Matter, Energy, and Measurements

Learning Outcomes

1. Study skills for CHEM 60.
2. Describe what a chemical is.
3. Describe the key parts of the scientific method.
4. Explain the difference between a theory and a law.
5. Explain what is and is not matter.
6. Compare and contrast the following three states of matter: solid, liquid, gas.
7. Describe energy in your own words.
8. Describe how energy relates to temperature.
9. Represent a number in both general notation and scientific notation.

Study Skills

1. Read the book
2. Actively participate in lecture
3. Do the homework questions: **4-5 hours a week**
4. Study
5. Repeat

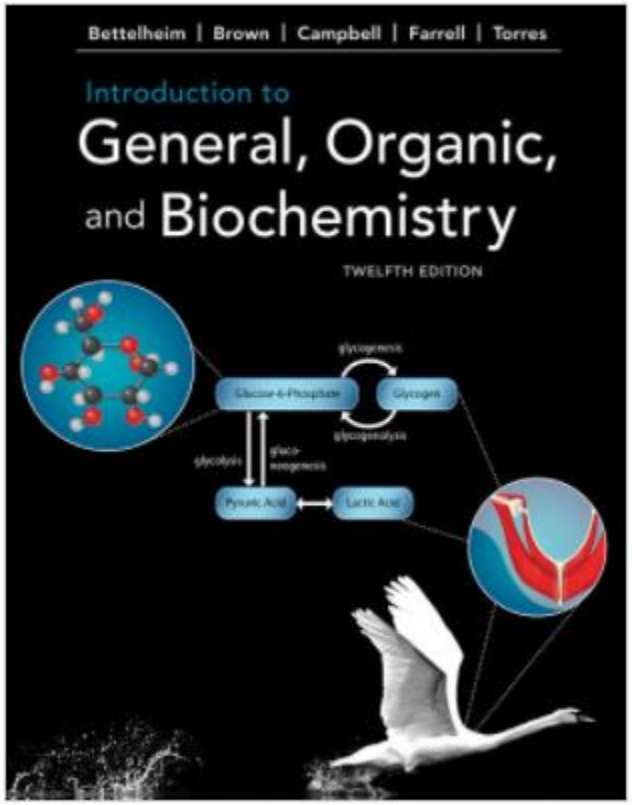
How Do I Study For CHEM 42

Sample Study Schedule

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
7:00 AM	Sleep	Sleep	Sleep	Sleep	Sleep		Sleep
7:30 AM		Get Dressed		Get Dressed			
8:00 AM		Breakfast		Breakfast			
8:30 AM							
9:00 AM		HIST 1020	Get Dressed	HIST 1020	Get Dressed	HIST 1020	
9:30 AM	Get Dressed						Get Dressed
10:00 AM	Breakfast	STAT 2510	Breakfast	STAT 2510	Breakfast	STAT 2510	Breakfast
10:30 AM	Study CHEM						Study STAT
11:00 AM		Lunch	ENGL 2260	Lunch	ENGL 2260	Lunch	
11:30 AM		Study CHEM		Study CHEM		Study CHEM	
12:00 PM			Lunch		Lunch		
12:30 PM			Study CHEM		CHEM 1041		
1:00 PM	Lunch						Lunch
1:30 PM	Study HIST						Study HIST
2:00 PM		CHEM 1040		CHEM 1040		CHEM 1040	
2:30 PM							
3:00 PM		Workout	KINE 4970	Workout		Workout	
3:30 PM							
4:00 PM			Study STAT				
4:30 PM	Study CHEM	Study HIST		Study HIST		Study HIST	
5:00 PM							
5:30 PM							
6:00 PM							
6:30 PM	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner
7:00 PM		Study STAT	CHEM SI	Talk to Mom	CHEM SI	Talk to Mom	Study CHEM
7:30 PM							
8:00 PM				Study STAT			
8:30 PM			Study HIST		Study CHEM		
9:00 PM							
9:30 PM							
10:00 PM		Study CHEM					
10:30 PM				Study CHEM			
11:00 PM			Sleep		Sleep		
11:30 PM							
12:00 AM							

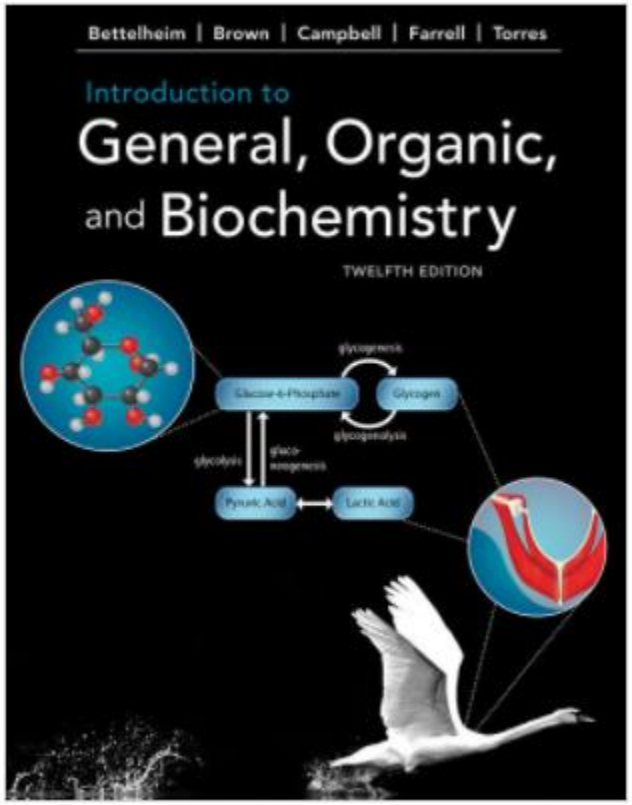
How Do I Study For CHEM 42

Do the homework



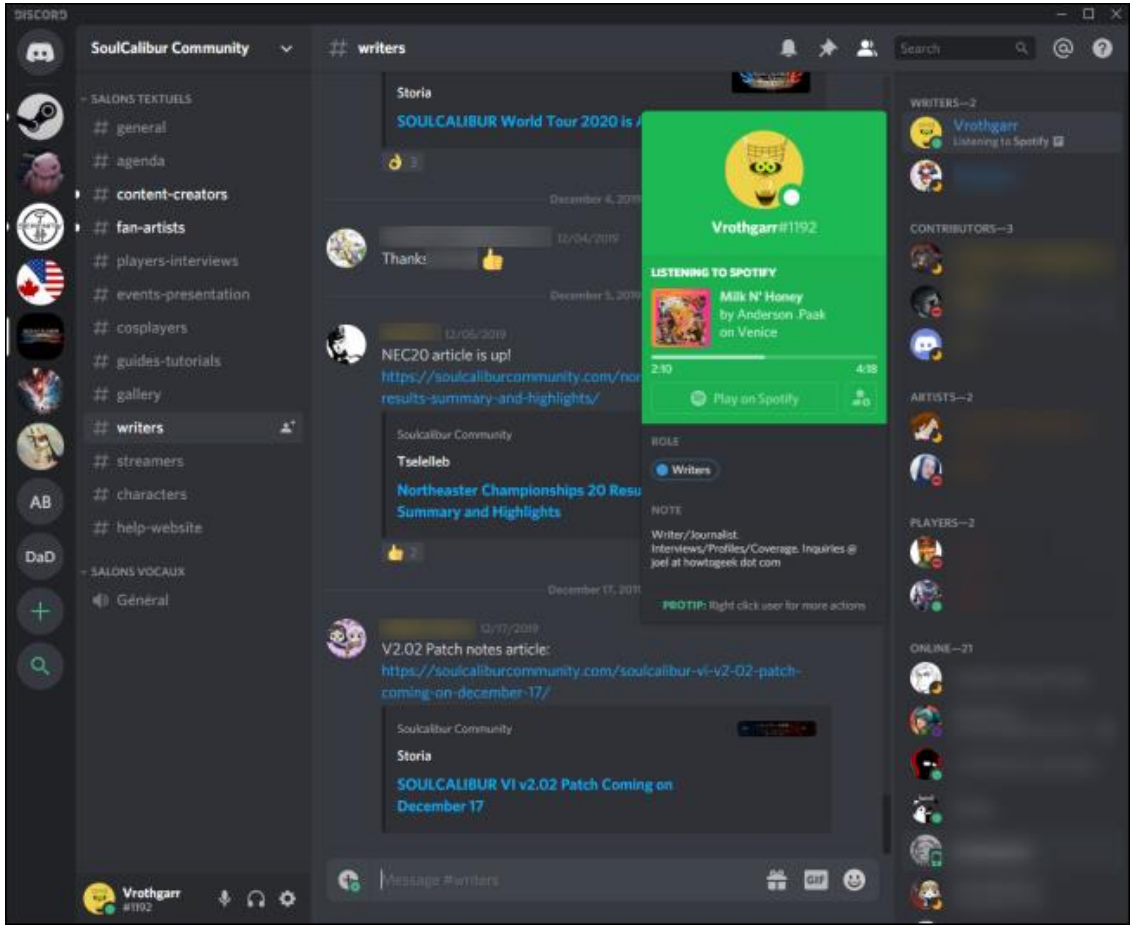
How Do I Study For CHEM 42

Study/review the homework



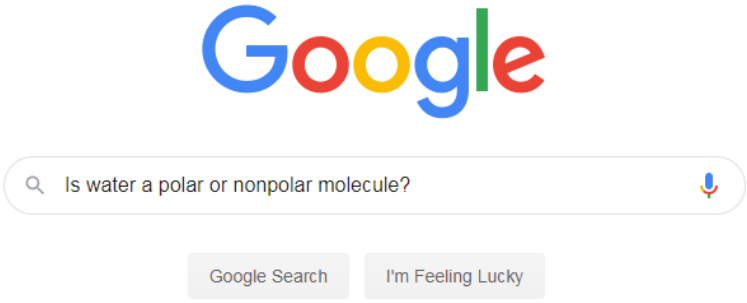
How Do I Study For CHEM 42

Work in Groups (digitally)



How Do I Study For CHEM 42

Find efficient uses of your time.



What is Chemistry?

What is Chemistry?

Helpful words:
Matter, Molecules, Chemicals, Reactions

What is Chemistry?

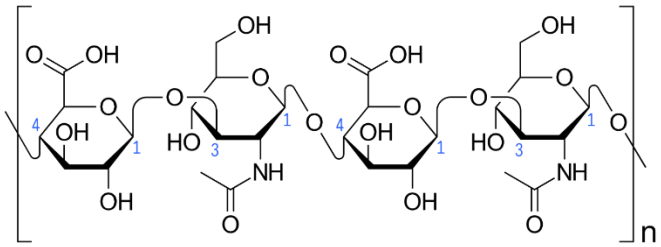
Helpful words:
Matter, Molecules, Chemicals, Reactions

Definition: *The science that tries to understand how matter behaves by studying how atoms and molecules behave.*

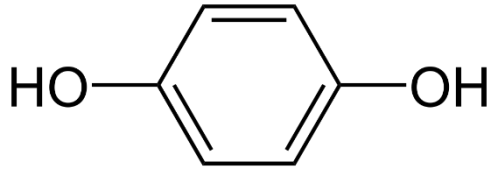
What is a Chemical?

Definition: *A substance that has been purified or prepared, especially artificially.*

Are Chemicals Good, Bad, or Neither?



