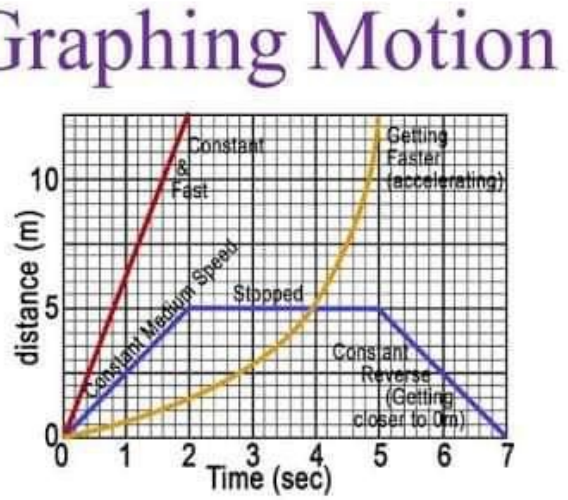
- Motion caused only by gravity
- All objects fall at the same time
- Presence of gravity, absence of air resistance
- From starting point going down > velocity of the object will increase
- **Acceleration of gravity:**

USE OF FORMULAS	
= + gt	to determine the velocity of a falling object after time
d =) g	to calculate the distance fallen after a time
= (+)	
d = (+) t	
d = t + g	
= + 2gd	

GRAPHING MOTION

Graph: used in analysis of the motion of the body and gives a representation of the motion of an object

TYPES OF GRAPHS	
DISPLACEMENT VS. TIME	***VELOCITY VS. TIME***
Rise: y axis = displacement	**Rise:** y axis = velocity
Run: x axis = time	**Run:** x axis = time
Find the slope to identify the velocity	Find the slope to identify the acceleration



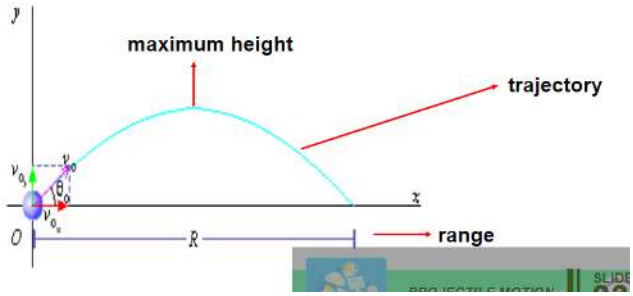
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LESSON 4: PROJECTILE MOTION

V = magnitude of velocity and θ = direction

- Two dimensional motion of an object
- Combination of uniformly horizontal motion and free fall

a. **Projectile –** an *object* being thrown horizontally or at some angle with respect to the horizontal
b. **Trajectory** – curved path of a projectile
c. **Range** – horizontal displacement where the projectile lands
d. **Maximum height** – where the vertical component of the projectile becomes zero (thrown at certain angle, thrown at certain height)



TWO COMPONENTS OF A PROJECTILE	
VERTICAL	***HORIZONTAL***
Motion of a freely falling object	Always constant
Changes with time	Gravity free path
Affected by gravity	
= + gt	= 0 (no change in velocity)
= + 2g	= constant
****independent to one another***	
***object going up:** velocity is decreasing ***object going down:** velocity is increasing	

FACTORS THAT AFFECT PROJECTILE MOTION	
initial velocity	Because of the amount of forcer exerted into it. The more force use, the farther the object.
angle	Determine where the object lands
***Note:** the lesser the air resistance is, the farther the object will land. The higher the air resistance, the nearer the object lands.	

TO ANALYZE PROJECTILE MOTION

***Always constant** / θ means theta	
v= vi cos θ	v= vi sin θ
Where:	

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