PHYS 107 - Week 1 - Wednesday

* Introductions
* Which physics courses are there?
  - PHYS 101/102 : calculus-based
  - PHYS 107/108 : algebra-based
  - PHYS 171/172 : astronomy
* Syllabus: premed → lab is required
* What is physics?

"Mathematical description of the inanimate world"
- empirical → tested by experiments
- foundational → physics → chemistry → biology
  → engineering
  → astronomy
- universal: from proton (10^{-15} m) to galaxy (10^{22} m)
  femto second (10^{-15} s) to universe (15×10^9 y)
- limitations: no ethics, no aesthetics

* Classical versus modern physics

< 1905 | > 1905

1905 : Einstein : quantum mechanics (transistors)
general relativity (GPS)

* Units :

all measurements have units !

SI / MKS system :

Time	:	second, s
Length	:	meter, m
Mass	:	kilogram, kg
Temperature	:	Kelvin, K
Electrical Current	:	Ampère, A
Luminous Intensity	:	candela, cd

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Derived units : Power : Watt, $\frac{kg \cdot m^2}{s^3}$

Energy = Power · Time

Joule, $\frac{kg \cdot m^2}{s^2}$

Acceleration = Length / Time^2, $\frac{m}{s^2}$

Force = Mass · Acceleration

Newton, $\frac{kg \cdot m}{s^2}$

Question Basic 4

* Unit conversion : "multiply by 1"

$$30\ \text{mpg} = \left(30\ \frac{\text{miles}}{\text{gallon}}\right) \times \left(\frac{1.609\ \text{km}}{1\ \text{mile}}\right) \times \left(\frac{1\ \text{gallon}}{3.786\ \ell}\right)$$

$$= 12.8\ \text{kg}/\ell$$

* Scientific notation

10^{9} : giga, G
10^{6} : mega, M
10^{3} : kilo, k
10^{-2} : centi, c
10^{-3} : milli, m
10^{-6} : micro, μ
10^{-9} : nano, n
10^{-12} : pico, p

Question Basic 3 : 10^{5} in IES notation

Question Basic 2 : $1\ m^3 = x\ cm^3$?

* Scaling Laws:

1) why aren't ants bigger? Scifi ...
ecoskeleton = chitin

ant 1 | ant 2
$L_1 = 1\,cm$ | $L_2 = 1\,m$

↓

Weight ~ Volume ~ $(Length)^3$
Strength ~ Area ~ $(Length)^2$

↓

Relative Strength ~ $\frac{Strength}{Weight}$ ~ $\frac{1}{Length}$

→ ant 2 has a relative strength that is 100× smaller

2) Cell viability . radius R = length

Oxygen use ~ Volume ~ R^3
oxygen absorption ~ Area ~ R^2

↳ Viability factor ~ $\frac{Area}{Volume}$ ~ $\frac{1}{R}$

→ larger cells are less viable

(Note: nerve cells)