Hyaluronic Acid

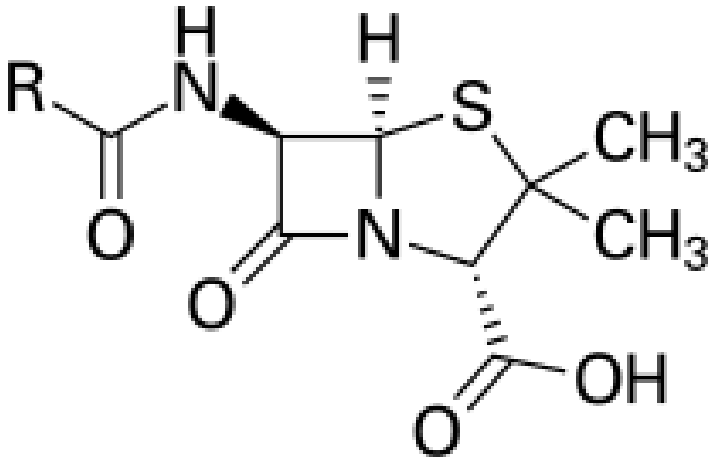


Hydroquinone

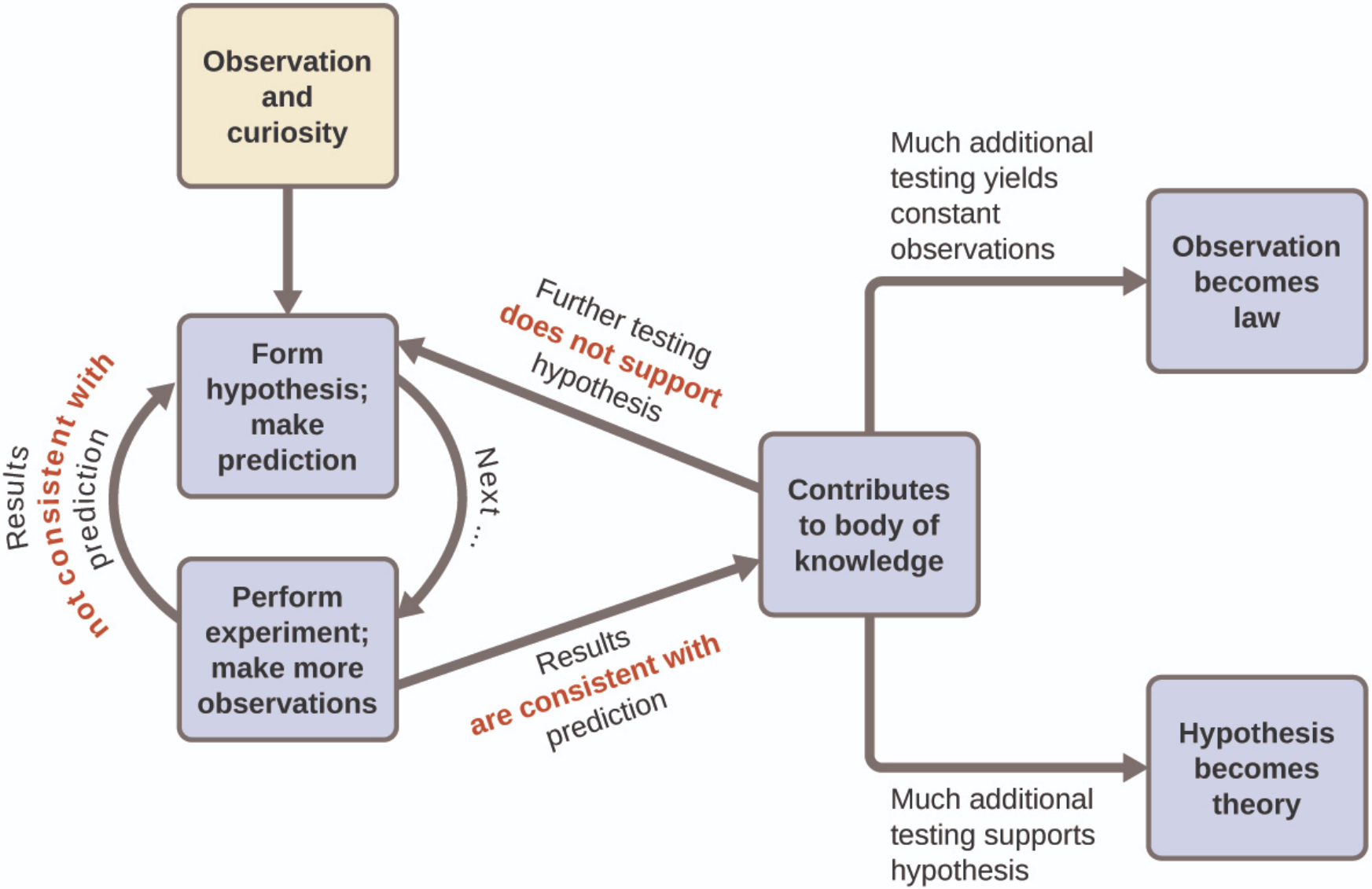
Penicillin

Dorothy Hodgkin determined the chemical structure of penicillin.

Alexander Fleming, who is credited with discovering penicillin in 1928.



Scientific Method



Question 1

(a) You wonder why an inflated balloon increases in volume when placed outside on a mailbox on a hot summer day. (i) What is your hypothesis? (ii) What experiment would you run to test your hypothesis?

(b) You notice your cat responds well (is alert) to short, high-frequency sounds. (i) What is your hypothesis? (ii) What experiment would your run to test your hypothesis?

Cat Paper!!

Applied Animal Behaviour Science 166 (2015) 106–111

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Cats prefer species-appropriate music

Charles T. Snowdon[a,*], David Teie[b], Megan Savage[a]

[a] Department of Psychology, University of Wisconsin, Madison, WI, USA
[b] School of Music, University of Maryland, College Park, MD, USA

We have found that domestic cats are more interested in and responsive to music that was composed with species-appropriate features relevant to cats. These results combined with others suggest that for auditory enrichment to be effective, the enrichment must contain features that are perceptible to the species that are the target of enrichment. Furthermore, managers should be aware of how different acoustic features can affect the emotional state of listeners and choose music carefully to match the goals of enrichment. It is not sufficient to simply turn on a radio or play some classical music in a laboratory or shelter and assume that acoustic enrichment needs are being met. Auditory enrichment must be appropriate for the species and for the goals of enrichment.

Question 1

(c) When your experiment does not support your hypothesis, what must you do?

(d) What is the difference between (i) a scientific theory and (ii) a scientific law?

What is Matter?

Matter: A substance that has mass and volume.

Matter is NOT energy (to be discussed shortly)

Matter

Question 2

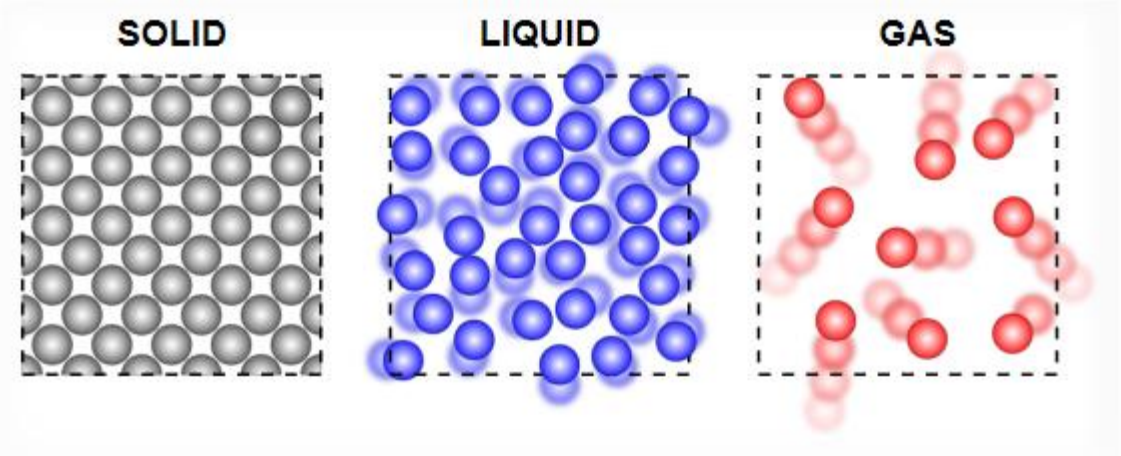
An atom is a submicroscopic particle that constitutes the fundamental building blocks of ordinary matter. What is the difference between an atom and a molecule?

Question 2 – Solution

Q: An atom is a submicroscopic particle that constitutes the fundamental building blocks of ordinary matter. What is the difference between an atom and a molecule?

A: An atom is the fundamental building block of matter. A molecule is two or more atoms joined together in a specific geometric arrangement.

States of Matter



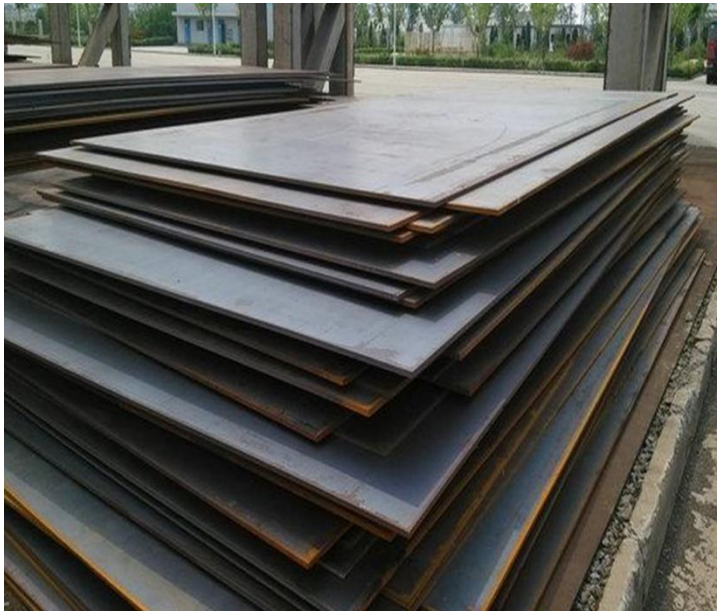
State of Matter	Interaction Strength
Solid	Strong
Liquid	Medium
Gas	Weak

Question 3

Complete the following table by entering “fixed” or “variable” to each table cell.

State of Matter	Shape	Volume
Solid	Fixed	Fixed
Liquid		
Gas		

Solids



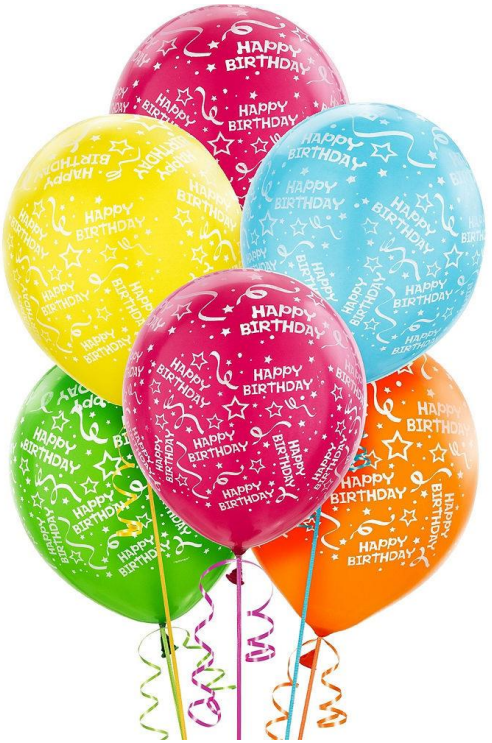
Steel

Quartz

Liquids

A glass of wine is 150 mL

Gases



Question 3 - Solution

State of Matter	Shape	Volume
Solid	Fixed	Fixed
Liquid	Variable	Fixed
Gas	Variable	Variable

Question 4

6. Classify each of the following substances as a solid, liquid, or gas.

(a) Water Vapor

(b) Dry Ice

(c) Mercury

(d) Graphite

(e) Silicon

(f) A Cat!

