Measurement

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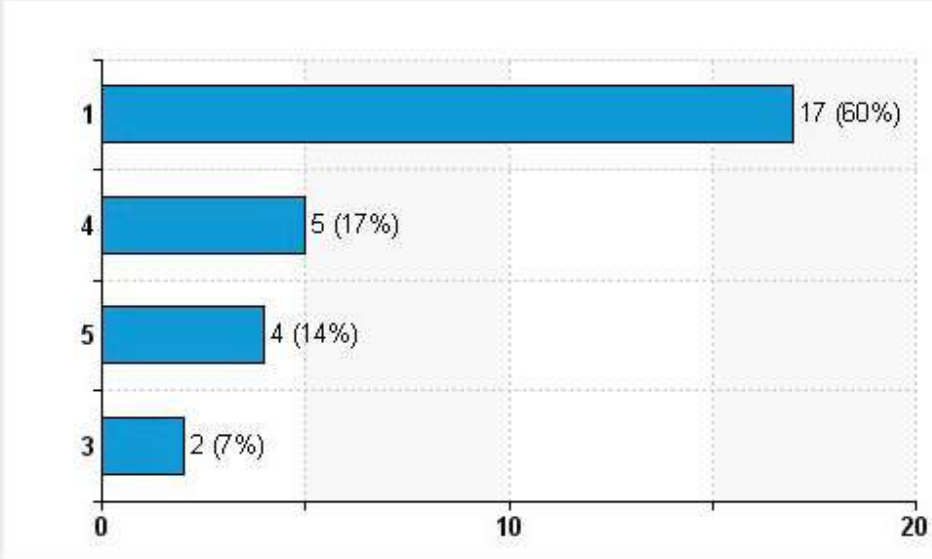
PHYS 211, Fall 2015

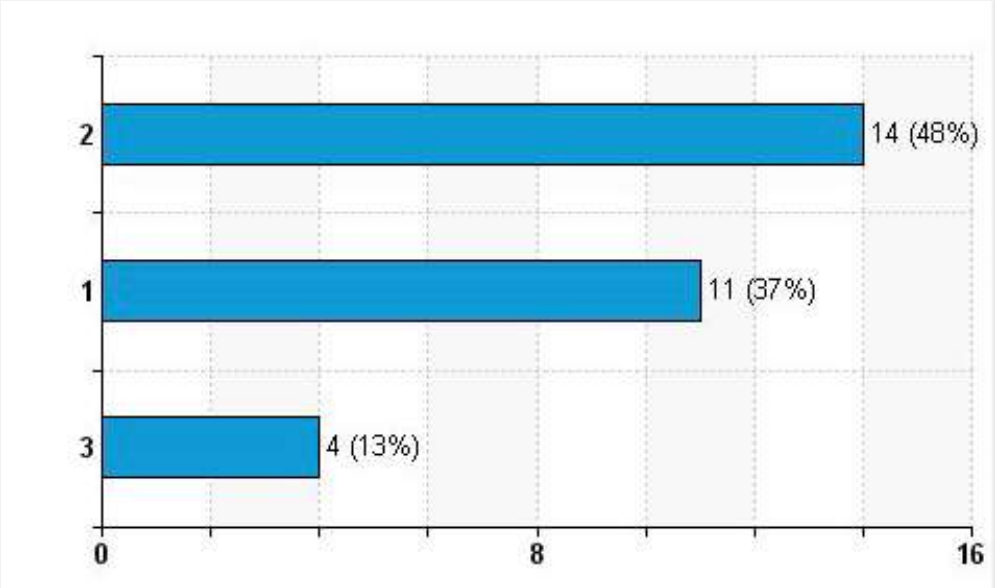
Pulse Question 1: (Anonymous)

- What best describes your view of Physics?
  1. Enthusiastic
  2. Don’t care, Nonchalant
  3. Terrified, just allow me to get a C professor!
  4. Confused, do not know where to make of it.
  5. None of the above



