Dear AP Chemistry student,

Welcome to AP Chemistry! I look forward to a year full of learning with you. A couple of pointers on being successful (as in getting an A) in this course:

- **Be open to learning – while the course is challenging, you will overcome feeling overwhelmed by reading the text as we go through the unit in order to better understand the material.**
- **Be willing to seek help – do not wait until the day before the test or quiz to ask me about material you do not understand**
- **Be willing to work – the course will involve a lot of laboratory experiments and write-ups which will require your participation. These activities are excellent opportunities to learn the material quickly and thoroughly.**

This summer assignment packet covers the first chapter of the book on pretty much the materials you cover at the beginning of Chemistry 1 or AC Chemistry. The first 9 pages covers key points on:

- **the nature of matter,**
- **physical and chemical properties and changes,**
- **basic separation techniques (filtration, chromatography and distillation),**
- **significant figure and how they relate to uncertainties in measurements in the laboratory**
- **standard SI units in measurement and the decimal system, and**
- **dimensional analysis.**

You would have covered all of these topics over the first semester of your Chem 1 classes. Please go over the notes, mark the material that you think you'll need to ask me over and please see me outside of class regarding your questions.

Also included are sample problems with their answers for you to practice on. Please work on these on your free time and mark the problems that you have difficulty over. On the first day of school, we will be going over those sample problems and you can as your questions regarding them if you have any.

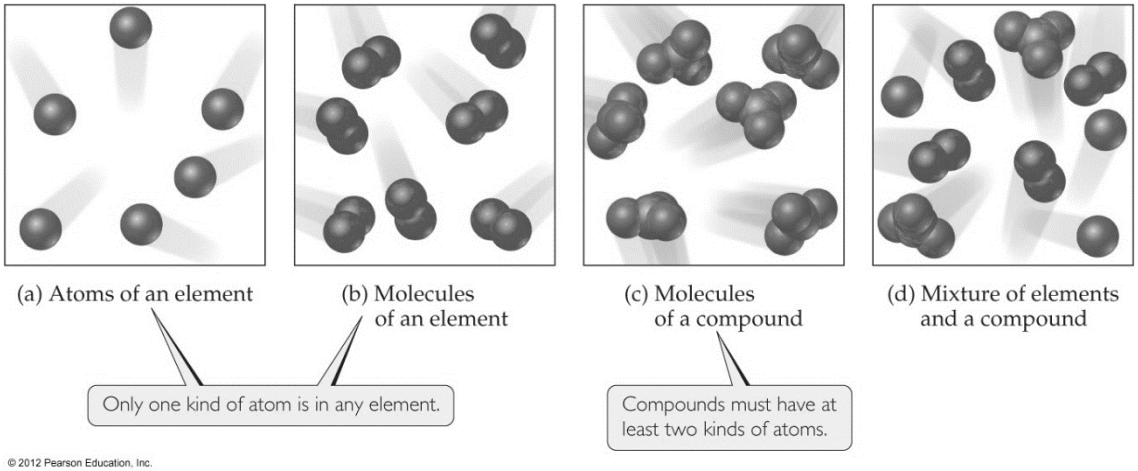
This is it for now. I hope that you are having a restful summer and I look forward to seeing you in class in August!

