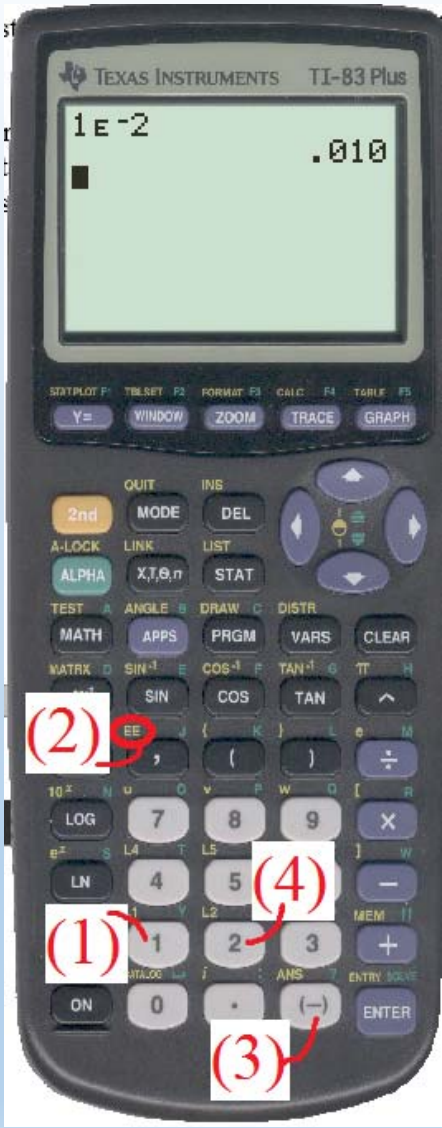
Basic Skills – 01-01 Notes

Unit 01, Physics Themed

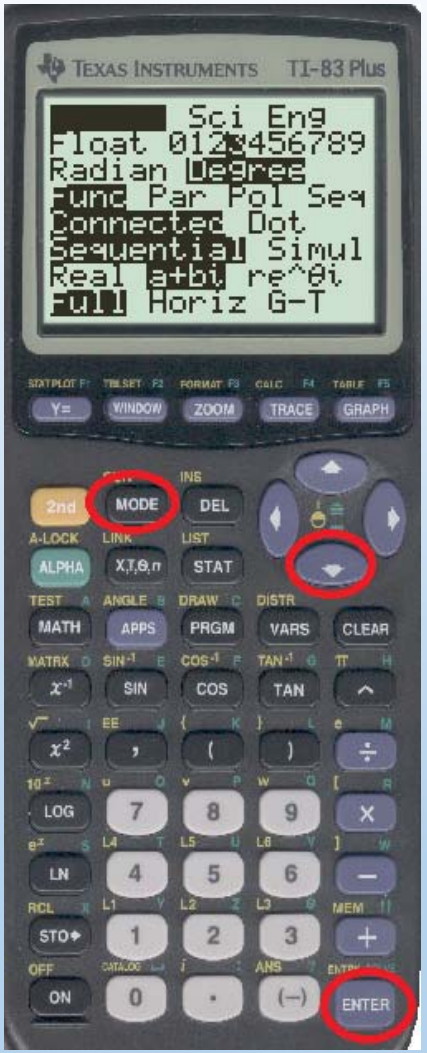
EE button ("times ten to the")

- Calculator button that makes exponents easier: the EE button
- Remember Avogadro's number? 6.02×10^{23}?
- Where you SAY "times ten to the" substitute EE
- Calculator displays single E
- Example: six point zero two **times ten to the** 23^{rd}
- The EE button literally substitutes for the red above
- Example at right show 1×10^{-2}
- Steps (1) to (4) at right produce 1×10^{-2}
  - Notice where the EE button is pressed
  - After step 4, the enter button was pressed showing the value is the same as .010
- IMPORTANT: use "negative" (-) button, not subtraction button!



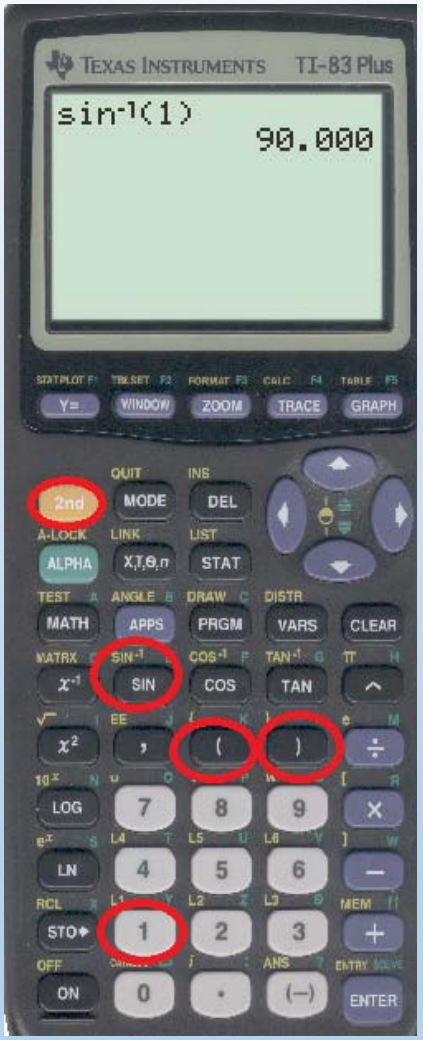
Sin, Cos, Tan and their inverses

- We only use degrees for angles in this class (never radians) – make sure you are in degree mode!
- Calculator at right shows how to set to degrees