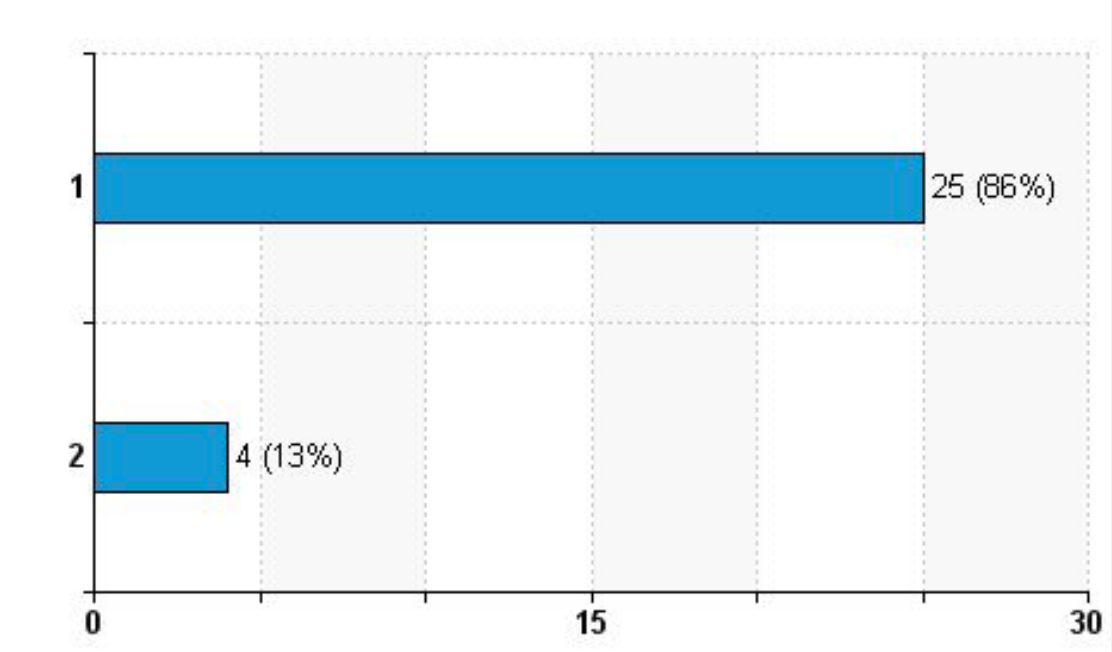
Pulse Question 2: (Anonymous)

- What best describes your current GPA?
  1. A, A+
  2. B, B+
  3. C, C+
  4. D, D+



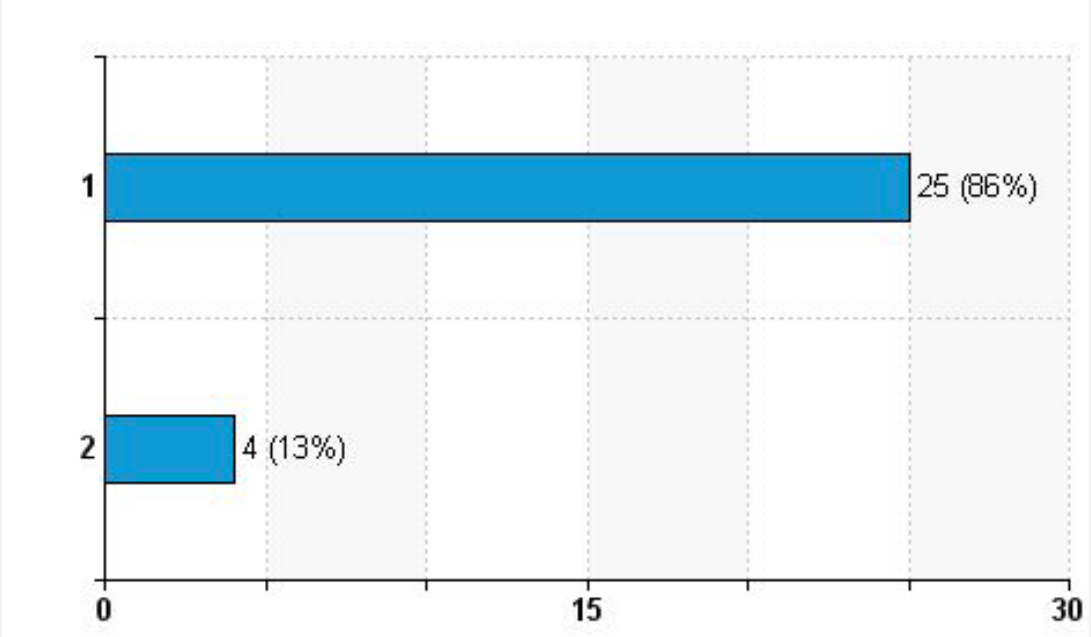
Pulse Question 3: (Anonymous)