Mr. Jamerlan

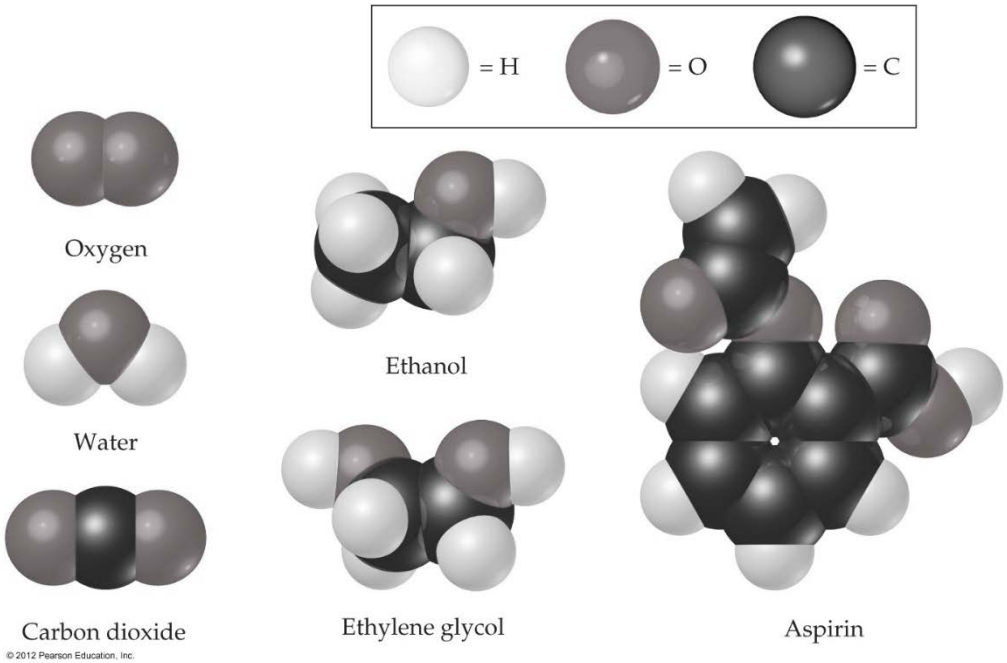
Introduction: Matter and Measurement

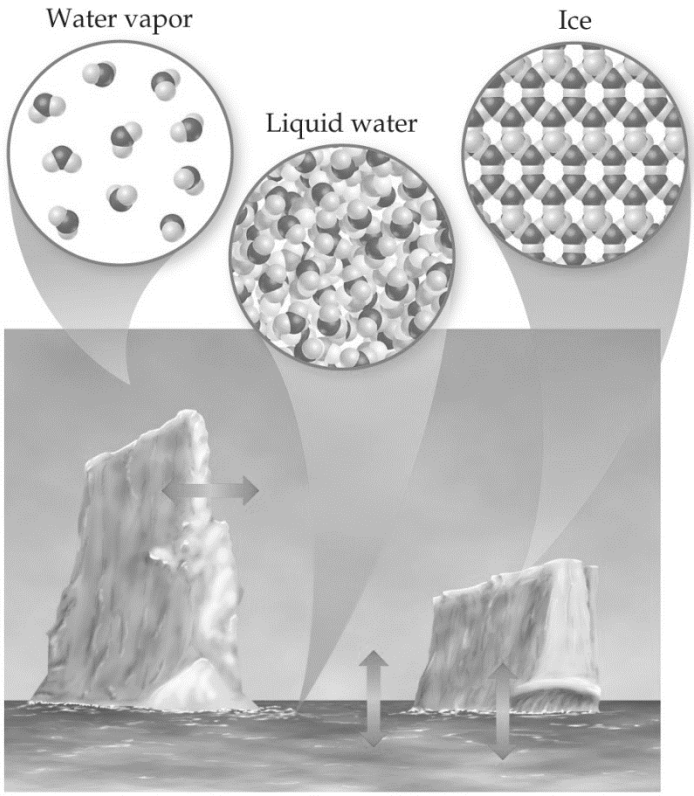
Chemistry - In this science we study **matter**, its **properties**, and its **behavior**.