Question 4 - Solutions

(a) Water vapor is a gas.

Water Vapor

Question 4 - Solutions

(b) Dry ice is a solid.

Dry Ice

Question 4 - Solutions

(c) Mercury is a liquid.

Mercury

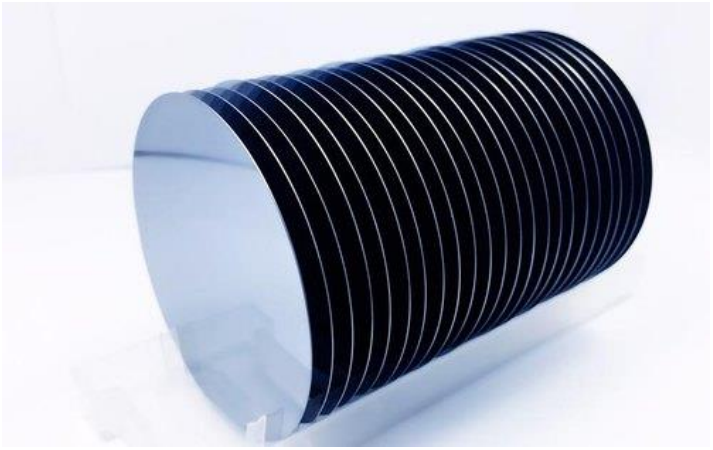
Question 4 - Solutions

(d) Graphite is a solid.

Graphite

Question 4 - Solutions

(e) Silicon is a solid.



Silicon

Question 4 - Solutions

(f) A cat is a liquid!!

Cat

On the rheology of cats

M.A. Fardin[1,2,3,*]

[1] *Université de Lyon, Laboratoire de Physique, École Normale Supérieure de Lyon, CNRS UMR 5672, 46 Allée d'Italie, 69364 Lyon cedex 07, France.*
[2] *The Academy of Bradylogists.*
[3] *Member of the Extended McKinley Family (EMF).*

(Dated: July 9, 2014)

In this letter I highlight some of the recent developments around the rheology of *Felis catus*, with potential applications for other species of the felidae family. In the linear rheology regime many factors can enter the determination of the characteristic time of cats: from surface effects to yield stress. In the nonlinear rheology regime flow instabilities can emerge. Nonetheless, the flow rate, which is the usual dimensional control parameter, can be hard to compute because cats are active rheological materials.

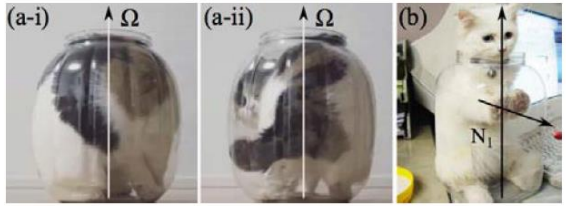
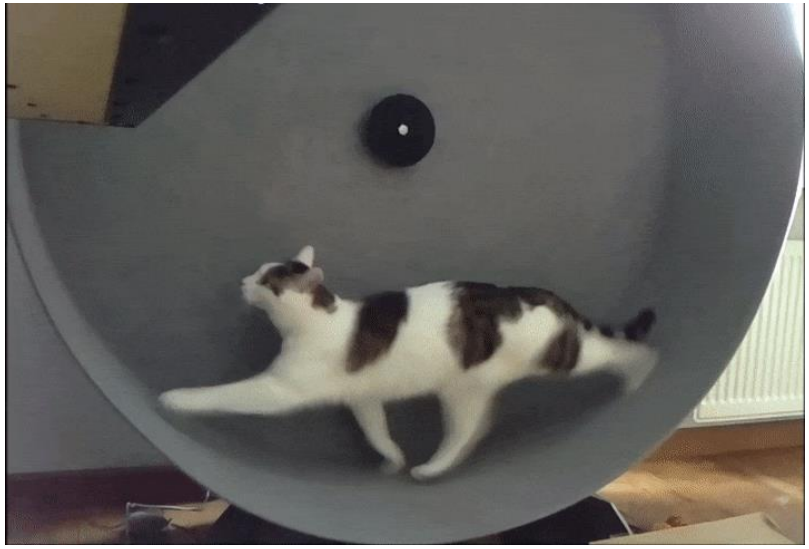


FIG. 3: (a) A cat spontaneously rotates in a cylindrical jar. (b) Normal forces and Weissenberg effect in a young sample of *Felis catus*. [Courtesy of (a) http://guremike.jp/, (b) http://buzzlamp.com/10-weird-places-cats-get-stuck-in/]

What is Energy?

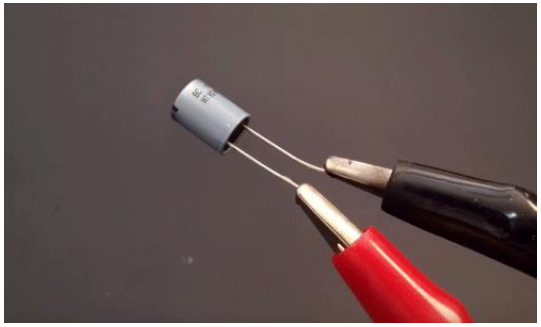


Energy is the capacity to do work!

Energy

Thermal Energy

Gravitational Potential Energy

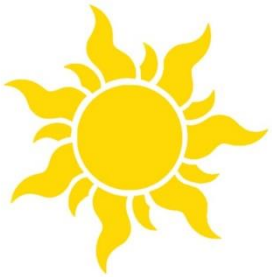


Electrical Energy

Electrostatic Potential Energy

Law of Conservation of Energy: Energy Is Neither Created Nor Destroyed

Solar Thermal Energy



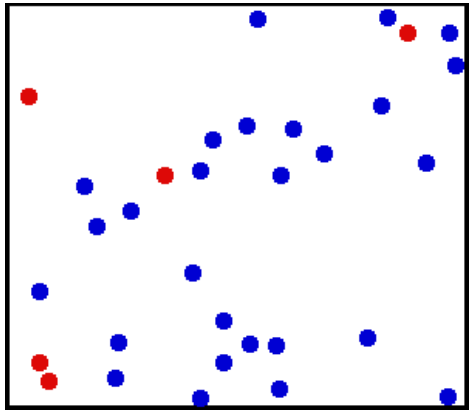
Electrical Energy

Chemical Energy

Electrical Energy

Mechanical Energy

Thermal Energy



Units of Energy

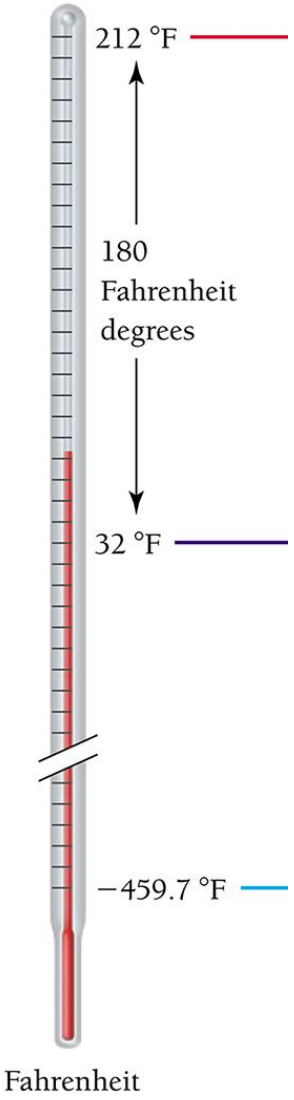
	J	cal	eV
Joule	1	4.184	6.24×10^{18}
calorie	4.184	1	2.61×10^{19}
electron Volt	1.602×10^{-19}	3.83×10^{-20}	1

Temperature Scales

History:

0 °F was set as the freezing point for a 50% ice-water and ammonium chloride solution.

96 °F was set as the human body temperature; a redefinition of the scale place it now at 98.6 °F.



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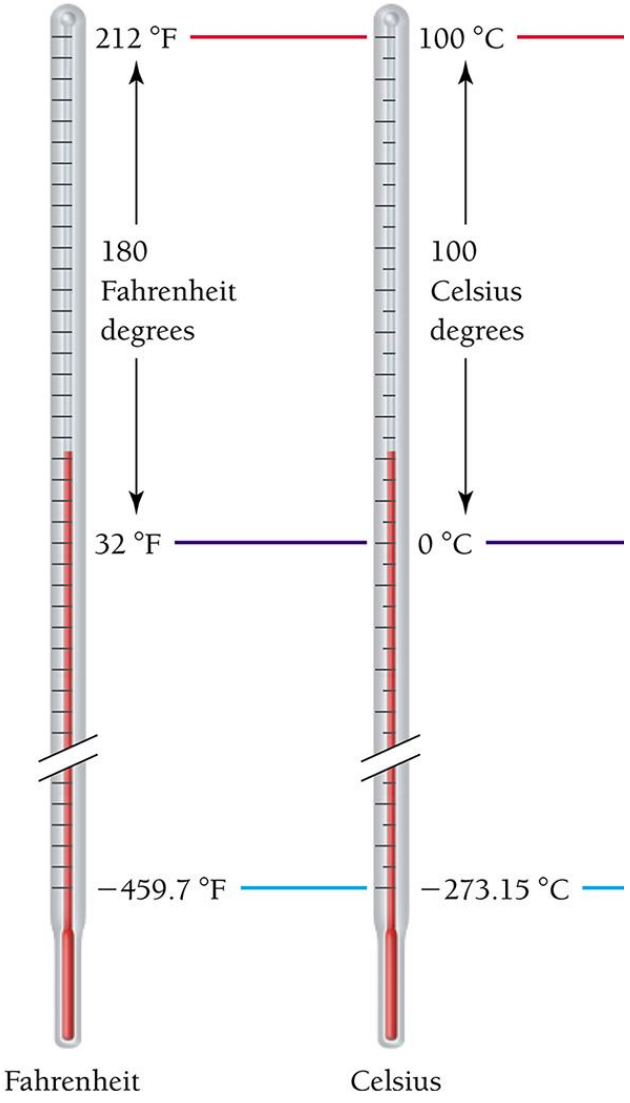