- What grade do you wish to make in PHYS 211?
  1. A
  2. B
  3. C
  4. D, Other (Do NOT Care)

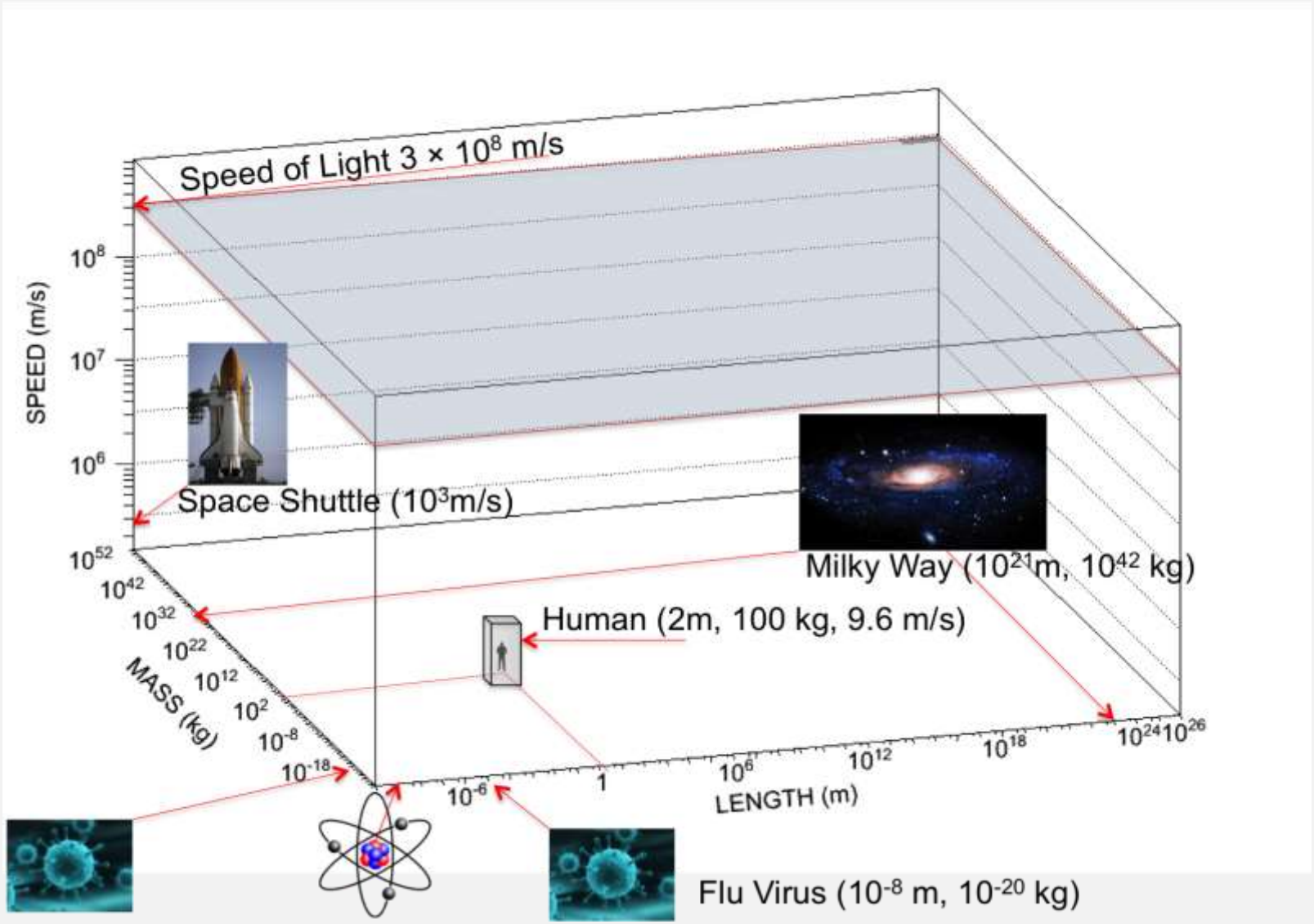