matter - anything that has mass and takes up space

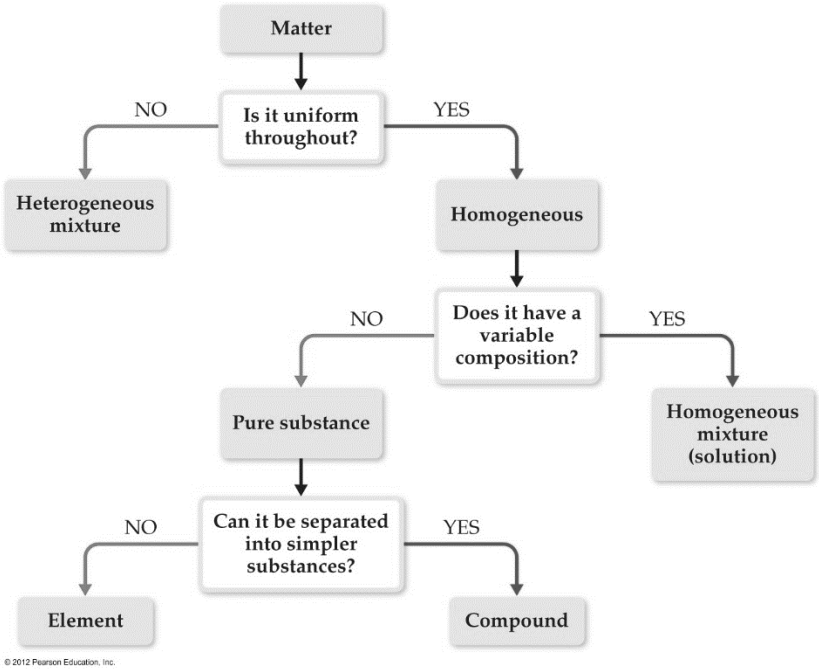


- **atoms** - the building blocks of matter
- **element** - made of the same kind of atom
- **compound** - made of two or more different kinds of elements





Classification of Matter



Types of Properties

- Physical Properties…
  - Can be observed without changing a substance into another substance.
    - Boiling point, density, mass, volume, etc.
- Chemical Properties…
  - Can *only* be observed when a substance is changed into another substance.
    - Flammability, corrosiveness, reactivity with acid, etc.

Types of Changes

- Physical Changes
  - These are changes in matter that do not change the composition of a substance.
    - Changes of state, temperature, volume, etc.
- Chemical Changes
  - Chemical changes result in new substances.
    - Combustion, oxidation, decomposition, etc.

- Chemical Reactions - In the course of a chemical reaction, the reacting substances are converted to new substances.

Separation of Mixtures

1. filtration - solid substances are separated from liquids and solutions

2. Distillation - uses differences in the boiling points of substances to separate a homogeneous mixture into its components.

3. Chromatography - separates substances on the basis of differences in solubility in a solvent.

Units of Measurement

- SI Units (*Système International d'Unités*)
- A different base unit is used for each quantity.

TABLE 1.4 • SI Base Units

Physical Quantity	Name of Unit	Abbreviation
Mass	Kilogram	kg
Length	Meter	m
Time	Second	s or sec
Temperature	Kelvin	K
Amount of substance	Mole	mol
Electric current	Ampere	A or amp
Luminous intensity	Candela	cd

- Know all these units except Candela

Metric System – based on decimal system. Prefixes convert the base units into units that are appropriate for the item being measured.

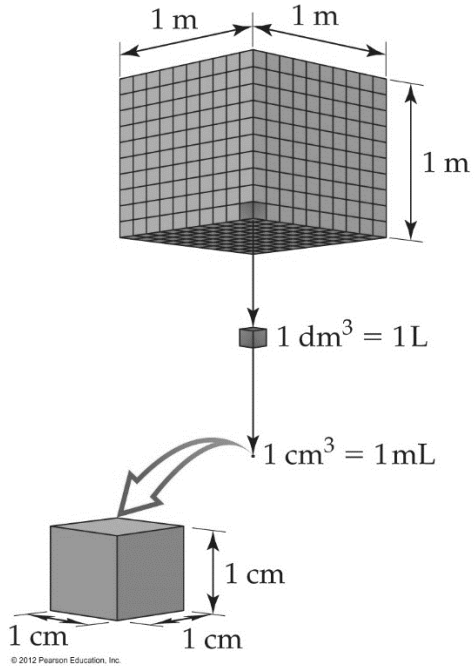
TABLE 1.5 • Prefixes Used in the Metric System and with SI Units