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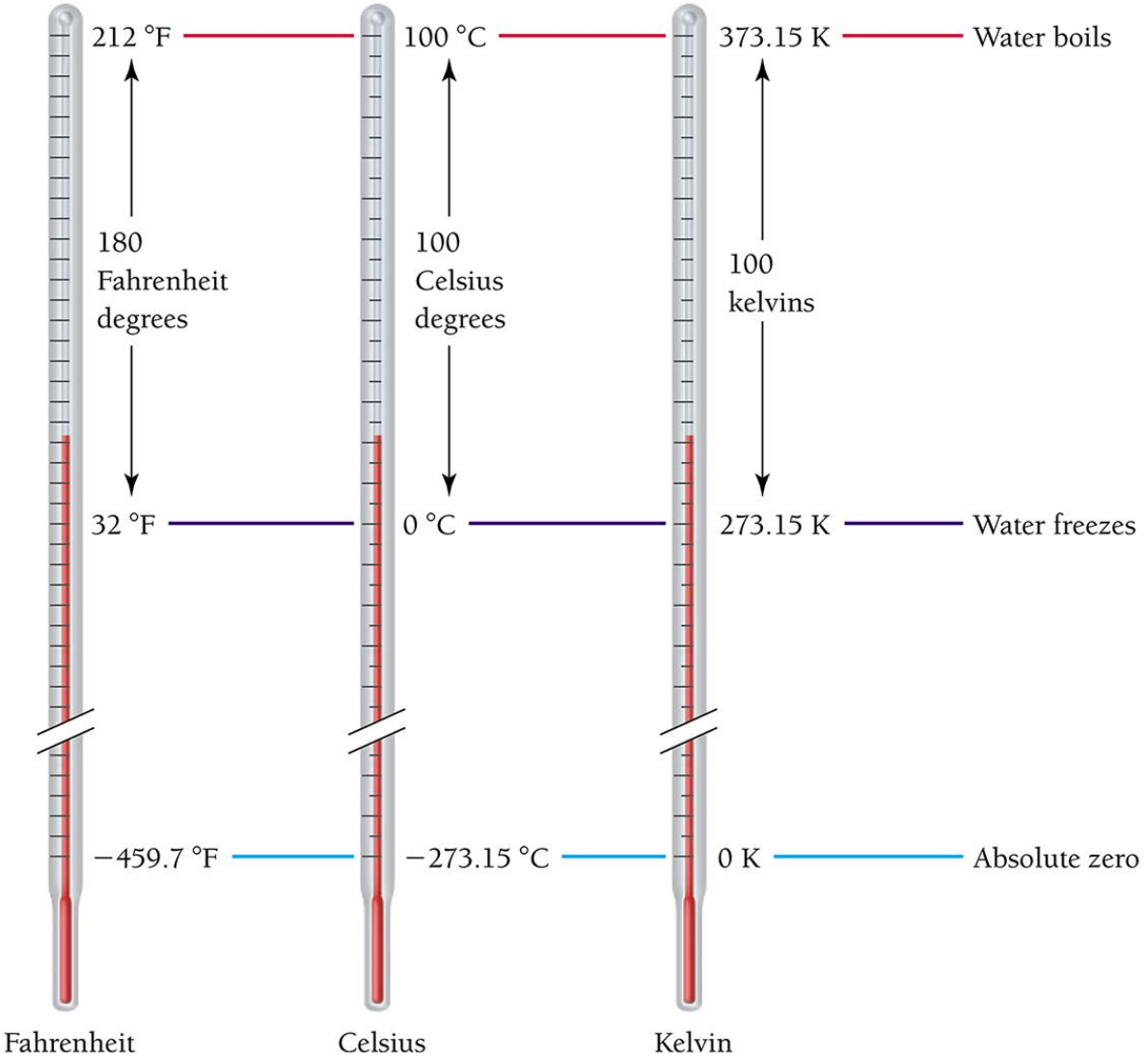
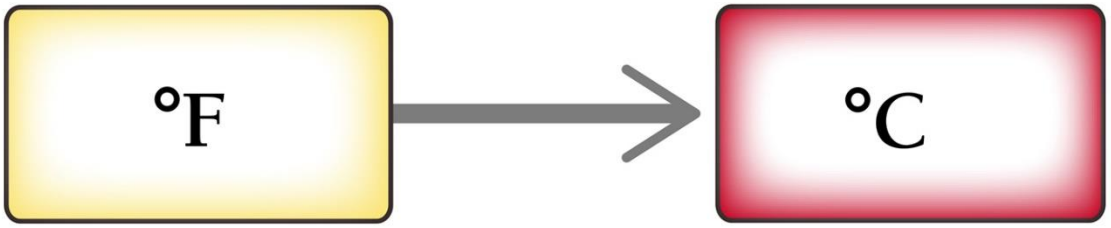
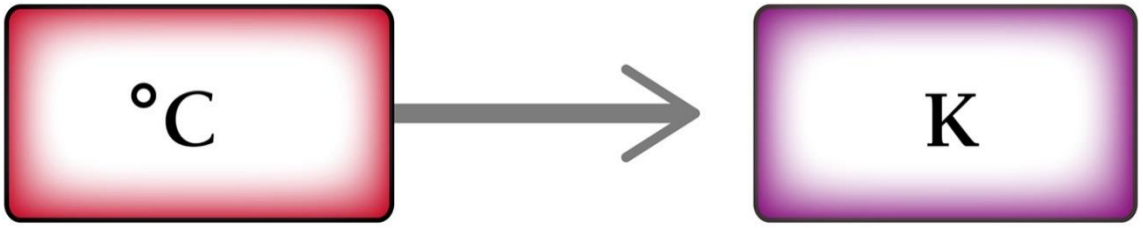


Temperature Unit Conversions



$$°C = \frac{(°F - 32)}{1.8}$$



$$K = °C + 273.15$$

Positive Exponents

$$10^3 = 10 \cdot 10 \cdot 10 = 1,000$$

Negative Exponents

$$10^{-2} = 10^{-1} \cdot 10^{-1}$$

Negative Exponents

$$10^{-2} = 10^{-1} \cdot 10^{-1}$$

$$10^{-1} = \frac{1}{10}$$

Problem 5

What is the product of the following two numbers in scientific notation?

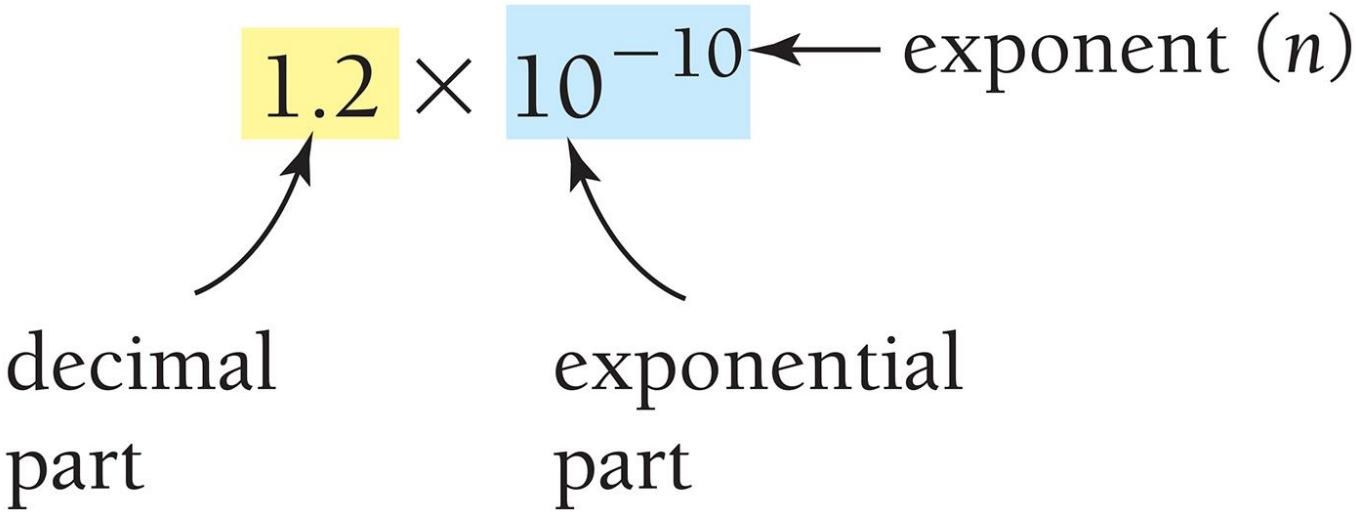
$$10^{-4} \cdot 10^{6}$$

Problem 5 - Solution

What is the product of the following two numbers in scientific notation?

$$10^{-4+6} = 10^{2}$$

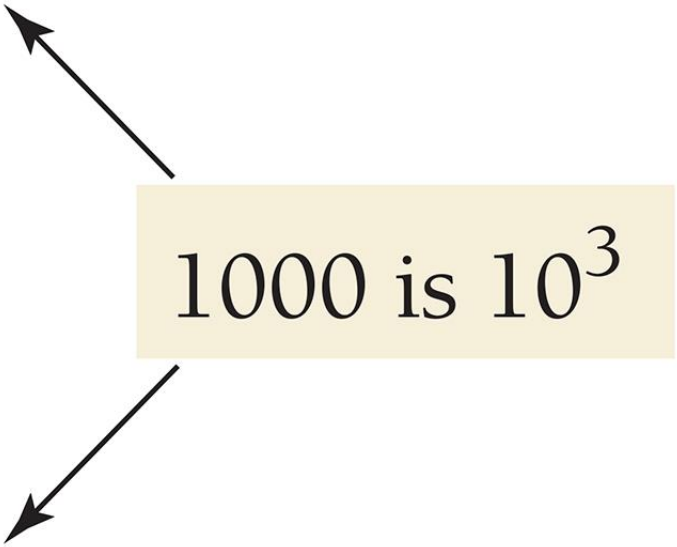
Scientific Notation Mechanics



It is standard convention for the decimal part to be in-between 1.0 and 9.9

Scientific Notation

$$5983 = 5.983 \times 1000$$



$$= 5.983 \times 10^3$$

Scientific Notation

$$5983 = 5.983 \times 10^{3}$$

Scientific Notation

$$0.00034 = 3.4 \times 10^{-4}$$

1 2 3 4

Problem 6

Write each number in scientific notation.

General	Scientific Notation
1,523,000,000	
0.00000123	

Problem 6 - Solution

General	Scientific Notation
1,523,000,000	1.523×10^{9}
0.00000123	1.23×10^{-6}

Scientific Notation: A Way To
Make Numbers Take Up Less Space

Problem 7

Represent the following numbers in scientific notation.