Clicker Question 1

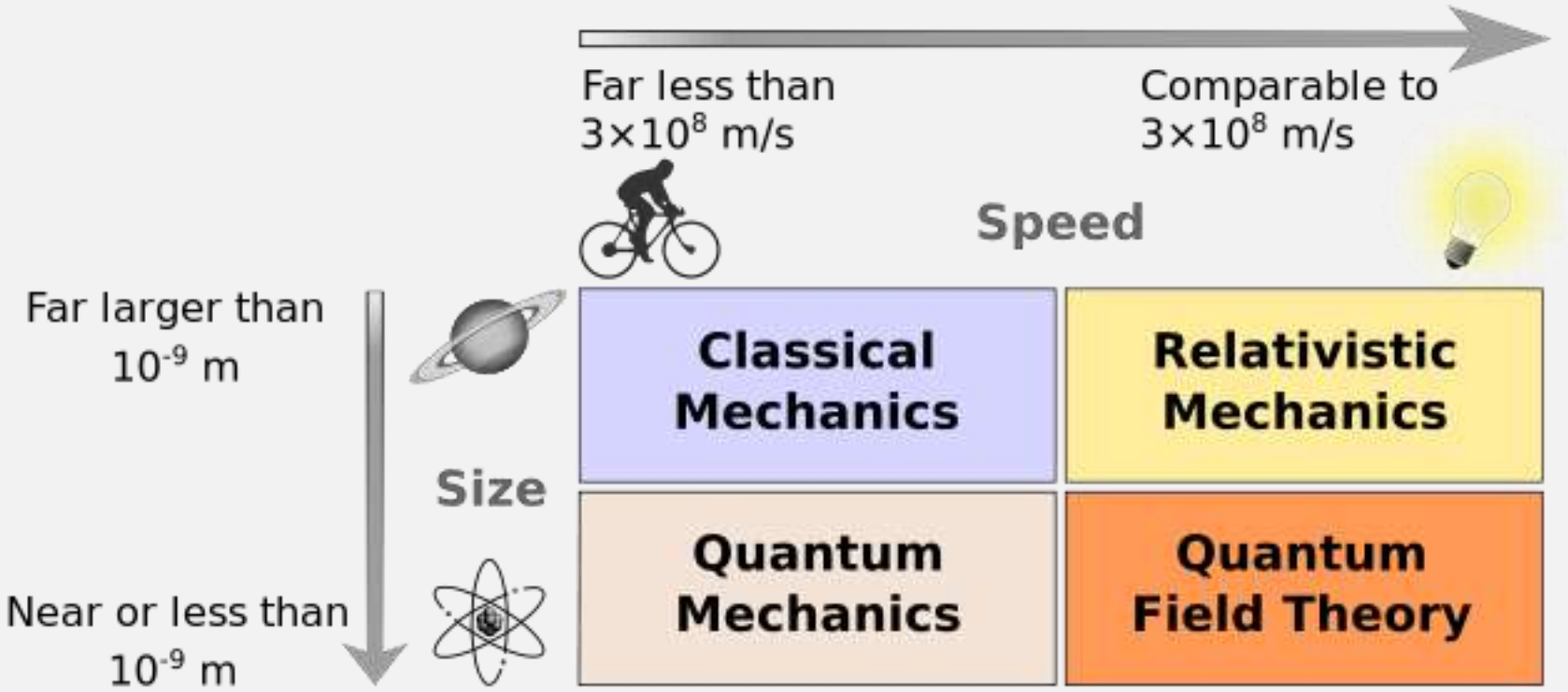
- I have read the syllabus (one or more times)
  1. YES, I HAVE
  2. NO, I HAVE NOT



