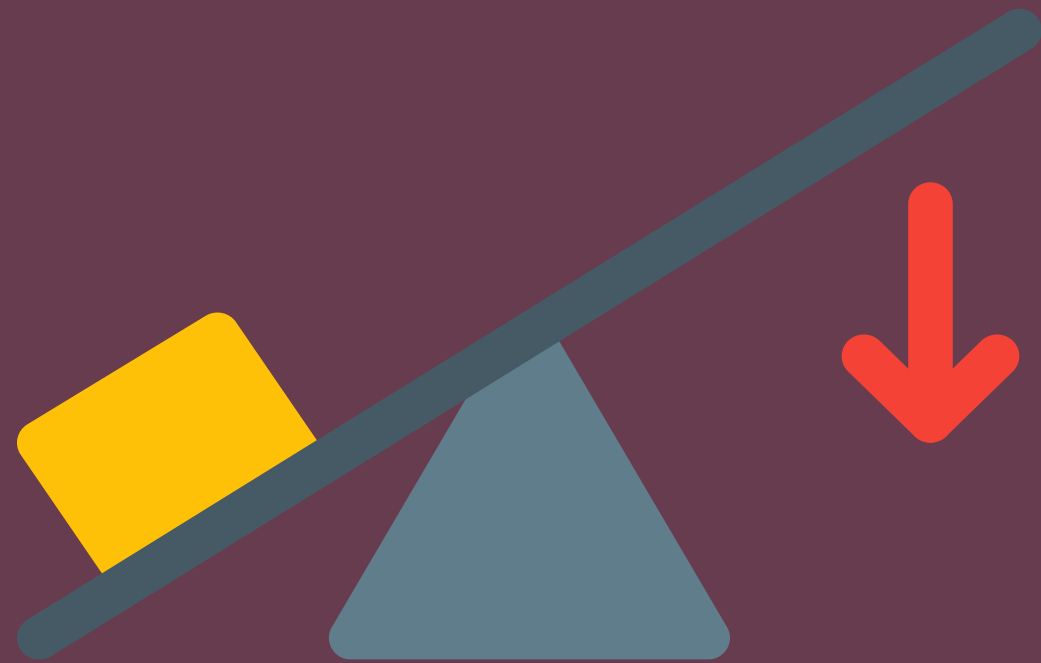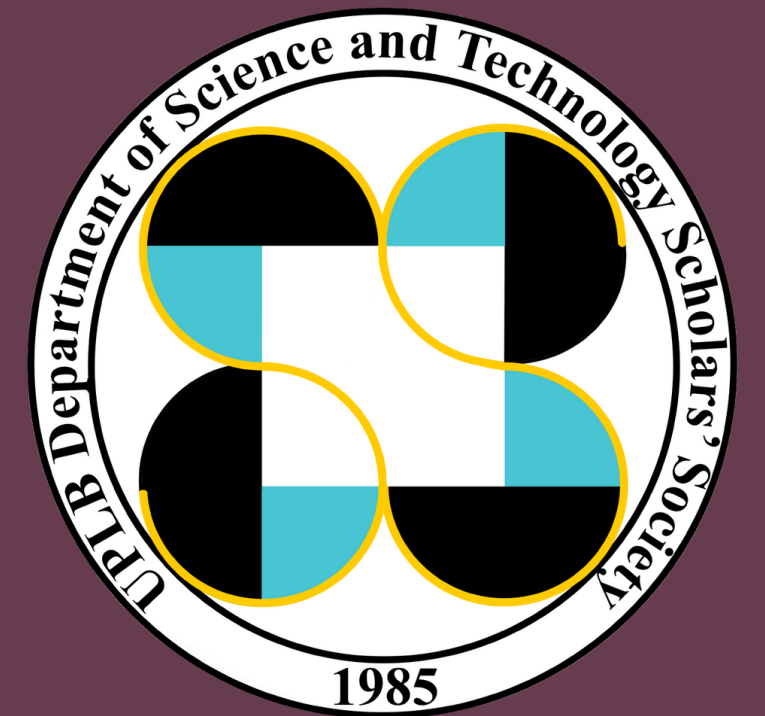SCIENCE, ENGLISH, MATHEMATICS
ENRICHMENT PROGRAM 2021