(a) 1,234 mL

(b) 0.00000000343 m

(c) 6,123 g

(d) 52 s

(e) 5 K

Problem 7 - Solutions

1234 mL

$$1.234 \times 10^3 \text{ mL}$$

Problem 7 - Solutions

0.00000000343 m

$$3.34 \times 10^{-9}\ \mathrm{m}$$

Problem 7 - Solutions

6,123 g

$$6.123 \times 10^3 \text{ g}$$

Problem 7 - Solutions

52 s

$$5.2 \times 10^1 \text{ s}$$

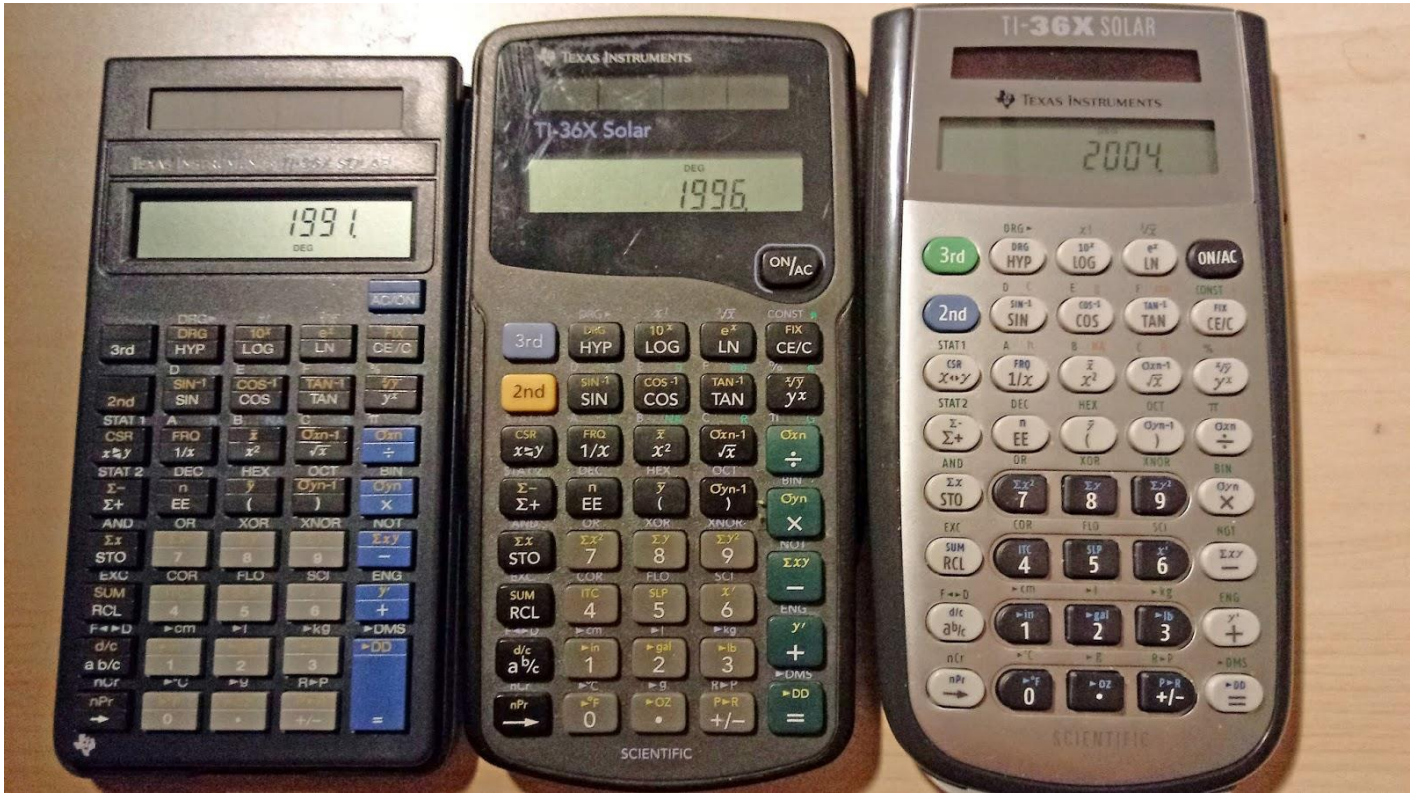
Problem 7 - Solutions

5 K

$$5 \times 10^0 \text{ K}$$

Recall that $10^0 = 1$

You Must Be Familiar With Your Scientific Calculator



Learning Outcomes

1. Know how to apply the SI prefixes m, c, and k to a measurement (example: write 0.025 L in mL).
2. Describe what a measurement is and what is the role/purpose of units.
3. Explain why chemists use significant figures and what significant digits tell a scientist about a measurement.
4. Correctly report a measurement from an analog (not digital) instrument (example: thermometer reading, volume measurement, etc.)
5. Explain what uncertainty is in a measurement.
6. Explain the difference between accuracy and precision.
7. Assign the correct number of significant digits to a measured value.
8. Assign the correct number of significant digits to a calculated value (where each value in the calculation is a measurement).

Prefix Multipliers Make Numbers With Units More Compact

Prefix	Symbol	Multiplier
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}

Prefix	Symbol	Multiplier
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}

SI Prefixes Needed for CHEM 60

Prefix	Symbol	Multiplier
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}

Prefix	Symbol	Multiplier
mega	M	10^{6}
kilo	k	10^{3}

Prefix Multipliers Make Numbers With Units More Compact

$$0.000005\ \mathrm{L} = 5 \times 10^{-6}\ \mathrm{L}$$

$$0.000005\ \mathrm{L} = 5\ \mu\mathrm{L}$$

It is standard convention for the number before the SI prefix to be in-between 1 and 999

Problem 8

Write 0.000000750 m using a SI prefix.

Problem 8 - Solution

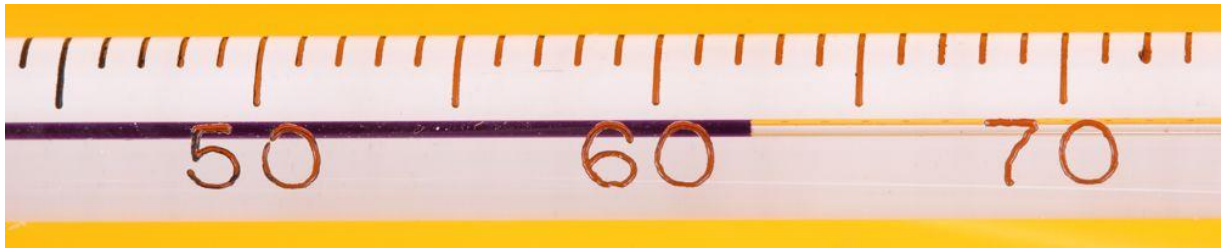
$$750 \times 10^{-9}\ \mathrm{m} = 750\ \mathrm{nm}$$

Problem 9

Convert 5 mm to m. Report your answer as a decimal (no scientific notation).

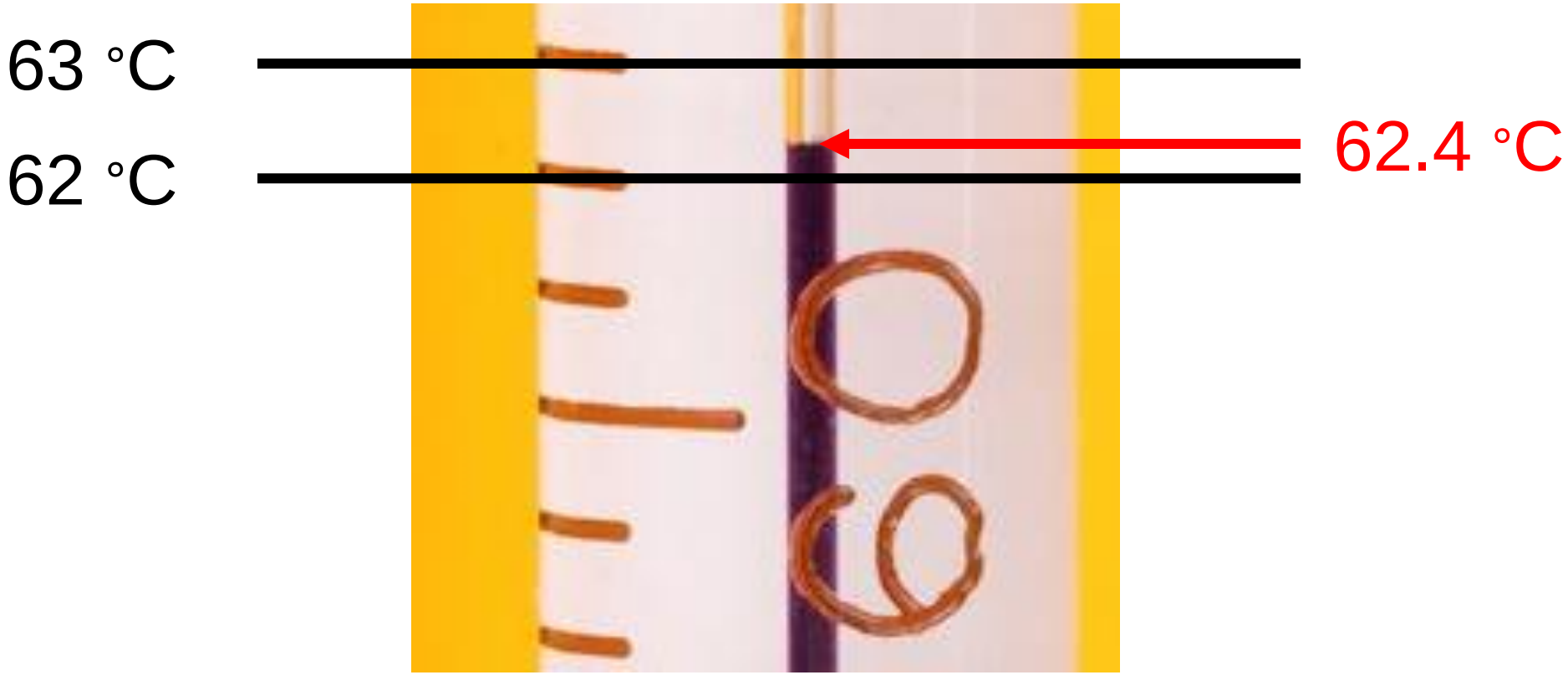
Measurement

Analog

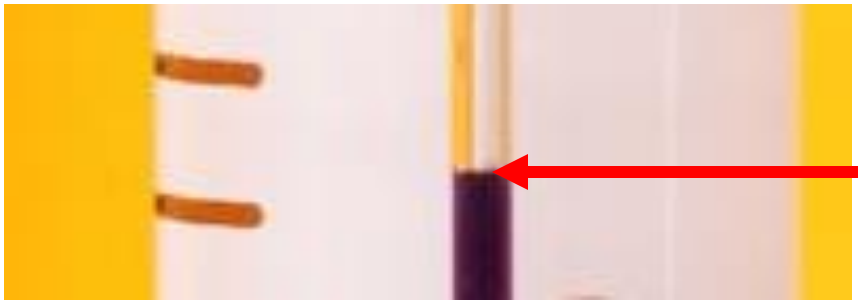


Digital

You Can Approximate to One Level of Added Precision for Analog Measurements



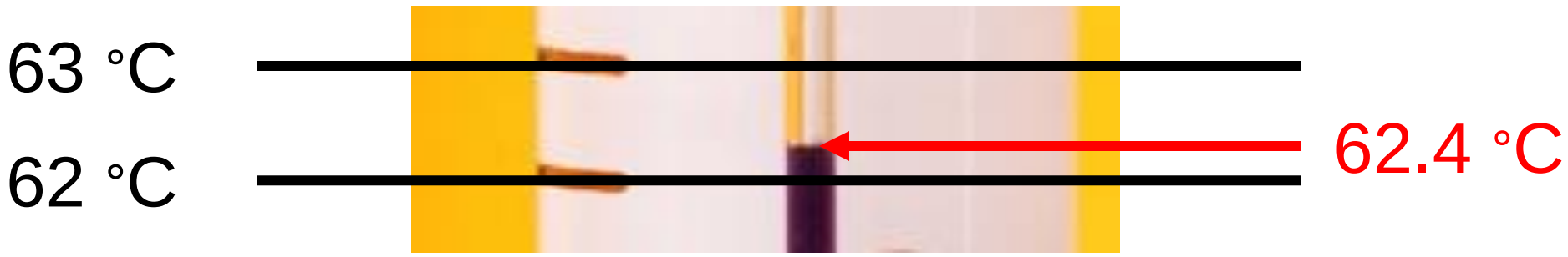
Is the “True Value 62.4 °C?



It could easily be 62.3 or 62.5 °C.

Similar to how the digital thermometer has an uncertainty value, an analog measurement has an uncertainty that is limited by how well you can estimate the last digit.