Our Limited Access To Reality



Classical Mechanics

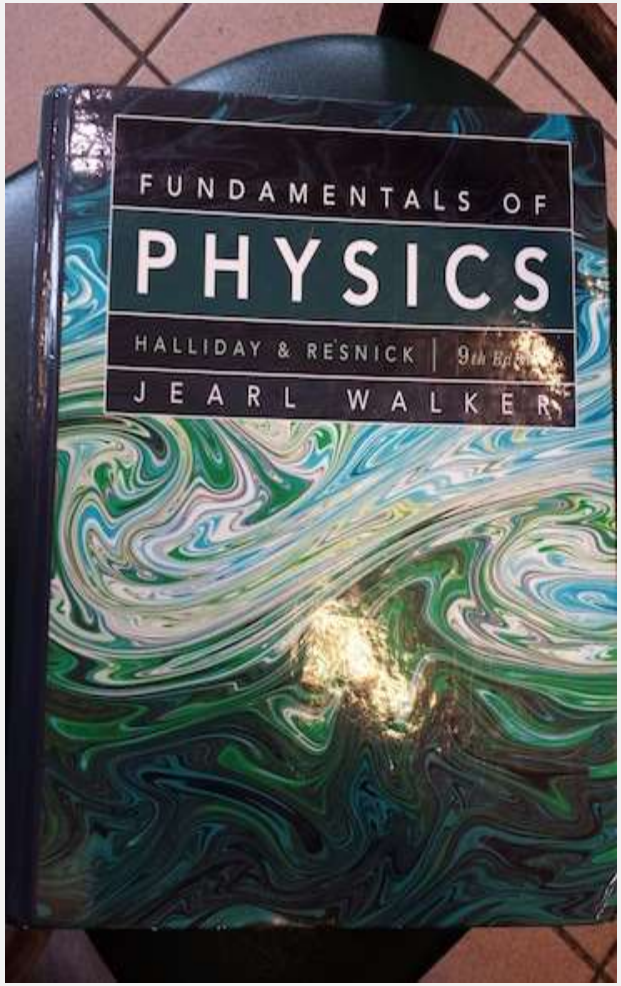


Measure

- Why do we measure?
  - Because we can, to extend our knowledge, test ideas… to name a few
  - So we can compare objects, phenomena
    - (large, miniscule), (thick, thin), (far, near), (now, future, past)
  - Associate a number with (or quantify) something – and is an essential part of scientific method
  - So we can claim the Eureka!! moment like Archimedes did
- What do we measure?
  - From the miniscule to the size/age of the universe and everything in between. 46 orders of magnitude!
    - 10,000,000,000,000,000,000,000,000,000,000,000,000,000,000 = 10^{46}
- How do we measure?
  - Using scientific instruments, devices or apparatus
  - We measure directly - e.g., controlling charged ions with laser trap
  - or indirectly – e.g., discovery of the structure of DNA

Physical Quantities

- Physical Quantity is defined as
  - a quantifiable property assigned to a phenomenon, body or a substance
- Take your text-book as an example
  - It's an object that has certain dimensions
  - You can hold it and feel it's heavy
- In Phys 211, 212 you will encounter some
  - Fundamental physical quantities: Mass, Length, Time, Temperature, Electric charge
  - Derived physical quantities: Speed, Acceleration, Electric/Magnetic Fields