PHYSICS

UPLB Department of Science and Technology Scholars' Society

1985
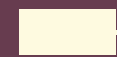
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Measurements

UPLB Department of Science and Technology Scholars' Society

1985
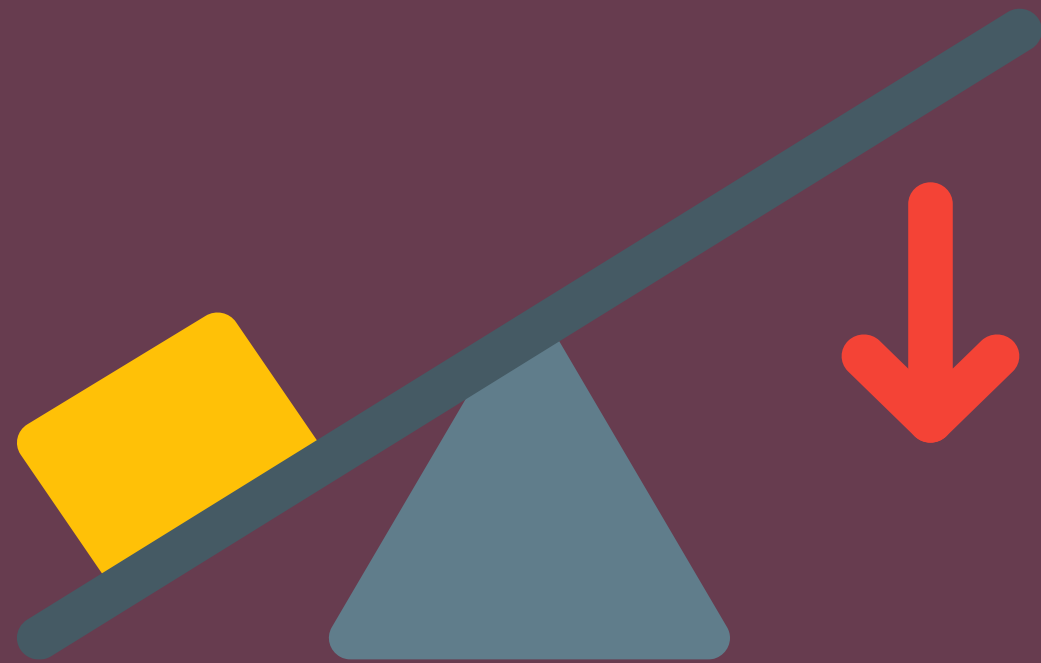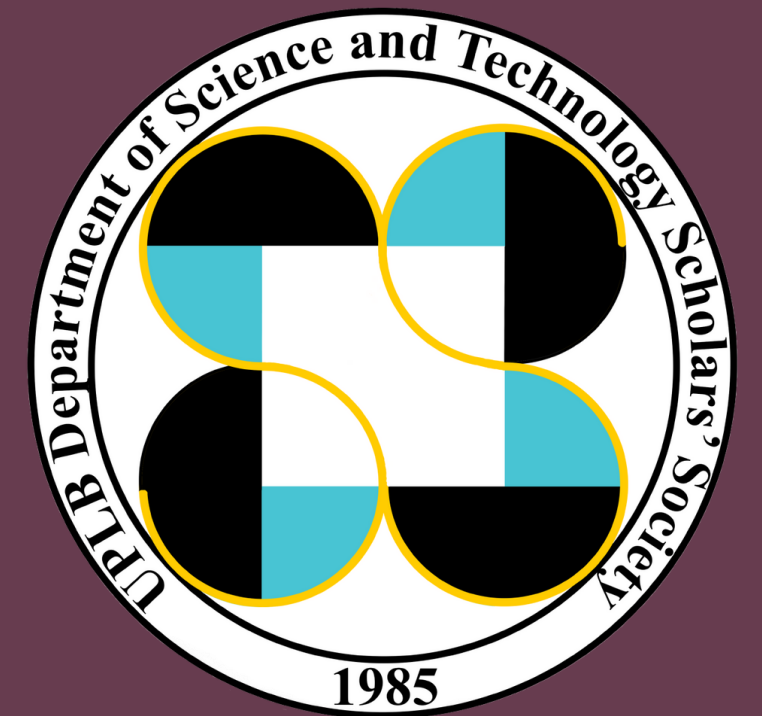
How to Use This Material

