WELCOME TO 1104 PERIOD 1

Today:  You will complete Activity Sheet 1 during class and turn it in at the end of class.

Next Tues/Weds:
Turn in Homework Exercise 1 at the beginning of class.

Read chapter 2.  Bring a blank Activity Sheet 2 to class.
PHYSICS 1104 – PERIOD 1

How can ratios be used to solve problems?
How efficient is energy use?  Light bulbs!
How is scientific notation used?
What are linear and exponential growth rates?
Course rules on phone use

During class students are not allowed to use cell phones, ipads, or other electronics for personal communication.

Sorry, but no phone calls, web surfing, or texting allowed during class.
How to get the most from 1104?

Physics education research studies show that students who use lab equipment learn more than those who just watch others:

Tell me, and I’ll forget
Show me, and I may remember
Involve me, and I’ll understand

Be sure to get the most from the class by using the equipment on your table!
How are ratios used to solve problems?

Ratios are fractions: \( \frac{60 \text{ miles}}{1 \text{ hour}} \) or \( \frac{26 \text{ gallons}}{1 \text{ second}} \)

Example: An oil rig leaked 900 gallons of oil every 2 minutes (120 seconds). What was the rate of flow of the oil? (How much oil leaked every second?)

Solution: Write the information as a ratio. Simplify the ratio by dividing the numerator by the denominator.

\[ \frac{900 \text{ gallons}}{120 \text{ seconds}} = \frac{7.5 \text{ gallons}}{1 \text{ second}} \]
Using ratios to convert units

The equality 1 hour = 3,600 sec can be written in 2 ways:
\[
\frac{1 \text{ hour}}{3,600 \text{ sec}} \quad \text{or} \quad \frac{3,600 \text{ sec}}{1 \text{ hour}}
\]

1 fluid barrel = 31.5 gallons can be written:
\[
\frac{31.5 \text{ gal}}{1 \text{ barrel}} \quad \text{or} \quad \frac{1 \text{ barrel}}{31.5 \text{ gal}}
\]

Example: Convert 7.5 gallons per second into barrels per hour. Choose ratios that cancel the unwanted units (seconds and gallons).

\[
\frac{7.5 \text{ gallons}}{1 \text{ second}} \times \frac{1 \text{ barrel}}{31.5 \text{ gallons}} \times \frac{3,600 \text{ seconds}}{1 \text{ hour}} = \frac{857 \text{ barrels}}{1 \text{ hour}}
\]
Generating electricity

Move a magnet near a coil of wire. What happens?

ELECTRICITY!

- How does shaking the longer flashlight generate electricity to light the bulb?

- How does squeezing the handle of the smaller flashlight generate electricity?

- What do you think happens when you turn the crank of the hand generator and generate electricity?
How are ratios used to find efficiency?

Efficiency is the ratio of the useful energy out of the system per total energy put into the system.

Efficiency = Useful energy (or power) out / Total energy (or power) in

Power is the rate at which energy is used: Power = \( \frac{\text{Energy}}{\text{Time}} \)
Measuring power with a wattmeter

1) Plug the wattmeter into the power strip.

2) Plug the bulb into the outlet in the front of the wattmeter.

3) The bulb wattage appears in the display screen.
SCIENTIFIC NOTATION

Scientific notation uses base 10 raised to an exponent. The exponent shows the number of times that 10 is multiplied by itself.

\[ 10^1 = 10 \]
\[ 10^2 = 10 \times 10 = 100 \]
\[ 10^3 = 10 \times 10 \times 10 = 1,000 \]
\[ 10^{-1} = \frac{1}{10} = 0.1 \]
\[ 10^{-2} = \frac{1}{10 \times 10} = 0.01 \]
\[ 10^{-3} = \frac{1}{10 \times 10 \times 10} = 0.001 \]

Example: \[ 3.74 \times 10^3 = 3.74 \times 10 \times 10 \times 10 = 3,740 \]
Writing numbers in scientific notation

1) For numbers equal to or greater than one (positive exponents), count the places the decimal point is shifted to the left.