Prefix	Abbreviation	Meaning	Example
Peta	P	10^{15}	1 petawatt (PW) $= 1 \times 10^{15}$ watts[a]
Tera	T	10^{12}	1 terawatt (TW) $= 1 \times 10^{12}$ watts
Giga	G	10^{9}	1 gigawatt (GW) $= 1 \times 10^{9}$ watts
Mega	M	10^{6}	1 megawatt (MW) $= 1 \times 10^{6}$ watts
Kilo	k	10^{3}	1 kilowatt (kW) $= 1 \times 10^{3}$ watts
Deci	d	10^{-1}	1 deciwatt (dW) $= 1 \times 10^{-1}$ watt
Centi	c	10^{-2}	1 centiwatt (cW) $= 1 \times 10^{-2}$ watt
Milli	m	10^{-3}	1 milliwatt (mW) $= 1 \times 10^{-3}$ watt
Micro	μ[b]	10^{-6}	1 microwatt (μW) $= 1 \times 10^{-6}$ watt
Nano	n	10^{-9}	1 nanowatt (nW) $= 1 \times 10^{-9}$ watt
Pico	p	10^{-12}	1 picowatt (pW) $= 1 \times 10^{-12}$ watt
Femto	f	10^{-15}	1 femtowatt (fW) $= 1 \times 10^{-15}$ watt
Atto	a	10^{-18}	1 attowatt (aW) $= 1 \times 10^{-18}$ watt
Zepto	z	10^{-21}	1 zeptowatt (zW) $= 1 \times 10^{-21}$ watt

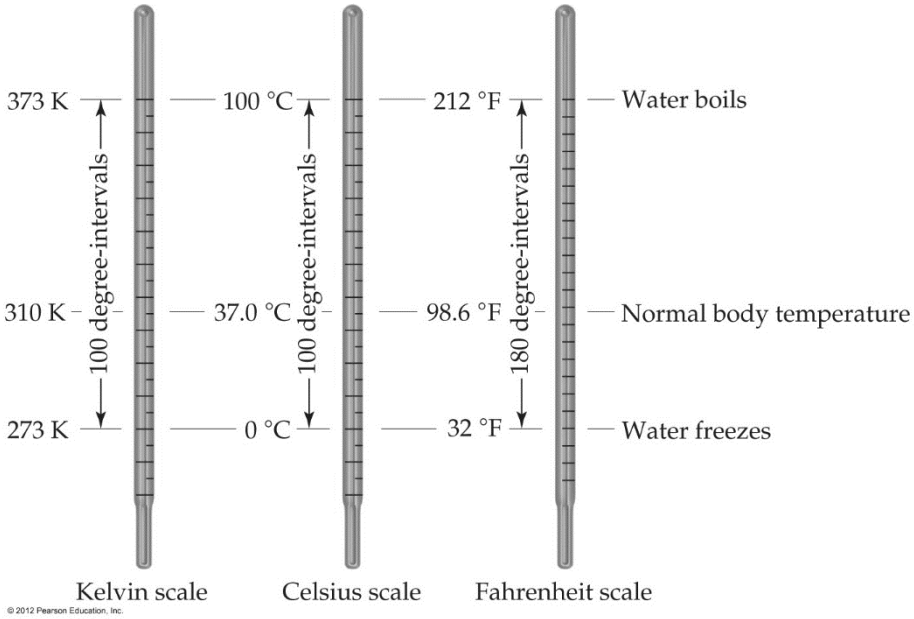
[a]The watt (W) is the SI unit of power, which is the rate at which energy is either generated or consumed. The SI unit of energy is the joule (J); 1 J = 1 kg · m^2/s^2 and 1 W=1 J/s.

[b]Greek letter mu, pronounced "mew."