Units

- Mass
  - 1 kilogram (kg), or pound (lb)
- Length
  - 1 meter (m) or mile (mi)
- Time
  - 1 second (s)
- Temperature
  - 1 degree Celsius (°C) or Fahrenheit (°F)
- Electric charge
  - 1 Coulomb (C)

- Speed
  - 1 meter/second (m/s)
  - 1 mile/hour (mi/h)
- Acceleration
  - 1 meter per second squared (m/s^2)
- Force
  - 1 kg m/s^2 = 1 N (newton)
- Energy
  - 1 kg m^2/s^2 = 1 J (joule)
- Electric Field
  - 1 N/C (newton per coulomb)

Unit: A unique name assigned to a measure of that physical quantity

International System (SI)

- Also called as “metric system” (1971)
  - Adopted seven base units at the conference of weights and measures
  - The kilogram (kg) – unit of measurement of mass
  - The meter (m) – unit of measurement of length
  - The second (s) – unit of measurement of time
  - The ampere (A) – unit of measurement of electric current
  - The kelvin (K) – unit of measurement of thermodynamic temperature
  - The mole (mol) – unit of measurement of amount of substance
  - The candela (cd) – unit of measurement of luminous intensity
- How to express very large or very small numbers?
  - Scientific notation: 5670 N = 5.67×10^3 N (or 5.67E3 on calculator)
  - Use of prefixes: 5670 N = 5.67 kN (kilo-newton) 1 kilo = 10^3

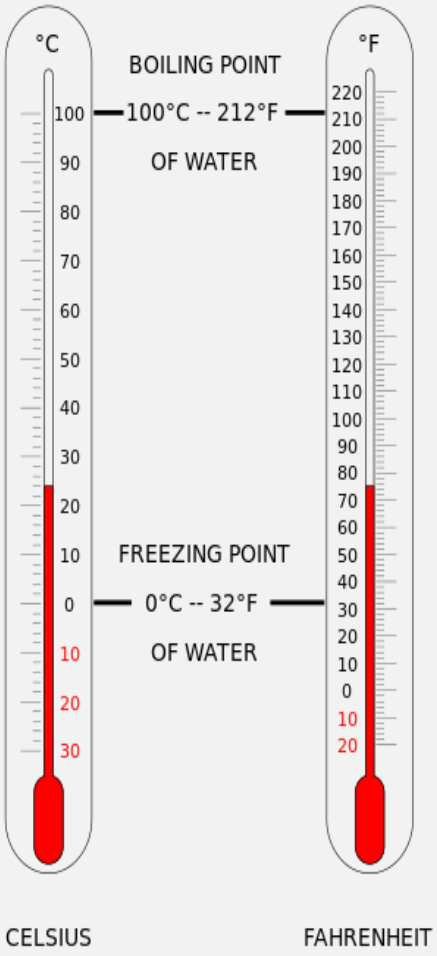
Converting Units

- Converting degree Celsius (°C) to degree Fahrenheit (°F)

Let C denote the value (in Celsius) corresponding to the value F (in Fahrenheit) of the same temperature. Notice their linear relationship. Assume a slope (m) and an intercept (b). Looking at the scales (C,F) = { (0, 32), (100, 212) } must lie on the line given by the equation $C = mF + b$. Solving for m and b, we get

$$m = 5/9, \quad b = -(5/9) \times 32$$

$$\boxed{C = \frac{5}{9}(F - 32)}$$



Reading Assignment

- Length
  - http://www.nist.gov/pml/wmd/metric/length.cfm
- Mass
  - http://www.nist.gov/pml/wmd/metric/mass.cfm
- Time
  - http://www.nist.gov/pml/wmd/metric/time.cfm
- SI Units
  - http://www.nist.gov/pml/wmd/metric/si-units.cfm