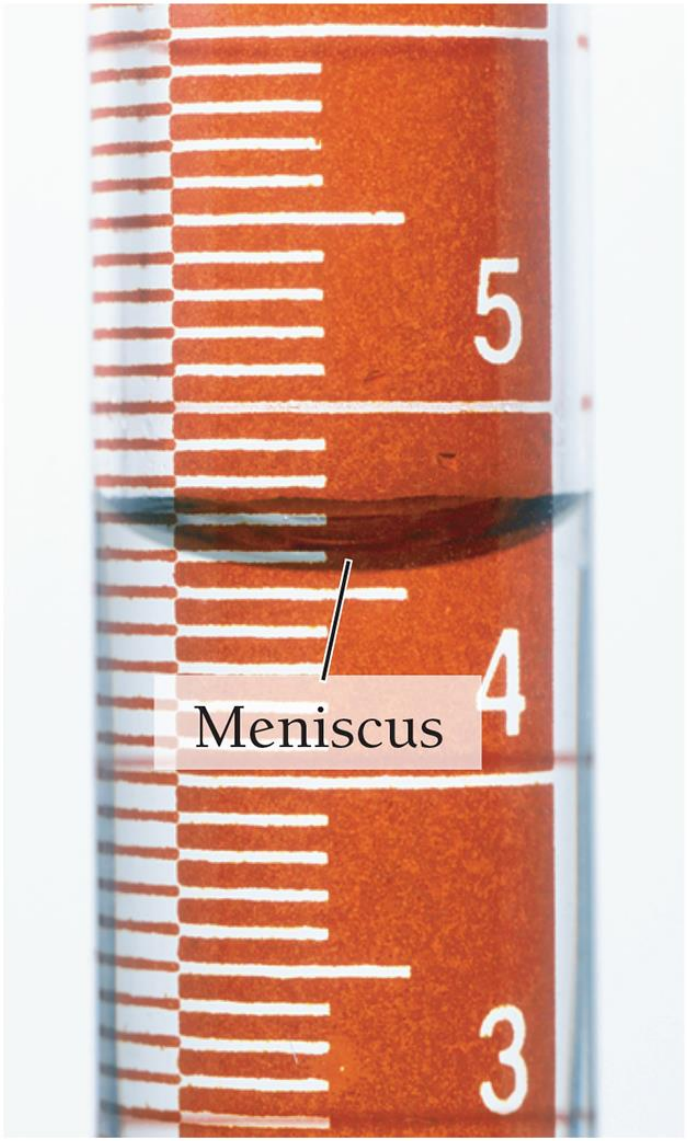
Why Should I Bother Estimating if I Know The Last Digit Is Uncertain?



We know the temperature is not 62.0 or 63.0 °C
so an estimation improves on either limit.

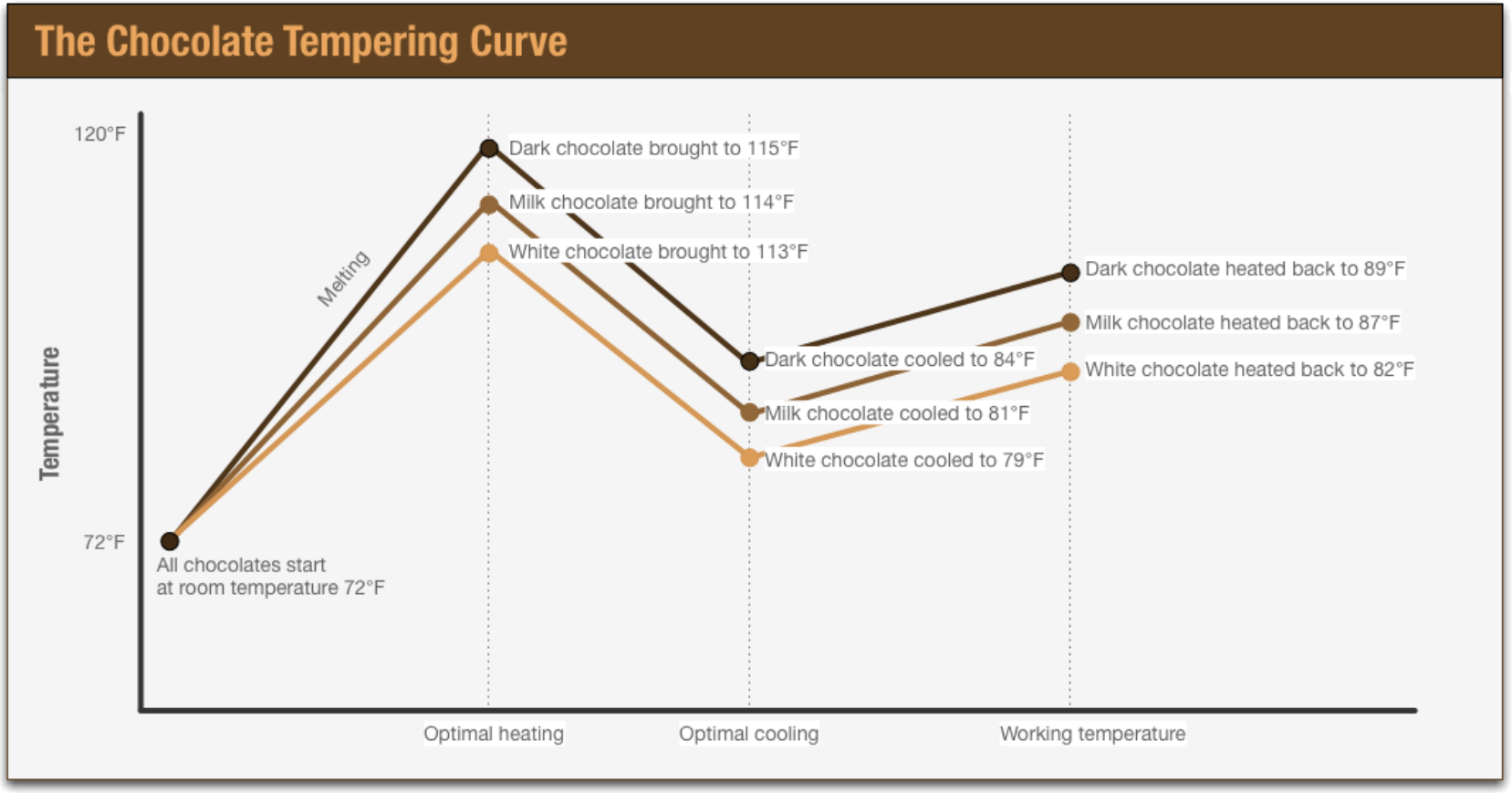
Problem 10

What is the measured volume in mL?



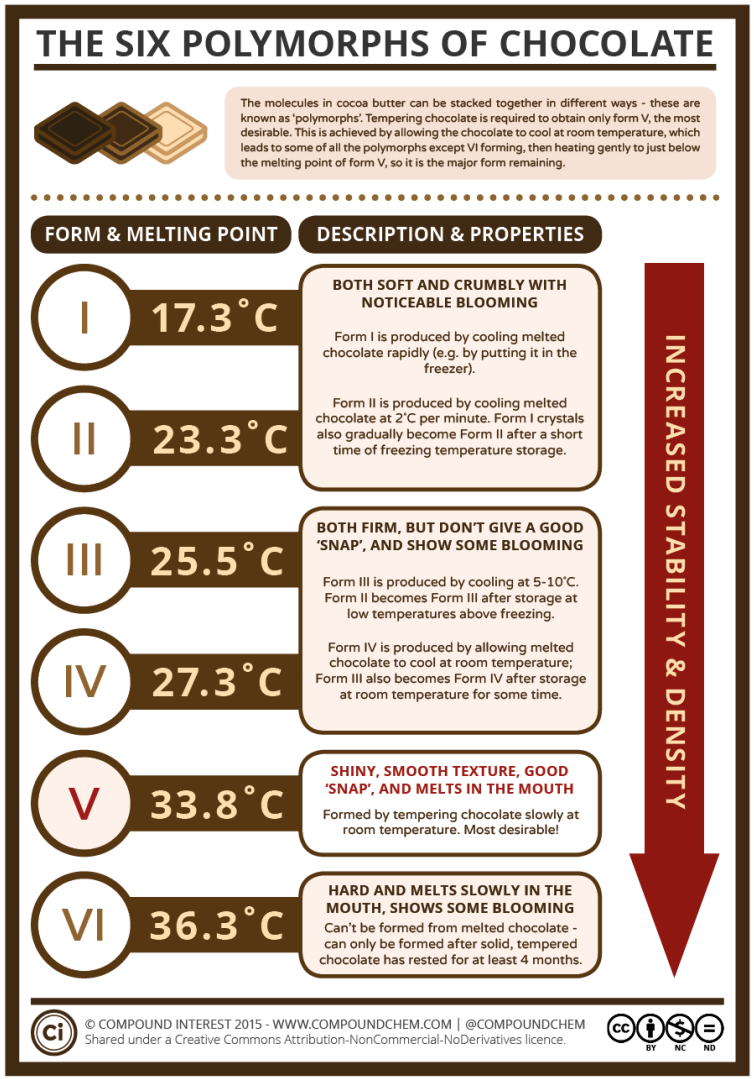
Tempering Chocolate: Precision Matters!!

Precision matters! If you are off by more than ***2 degrees F***, your chocolate will not temper properly.



By Maia Cheslow Baff

Chocolate Can Exist in Six Different Crystal Structures. Each One Has Its Own Melting Point Range.



What Is the Right Tool For the Job?

Thermometer	Precision	Cost
	± 2 °F	$9.00
	± 0.9 °F	$29.00
	± 0.7 °F	$99.00
	± 0.13 °F	$204.00

What Is the Right Tool For the Job?

Thermometer	Sample Reading	Range
	100 °F	98 – 102 °F
	100.0 °F	99.1 – 100.9 °F
	100.0 °F	99.3 – 100.7 °F
	100.00 °F	99.87 – 100.13 °F

Problem 11

When poll is active, respond at **PollEv.com/matthewfonta586**

Which thermometer corresponds to a temperature reading of 95 degrees F?

Black (Precision is +/- 2 Degrees F)	Red (Precision is +/- 0.7 Degrees F)	White (Precision is 0.13 Degrees F)

Poll Everywhere

Answers to this poll are anonymous

Problem 12

When poll is active, respond at **PollEv.com/matthewfonta586**

Which thermometer corresponds to a temperature reading of 85.0 degrees F?

Black (Precision is +/- Degrees F)	Red (Precision is +/- 0.7 Degrees F)	White (Precision is +/- 0.13 Degrees F)

Poll Everywhere — Answers to this poll are anonymous

Problem 13

What is the meaning behind reporting digits and not reporting others? Example: does 95.0 °F convey the same scientific meaning as 95 °F

Significant Figures/Digits

Textbook Definition:

Significant figures (sig.figs) are the

non-place-holding digits in a reported measurement. They represent the precision of a measured quantity.

Working Definition:

Sig. figs. are the ***meaningful*** numbers in numbers reported value.

How Do We Know Which Digits Are Significant When We Do Math?

Short Answer:

We follow a series of sig. fig. rules (discussed in later slides) that ensures our calculated result includes only significant digits.

Long Answer:

The sig. fig. rules are based on statistics.

Why Should I Care About Significant Figures When Uncertainty Is Introduced Via Laboratory Measurement? Doesn't The Textbook Just Make Up These Numbers??

Answer:

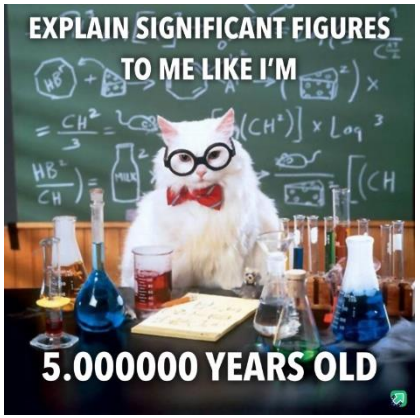
We will pay careful attention to significant digits in the lab. For the textbook, we will assume all numbers are collected in the lab.