- To **refresh your memory** of content

- To **familiarize you** on how the topic might be incorporated into this year's entrance tests and DOST exam **(if there are any!)**

- To **support (not replace!)** your own in-depth review of measurements

Things to Keep in Mind

- I will make mistakes. It's unavoidable.
- You can ask questions and raise clarifications, just comment them below or message us.
- Mental health is more important than exam prep!

Topics Covered

01

BASIC QUANTITIES

- **Physical quantity** is any number that is used to describe a physical phenomenon.
- **Units are very important!**

Basic Quantity	Example of Units
Length (l)	**m, cm, in, ft, mi**
Mass (s)	**g, kg, lb, ton, amu**
Time (t)	**s, min, h, day, year**

DERIVED QUANTITIES

- They are obtained by **combining** basic quantities.

VOLUME

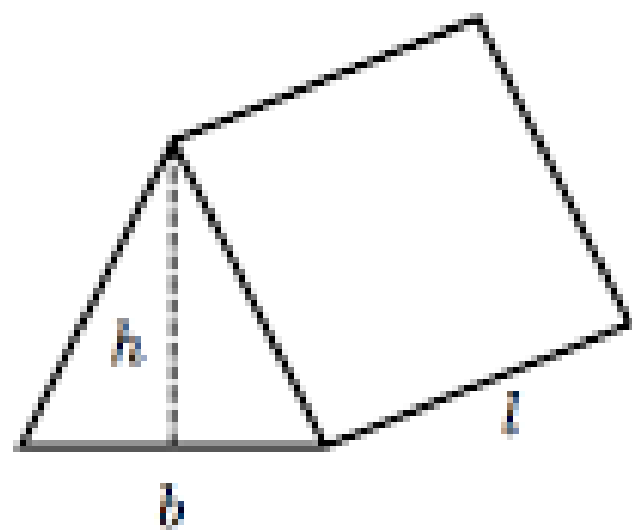- Amount of space an object takes up
- Expressed in cubic units (m^3 , cm^3, in^3, **etc.)**

DENSITY

- A substance's mass per unit volume
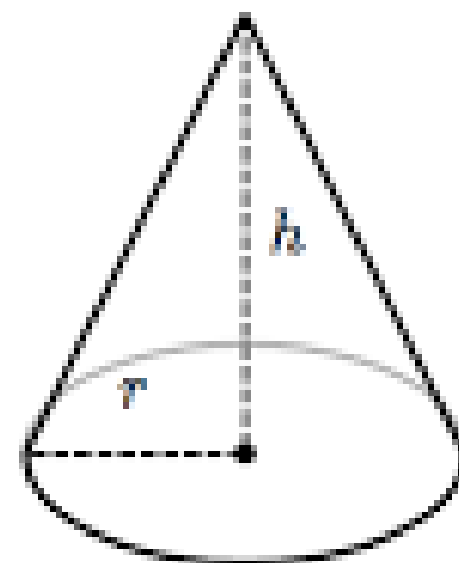- SI Unit: kilogram per cubic meter (kg/m^3)