\[ 2,600.0 = 2.6 \times 10^3 \]

2) For numbers less than one (negative exponents), count the number of places the decimal point is shifted to the right.

\[ 0.035 = 3.5 \times 10^{-2} \]
Rules for using exponents

1. When multiplying numbers with exponents, add the exponents
   \[ 10^A \times 10^B = 10^{(A + B)} \]

2. When dividing numbers with exponents, subtract the exponents
   \[ 10^A / 10^B = 10^{(A - B)} \]

3. When raising numbers with an exponent to a power, multiply the exponents.
   \[ (10^A)^B = 10^{(A \times B)} \]

4. Any number to the zero power = 1:
   \[ 10^0 = 1 \quad 237^0 = 1 \]
Prefixes for multiples of ten

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Examples:

3 kilograms = $3 \times 10^3$ kg = 3,000 kg

6 milliliters = $6 \times 10^{-3}$ liters = 0.006 liters
Powers of ten on a calculator

• To enter $8 \times 10^7$: press 8, $\times$, the $10^x$ key, and enter the exponent (7).

• If the $10^x$ symbol is above another key, press 2$^{nd}$ F before the $10^x$ key.

• For a negative exponent, press the +/- key before entering the exponent:

• If your calculator has an EE or EXP key, press that key and then enter the exponent.

• A calculator’s $y^x$ key does NOT give powers of 10. For example, $3.4^8$ is NOT the same as $3.4 \times 10^8$
Linear growth: The same amount is added during each time period. Result: a **constant growth rate** (slope).

Exponential growth: The amount doubles during a fixed (constant) time period called the **doubling time**.

Exponential decay: The amount is cut in half during a fixed time period called the **halving time** or **half-life**.
Linear Growth

1) **Linear growth is constant.** Its graph is a straight line.

2) The **same amount** is added during each time period.

3) The amount added is **independent** of the initial amount and number of time periods.

Exponential Growth

1) **Exponential growth is not constant.** Its graph is an upward curving line.

2) The amount added **changes** with each time period.

3) The amount added **depends** on the initial amount and on the number of time periods.
Linear and exponential equations

Linear growth is expressed by

\[ N = A \times t + B \]

Exponential growth is expressed by

\[ N = B \times 2^t \]

Exponential decay is expressed by

\[ N = B \times 2^{-t} = B \times \frac{1}{2}^{-t} \]

where

- \( N \) = the amount of the quantity
- \( A \) = the amount of increase per time period
- \( B \) = the initial amount
- \( t \) = the number of time periods elapsed

(Assume there is one doubling or halving per each time period.)
Find doubling time of an exponential graph

1) Pick a point on the exponential graph.
2) Move up the graph line to the point where the quantity has doubled.
3) Read the elapsed time between these points on the horizontal axis.
4) Repeat steps 2) and 3) to find the next doubling time.
5) If the doubling times are equal, the graph is exponential growth.
# Results of dice roll

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Use the data in the TOTAL column for your graph.
Annual Electricity Production in the U.S.

- **Kilowatt Hours (billions)**
- **Year**

Graph showing the annual electricity production in the U.S. from 1950 to 1995, categorized by fuel sources:
- **All fuels**
- **Fossil fuels**
- **Nuclear**
- **Hydroelectric**
Global renewable power capacities (excluding hydro)

(1) Renewable power excluding hydro
(2) Wind
(3) Biomass
(4) Solar PV
(5) Geothermal
Growth rates and doubling times

<table>
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<th>Doubling Time (in years)</th>
<th>Annual Growth Rate (in percent)</th>
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What interest rate is needed to grow $1,000 to $2,000 in 9 years?
BEFORE THE NEXT CLASS…

✓ Read textbook chapter 2
✓ Complete Homework Exercise 1 found at the end of Activity Sheet 1.
✓ Print out Activity Sheet 2 and bring it to the next class.

For hints/help answering the Homework questions, refer to the sample problems and concept check solutions in textbook Chapter 1 and the Period 1 Multiple Choice questions found on the course web site.