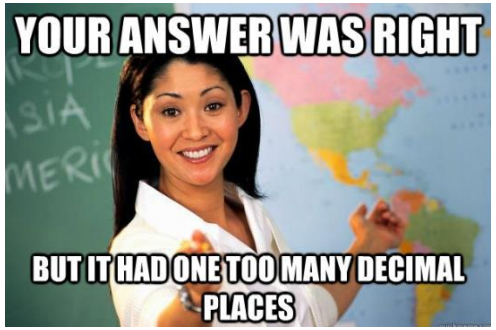
Important Note:

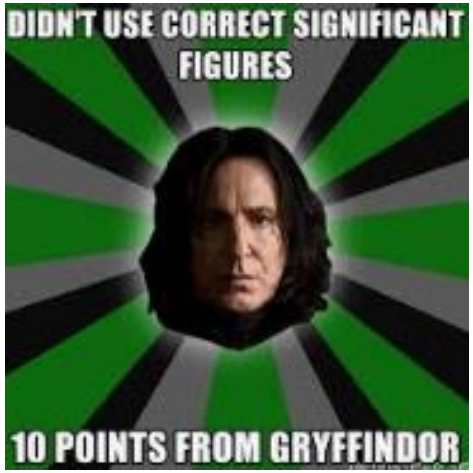
Sometimes I will not rigorously follow the sig. fig. rules. This is especially true for longer and multi-step calculations. This is because ***first, I want you to focus on the concept and conceptual flow of the problem.***

Guideline: Always be aware of significant figures and try your best. Make sure to pay special attention to sig. figs. for both lab calculations and shorter calculations.

The Internet's Definition of Significant Figures

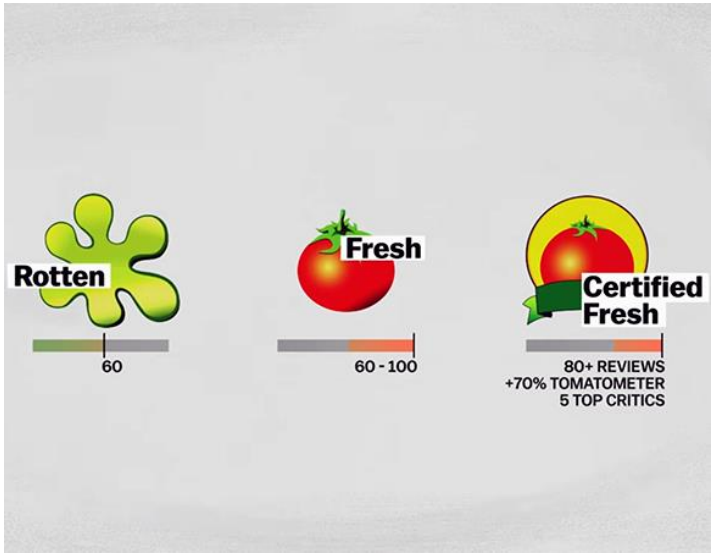






Why Are Significant Figures Good?

Significant figures tell us how good our data is, just like any other metric.



81 °F 135.0 °F 155.47 °F

Not all Digits Are Significant

What rules do you think apply for significant figures? Note, the zeros are highlighted in blue.

Measured Quantity	Number of Zeros	Significant Digits
1234 s	0	4
1.234 s	0	4
1.0234 s	1	5
0.001234 s	3	4
0.0001234 s	4	4
0.00012340 s	5	5
0.00123400 s	5	6
0.001234005 s	5	7

Think-Pair-Share: Problem 14

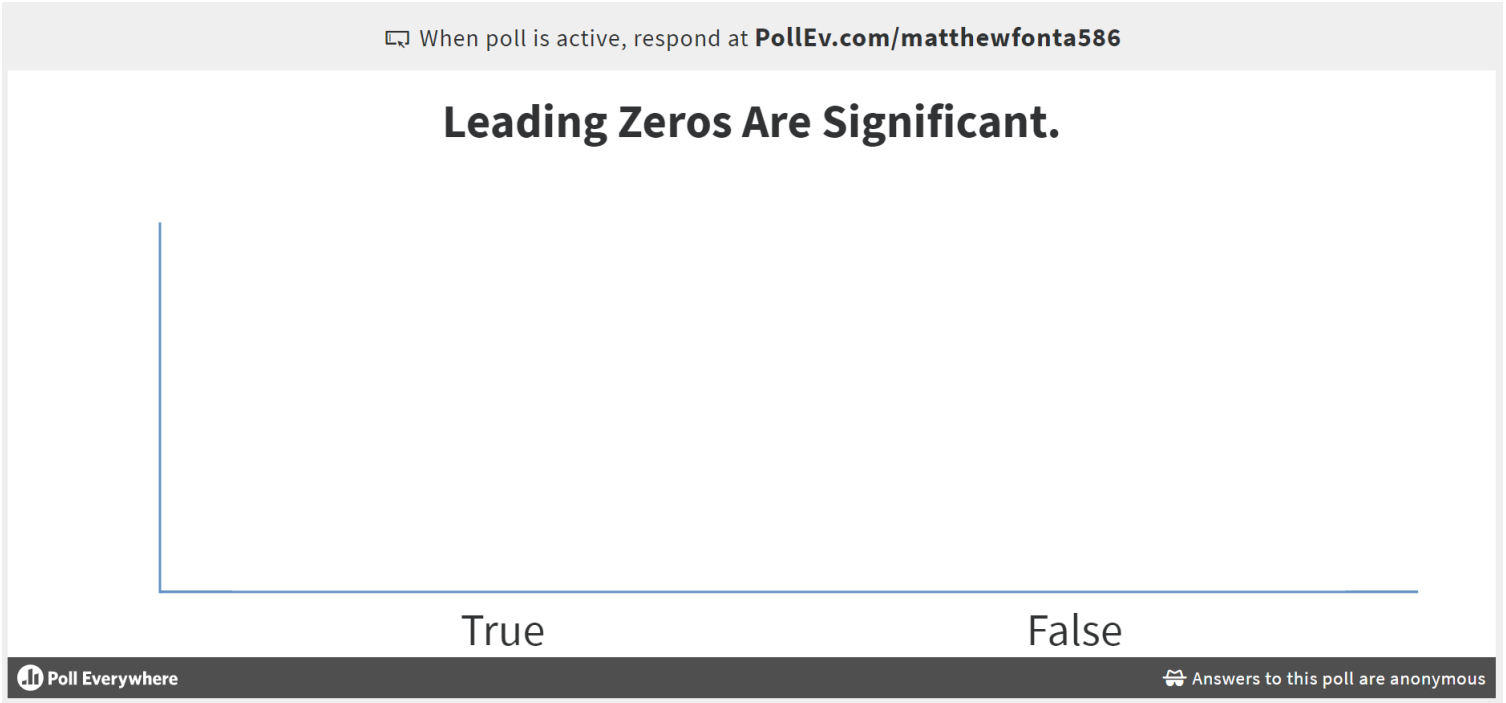
When poll is active, respond at **PollEv.com/matthewfonta586**

Trailing Zeros Are Significant.

Poll Everywhere

Answers to this poll are anonymous

Think-Pair-Share: Problem 15



Problem 16

How many significant figures does each of the following measurements have?

(a) 2×10^{3} mL

(b) 25×10^{-6} L

(c) 0.025×10^{3} L

Math With Significant Figures

Now that we know how to assign the number of sig. figs. to a number, let's learn how to assign the number of sig. figs. to a calculated result!

Note, this requires some sig. fig. rules.

Significant Figure Rules

Rule 1: Addition/Subtraction: The number with the least amount of decimal places determines how many digits after the decimal place your final answer will have.

Rule 2: Multiplication/Division: The number with the smallest amount of sig figs determines how many sig. figs. your final answer will have.

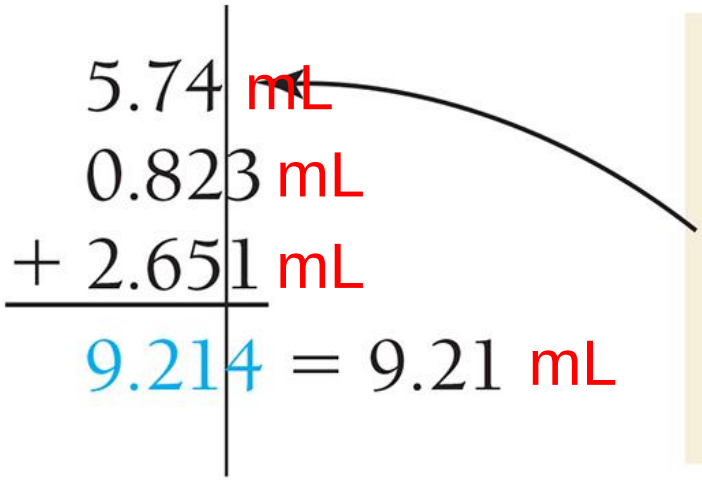
Rule 3: Mixed Operations: When doing mixed operations, do one type of sig. fig. calculation and then use that new answer as an input into the next calculation.

Why Are These Rules Needed?

Music: A band is only as good as its weakest member.

Chemistry: A calculated number's precision is largely determined by the number with the least amount of precision.

Rule 1: Addition and Subtraction



It is sometimes helpful to draw a vertical line directly to the right of the number with the fewest decimal places. The line shows the number of decimal places that should be in the answer.

Does this make sense?

Sig. figs. make sense only with units!!

Problem 17

Calculate the following operations. Make sure your answer has the correct number of significant digits.

(a) 5.0 mL + 5.00 mL

(b) 0.5 mL + 1.0 mL + 2 mL

Rule 2: Multiplication/Division

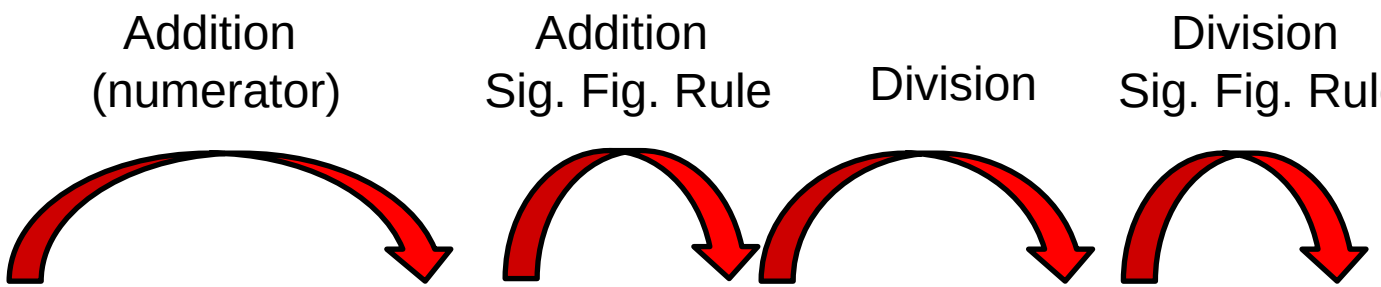
$$12.20\ \text{ft} \times 3.00\ \text{ft} = 36.6\ \text{ft}^2$$

$$12.2\ \text{m} \times 3.0\ \text{m} = 36.6\ \text{m}^2 = 37\ \text{m}^2$$

$$12.20\ \text{cm} \times 3\ \text{cm} = 36.6\ \text{cm} = 40\ \text{cm} = 4 \times 10^1\ \text{cm}$$

$$\frac{52.2\ \text{mL} \times .232\ \text{M}}{2.3\ \text{M}} = 5.265\ \text{mL} = 5.3\ \text{mL}$$

Rule 3: Mixed Operations



$$\frac{1.1\ \text{g}+2.2\ \text{g}+0.12\ \text{g}}{4.23\ \text{mL}} = \frac{3.42\ \text{g}}{4.23\ \text{mL}} = \frac{3.4\ \text{g}}{4.23\ \text{mL}} = 0.8037\ g/\text{mL} = 0.80\ g/\text{mL}$$

Learning Outcomes

1. Explain the terms conversion factor and exact number and understand the difference between the two terms.
2. Convert from one SI prefix to another SI prefix
3. Use one conversion factor to convert a given unit to different unit of the same quantity. For example, converting seconds to minutes (the quantity is time) or cups to mL (the quantity is volume).
4. Identify conversion factors as links in multi-step calculations and prepare a conceptual road map.
5. Use multiple conversion factors to convert a given unit to different unit of the same quantity. For example, converting seconds to hours (the quantity is time, but requires more than one conversion factor in the calculation).