$$V = a^3$$

$$\rho = \frac{m}{V}$$

$$V = \frac{b \cdot h \cdot l}{2}$$
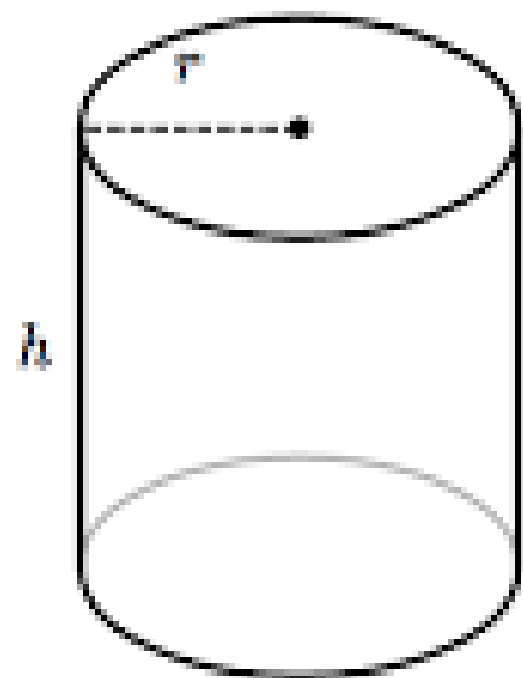
$$V = \pi r^2 h$$

$$V = \frac{\pi r^2 h}{3}$$
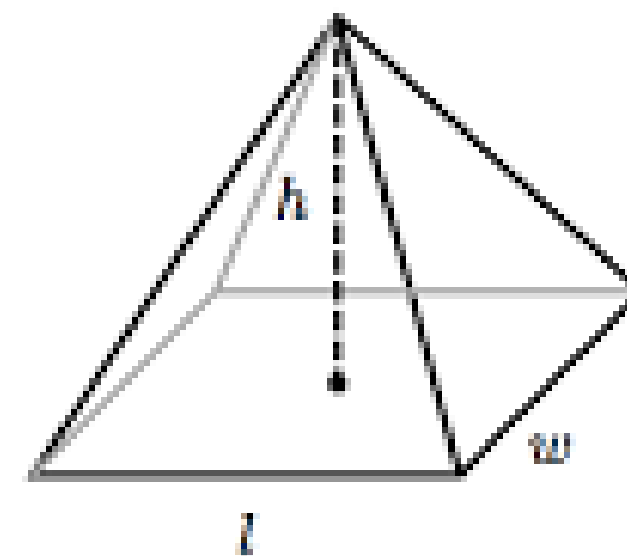
$$V = \frac{l \cdot w \cdot h}{3}$$
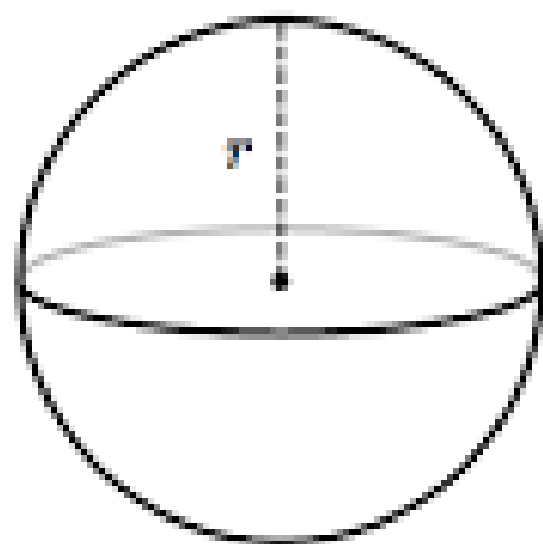
$$V = \frac{4}{3}\pi r^3$$
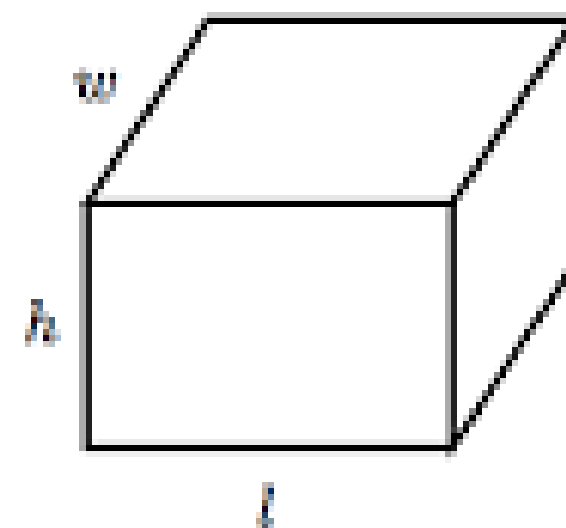
$$V = l \cdot w \cdot h$$