Sin, Cos, Tan and their inverses

- Sin, Cos and Tan functions are ratios of the length of two sides
- Units cancel, so there are not dimensions
- For these, input an angle, press enter and the calculator computes a ratio of two sides (review SOH-CAH-TOA if needed)
- Inverse functions do the inverse: Input a ratio and calculator computes an angle, again according to SOH-CAH-TOA rules
- Inverse functions are "2nd" functions, the yellow button must immediately precede the trig function
- Test sin (90°) to make sure it's 1 (if not, check degree mode)
- Test $\sin^{-1}(1)$ and make sure to get 90°



A flexible conversion method: Factor label method, or T-charts

- Multiply a data value by the number "1"
- Example:
  - 1 = 12 in/30.48 cm (check a ruler and you'll see that 12 in. = 30.48 cm)
  - Sam's phone is 14.5 cm long. How many inches is that?
  - 14.5 cm x (12 in/30.48 cm) = 5.71 inches
  - Do you see how the stuff in red is just equal to 1? See how the cm units cancel out leaving only inches? (do the algebra is you don't see it)
- See the example below and note: 1) how each conversion factor has numerators equivalent to the denominators 2) units ALWAYS cancel algebraically on diagonals

$$1.25\ \text{days} \times \frac{24\ \text{hours}}{1\ \text{day}} \times \frac{60\ \text{min}}{1\ \text{hour}} \times \frac{60\ \text{s}}{1\ \text{min}} = 108000\ \text{s}$$

Making measurements – Metric system

- Identify the base unit and prefix in each of the following
  - Kilometer
  - Milligram
  - Dekameter
  - Kilojoule
  - Centigrams
  - Hectoliters
  - Kilometers/hour
  - Decigram

SI Units (not the same as metric units)

- SI units are standard metric units
- Example:
  - km, cm, mm and m are all metric units
  - m is the SI unit for length
- There are many SI units, but only 7 fundamental (base) SI units
  - m^2 is an SI unit, but it's composed of the base SI unit, the meter
  - m/s is a measure of speed, composed of the SI units for length and time
  - You learned two SI base units we won't deal with much this year: mol, K (kelvin)
  - There are four SI base units you will deal with a lot: m, kg, s, A (length, mass, time, electric current)
  - In problem solving, you will be making a lot of lists this year in (base) SI units, so you need to be familiar with identifying them
  - Please note: the ONLY base SI unit with a prefix is the kg, so the SI unit when listing variables will be the one without a prefix (except for mass!)

Prefixes & conversion factors

- It's so easy to created conversion factors using the metric system
- Conversion factors are rewritten statements of equality, like
  - 1 dozen donuts = 12 donuts can be rewritten as
    - 1 = 1 dozen donuts /12 donuts (useful fraction to get rid of donuts)
    - 1 = 12 donuts / 1 dozen donuts (useful faction to get rid of dozens of donuts)
- You will need to know these for tests (values may not be given to you)

Prefix	Symbol	Amount as #	Amount as exponent
Tera	T	Trillion	10^{12}
Giga	G	Billion	10^{9}
Mega	M	Million	10^{6}
Kilo	K	Thousand	10^{3}
Centi	C	Hundredth	10^{-2}
Milli	m	Thousandth	10^{-3}
Micro	μ	Millionth	10^{-6}
Nano	n	Billionth	10^{-9}

Metric System – Powerful Prefixes

- It's so easy to created conversion factors using the metric system
- Just substitute a prefix for the number that has the same meaning
- Set the two equal (that's your conversion factor!)
- Example:

GHz to Hz

- G is the same as 10^9
- 10^9 Hz = 1 GHz
- Conversion factor:

$1 = 10^9$ Hz / 1 GHz

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Rounding and Scientific Notation (review)

- Rules for rounding (review)
  - Digits 0-4 round down, 5-9 round up.
    - 0.499 rounded to 1 sig fig is 0.5, to 2 sig figs is 0.50, to three sig figs is 0.500
    - 2,300 rounded to 1 sig fig is 2,000, to 2 sig figs is 2,300, to 3 sig figs is 2.30×10^3. There is no way to express this number with 3 sig figs in standard notation. 2,300 rounded to 4 sig figs is 2,300. The decimal point at the end makes it four sig figs (use the Pacific rule for yourself and prove it!)
- Scientific Notation to decimal (standard) and vice versa
  - Scientific notation: $a.bcde \times 10^z$, a is a number 1-9 (not zero!), numbers after decimal point (bcde, etc.) are there for sig figs of measurement, z is the exponent (base 10).
  - Sci → standard example: 3.52×10^2: The exponent tells you how many places to move the decimal point. If the exponent is positive, move the decimal right, if the exponent is negative, move the decimal left. Pad with zeroes (holding places) as needed. In this case, answer is: 352
  - Sci → standard example, small number: 3.52×10^{-4}: Move decimal point over three places left and pad with leading zeroes needed: 0.000352.
  - Standard → Sci example: 220,000: Move the decimal point five places over and keep two sig figs: 2.2×10^5.