Units!

Quantity	SI		English	
	Unit	Symbol	Unit	Symbol
Length	meter	m	foot	ft
Mass	kilogram	kg	pound mass	lb
Time	second	s	second	s
Temperature	kelvin	K	degree Fahrenheit	°F
Amount of Substance	mole	mol	mol	mol
Electric Current	ampere	A	ampere	A
Luminous Intensity	candela	cd	candlepower	cp

Common Conversion Factors

Quantity	SI	Engish	Conversion Factor
Length	meter	foot	1 m = 3.28 ft
Mass	kilogram	pound-mass	1 kg = 2.21 lb
Temperature	kelvin	degree Fahrenheit	$^\circ\mathrm{F} = \frac{9}{5}(\mathrm{K} - 273) + 32$
Luminous Intensity	candela	candlepower	1 cd = 1.02 cp

Caution!

Conversion factors are ***exact!***

Make sure to not include numbers from conversion factors into your sig. fig. analysis.

Although they may appear to have few sig. figs., these conversion factors are definitions with no associated measurement. Therefore, we can look at them as having an ***infinite*** number of sig. figs. For simplicity, we do not write out all the extra digits.

$$\frac{1 \text{ dozen eggs}}{12 \text{ eggs}} = \frac{1.00000000 \text{ dozen eggs}}{12.00000000 \text{ eggs}}$$

Problem 18

Convert 62,205 mm to km.

Problem 19

Convert 0.000525 mm to nm.

Multiplication of Fractions: Computation Heavy

$$\frac{8}{27} \cdot \frac{9}{14}$$

Requires (mostly) a calculator! ☹

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{72}{378}$$

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{36}{189}$$

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{12}{63}$$

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4}{21}$$

Multiplication of Fractions: A More Elegant Method

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4 \cdot 2}{9 \cdot 3} \cdot \frac{9}{7 \cdot 2}$$

No calculator needed! ☺

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4}{3} \cdot \frac{2}{2} \cdot \frac{9}{9} \cdot \frac{1}{7}$$

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4}{3} \cdot 1 \cdot 1 \cdot \frac{1}{7}$$

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4}{3 \cdot 7}$$

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4}{21}$$

Multiplication of Fractions: Cross Canceling

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4 \cdot \cancel{2}}{\cancel{9} \cdot 3} \cdot \frac{\cancel{9}}{7 \cdot \cancel{2}}$$

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4}{3 \cdot 7}$$

$$\frac{8}{27} \cdot \frac{9}{14} = \frac{4}{21}$$

Unit Division Is Treated The Same As Numbers and Variables!

$$\frac{5}{5} = 1 \qquad \frac{0.5}{0.5} = 1$$

$$\frac{x}{x} = 1 \qquad \frac{y}{y} = 1$$

$$\frac{\mathrm{P}}{\mathrm{P}} = 1 \qquad \frac{\mathrm{n}}{\mathrm{n}} = 1$$

$$\frac{\mathrm{inch}}{\mathrm{inch}} = 1 \qquad \frac{\mathrm{meter}}{\mathrm{meter}} = 1$$

$$\frac{\mathrm{cat}}{\mathrm{cat}} = 1$$

Dimensional Analysis

1. Start with the number you are given. This is the number you usually want to convert to a different unit.

2. Identify conversion factors that link ***two*** units together.

3. Multiply numbers together to move from one unit to another until you arrive at the desired unit.

4. Check to see if your answer makes physical sense.

Problem 20

You have 36 eggs. How many dozen eggs do you have? Note: 1 dozen eggs = 12 eggs.

Problem 21

You buy 5.00 quarts of milk. How many gallons of milk did you buy? 4 quarts = 1 gallon.

Problem 22

How many tablespoons of water are present in 32 mL of water. Note, 3 teaspoons (t) = 1 tablespoon (T) and 1 teaspoon = 4.92 mL.

Problem 23

A Hershey's bar weighs 7.00 oz. How many grams does the Hershey's bar weigh? Note, 1 oz = 28.35 g.

Problem 23 - Solution

Problem 24

You cook a pepperoni pizza and the recipe calls for 1.5 tablespoons (T) of crushed red pepper flakes to be placed onto the pizza. Note, 1 tablespoon (T) of crushed red pepper flakes weighs 0.169 oz and 1 oz = 28.35 g. How many grams of crushed red pepper flakes were added to the pizza?

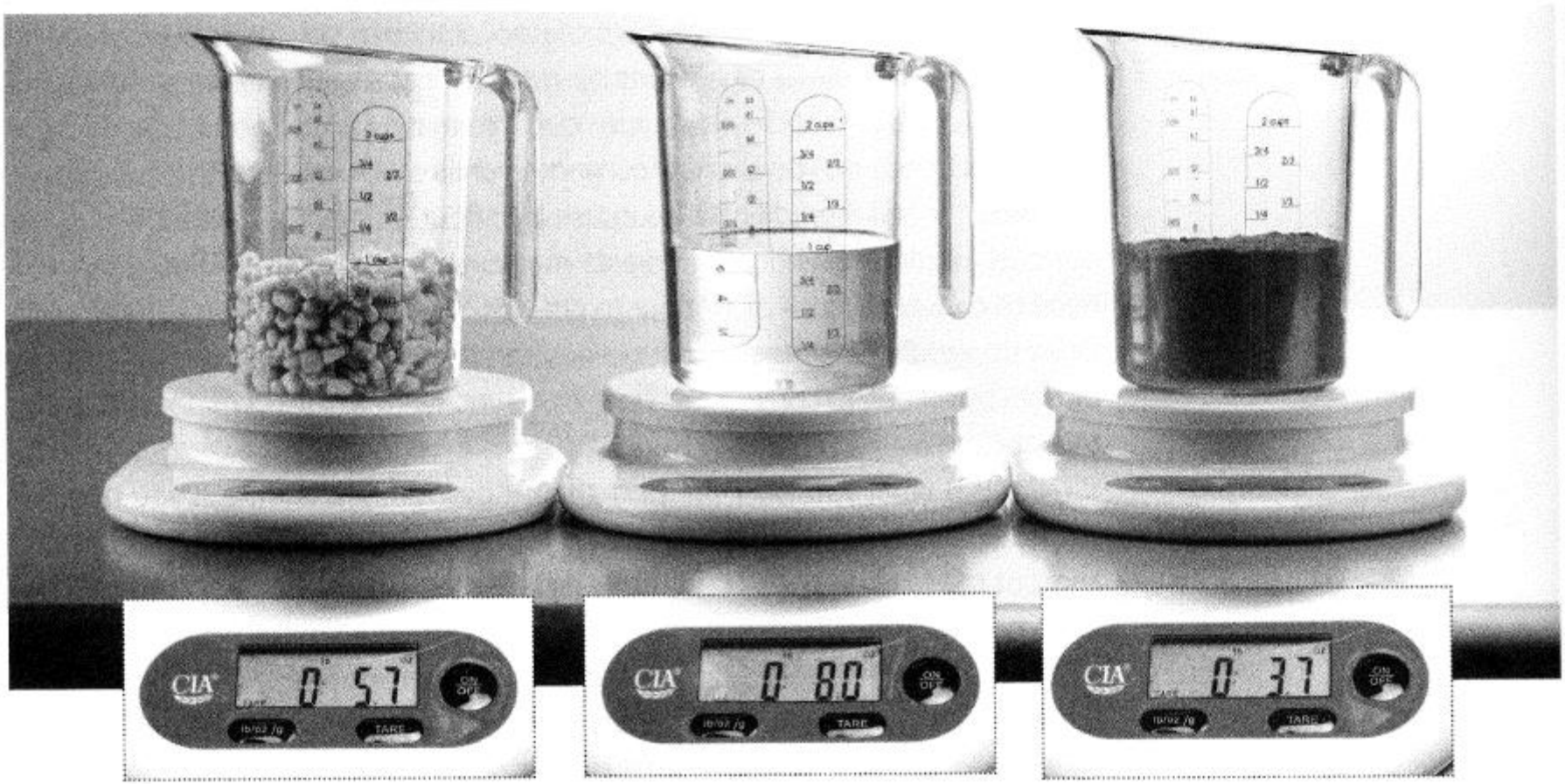
Problem 25

A cake recipe calls for 2 tablespoons of vanilla. However, you do not have a tablespoon in your kitchen! You instead have a teaspoon. How many teaspoons of vanilla must you add to the mix? Note, 1 T = 3 t.

Problem 26

A standard bottle of wine is 750.0 mL. How many fluid ounces does the bottle hold? Note, 1 L = 33.8 fl oz.

Density

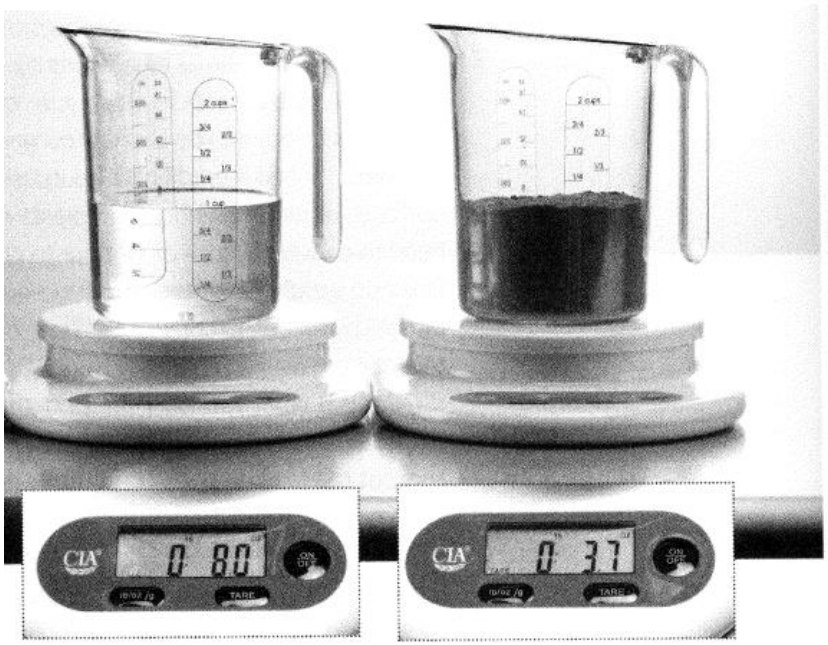


1 C Corn | 1 C Water | 1 C Chili Powder

The same volume (1 cup), but different weight!
Density describes how much a given volume of material weights
Density has units of mass per volume. Ex: g/mL.

Problem 12

Is water of chili powder more dense? Use math to support your answer.



1 C Water
8.0 oz

1 C Chili Powder
3.7 oz

Problem 13

You have 4 sticks of butter. How many pounds of butter do you have? Note, 1 cup of butter = 2 stick of butter and 1 pound of butter = 2 cups of butter.

Problem 13 - Solution

Problem 14

A jar of honey is 1 C in volume. Given that 1 C of honey weighs 12 oz, how many grams does a jar of honey weigh? Note, 1 oz = 28.35 g.

Problem 14 - Solution

Learning Outcomes

1. TBA based on how far we get!

2. Use conversion factors to convert a given unit to a unit with a different quantity. For example, converting g to mL (the quantity is converted from mass to volume) or mL to g (the quantity is converted from volume to mass).

3. Perform multi-step conversion calculations involving any of the following concepts learned: scientific notation, SI prefixes, conversions within the same quantity, conversions to different quantities. For example, convert 5 × 1 0 -3 L of acetone to grams of acetone or convert 5 km to mm.