Quick Exercise 1

If the radius of a cylinder is doubled. What will happen to its volume?

a. Doubled
b. Quadrupled
c. Halved
d. Stay the same

Topic 3: Units of Measurements

SI UNIT

Physical quantity measured	Base unit	SI abbreviation
Amount of substance	mole	mol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Thermodynamic temperature	kelvin	K
Electric current	ampere	A
Luminous intensity	candela	cd

Topic 3: Units of Measurements

SI Prefixes

Factor	Name	Symbol	Factor	Name	Symbol
10^{24}	yotta	Y	10^{-1}	deci	d
10^{21}	zetta	Z	10^{-2}	centi	c
10^{18}	exa	E	10^{-3}	milli	m
10^{15}	peta	P	10^{-6}	micro	μ
10^{12}	tera	T	10^{-9}	nano	n
10^{9}	giga	G	10^{-12}	pico	p
10^{6}	mega	M	10^{-15}	femto	f
10^{3}	kilo	k	10^{-18}	atto	a
10^{2}	hecto	h	10^{-21}	zepto	z
10^{1}	deka	da	10^{-24}	yocto	y

We can use mnemonic variables instead...

Topic 4 : Conversion of Units

Length	Mass	Time	Volume
1 ft = 12 in 1 in = 2.54 cm 1 mi = 5280 ft 1 cm = 10 mm 1 m = 100 cm = 1000mm 1 km = 1000 m = 100000 cm $1 \, km^2 = 1000000 \, m^2$ $1 \, km^3 = 1000000000 \, m^2$	1 kg = 1000g 1 g = 1000 mg 1 kg = 2.2lbs	1 year = 365 days 1 day = 24 h 1 h = 60 mins 1 min = 60 s 1 h = 3600 s	1 L = 1000 mL 1000 mL = $1000 \, cm^3$ 1 mL = $1 \, cm^3$

Topic 4 : Conversion of Units

In conversion of units, we use **equations**.

Equations express **relationship** among physical quantities.

Equations must be **dimensionally consistent**.

100 **m** + 200 **in** = 300 **??**

Topic 4 : Conversion of Units

Dimensional Analysis can be used to:

- **Derive** an equation
- Check if the equation is **dimensionally correct**
- Know the **units or the dimension** of the physical quantity

Example on Dimensional Analysis

Check whether the equation is correct: $s = vt + \frac{1}{2}at^2$

Use

$s = Length$ $\qquad$ $m = Mass$

$v = \dfrac{Length}{Time}$ $\qquad$ $t = Time$

Quick Exercise 2

According to the song Live Like We're Dying, how many seconds are there in a day?

Topic 4 : Significant Digits

Rules:

1. Nonzero digits are always significant.

Topic 4 : Significant Digits

Rules:

2. All final zeros after the decimal points are significant.

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Topic 4 : Significant Digits

Rules:

3. Zeros between two other significant digits are always significant.

16

Topic 4 : Significant Digits

Rules:

4. Zeros used solely for spacing the decimal point are not significant.

17

Topic 4 : Significant Digits

Rules:

5. In addition and subtraction, round up your answer to the less precise measurement.

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Topic 4 : Significant Digits

Rules:

6. In multiplication and division, round it up to least number of significant digits.

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Quick Exercise 3

How many significant digits do 1020.001 have?

Best way to review is to solve actual problems…

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Solved Problems

iPadCutie. Kylie is on hunt to buy a new gadget. He is looking for a low-density gadget for convenience. Assuming that all masses are equal, which of the following will have the lowest density?

a. An iPad Air (V=18 in^3)
b. An iPad Mini (V=12 in^3)
c. An iPhone (V = 3 in^3)
d. An iPod Touch (V = 2 in^3)

Solved Problems

Dapat Consistent! If ρ has a unit of $\left[\mathrm{kg/m^3}\right]$, v has a unit of $[\mathrm{m/s}]$, D has a unit of $[\mathrm{m}]$ and R is unitless, what is the unit of μ in the equation $R = v\rho D/\mu$?

A. unitless

B. $\dfrac{\mathrm{kg}}{\mathrm{m} \cdot \mathrm{s}}$

C. $\dfrac{\mathrm{kg} \cdot \mathrm{m}}{\mathrm{s}}$

D. $\dfrac{\mathrm{kg} \cdot \mathrm{s}}{\mathrm{m^2}}$

Solved Problems

Edi Wow. In a foreign land, $1 \, \text{edi} = 13.67 \, \text{m}$ and $1 \, \text{wow} = 28.41 \, \text{s}$. What is $5.00 \, \text{m/s}^2$ in units of edi/wow^2?

      A. $10.4 \, \text{edi/wow}^2$

      B. $295 \, \text{edi/wow}^2$

      C. $8.47 \times 10^{-2} \, \text{edi/wow}^2$

      D. $2.41 \, \text{edi/wow}^2$

Solved Problems

Tinimbang ka ngunit kulang. The weight of a computer on earth is 20.0 N. What is the weight of the same computer if it is placed at the surface of Jupiter's moon Io? The acceleration due to gravity in Io is 1.81 m/s^2.

A. 3.69 N   B. 11.0 N   C. 36.2 N   D. 4.90 N

Solved Problems

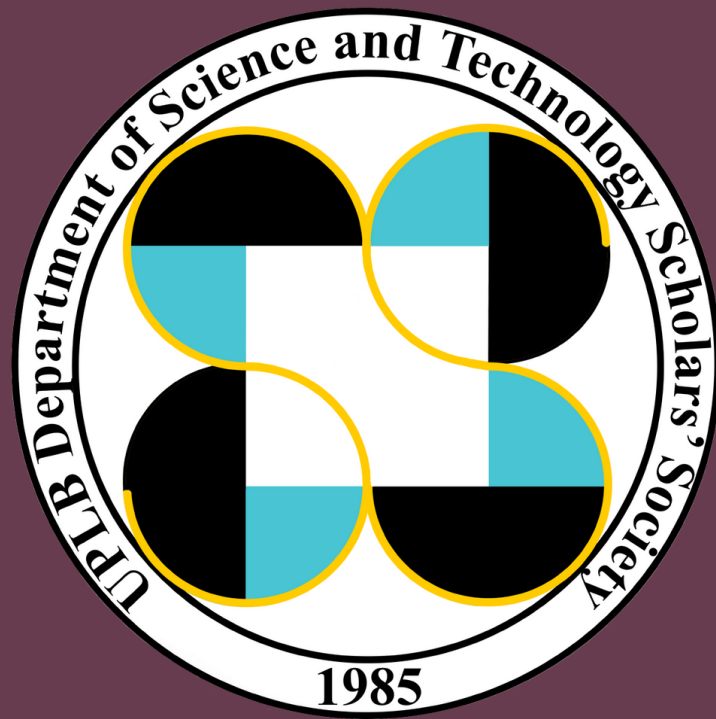**Dimensyon.** In simple harmonic motion, the frequency is given by

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

where π is a dimensionless constant. If the unit for m is in kg and the unit for f is in s^{-1}, what should be the unit of k for the equation to be dimensionally consistent?

    A. $\mathrm{N/m^2}$

    B. $\mathrm{N/m}$

    C. $\mathrm{N \cdot m}$

    D. $\mathrm{N/(m \cdot s)}$