- Volume - most commonly used metric units are the liter (L) and the milliliter (mL).
- **A liter** is a cube of 1 decimeter long on each side. 1 L = 1 dm^3
- A milliliter is a cube 1 centimeter long on each side. 1 mL = cm^3



Temperature - is a measure of the average kinetic energy of the particles in a sample.



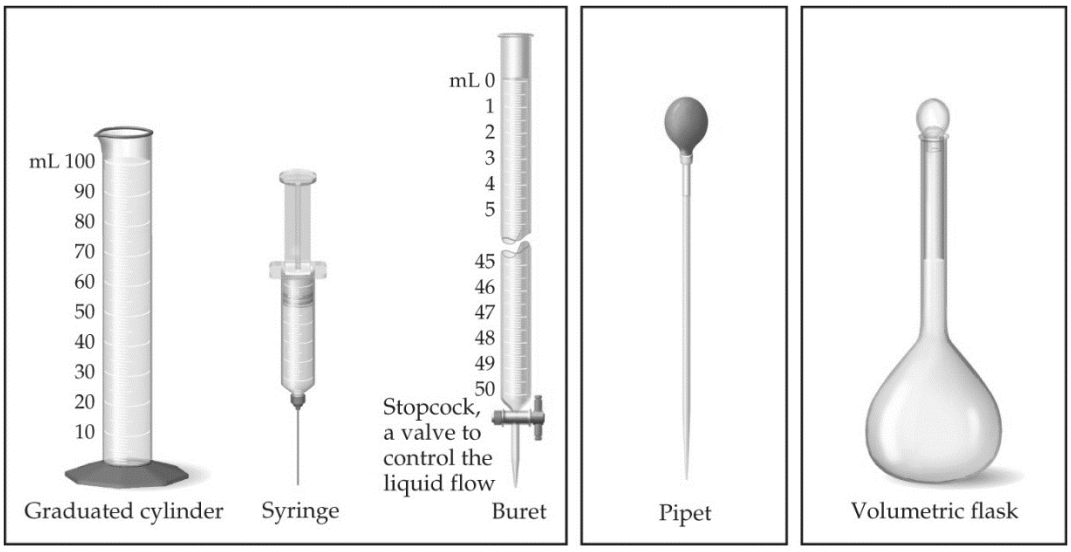
- The kelvin is the SI unit of temperature.
- It is based on the properties of gases.
- There are no negative Kelvin temperatures.
- K = °C + 273.15

Derived Units

- **Density** is a physical property of a substance; has units (*g*/*mL*, for example) that are derived from the units for mass and volume.

Uncertainty in Measurement

- Different measuring devices have different uses and different degrees of accuracy.



- **significant figures** - refers to digits that were measured; when rounding calculated numbers, we pay attention to significant figures *so we do not overstate the accuracy of our answers.*
- **Guidelines for determining significant Figures**
  - All **nonzero digits** are significant.
  - **Zeroes between two significant figures** are themselves significant.
  - Zeroes at the beginning of a number are never significant.
  - **Zeroes at the end of a number** are **significant if a decimal point is written** in the number.
  - In logarithms, only the **digits (zeros and non-zeros) past the decimal point** are significant.
  - ex. Log X = 10.043 has 3 significant digits
- Significant figures in calculations
  - When addition or subtraction is performed, answers are rounded to the least significant **decimal place**.
    - *1.095 + 3.1 = 4.195 = 4.2*
  - When multiplication or division is performed, answers are rounded to the number of digits that corresponds to the ***least* number of significant figures** in any of the numbers used in the calculation.
    - 0.043 x 1.052 = 0.045236 = 0.045

Scientific Notation - The least confusing way to represent reported values in their correct number of significant figures.

$0.00\underline{568} = 5.68 \times 10^{-3}$

$0.\underline{143} = 1.43 \times 10^{-1}$

$\underline{1}000 = 1 \times 10^{3}$

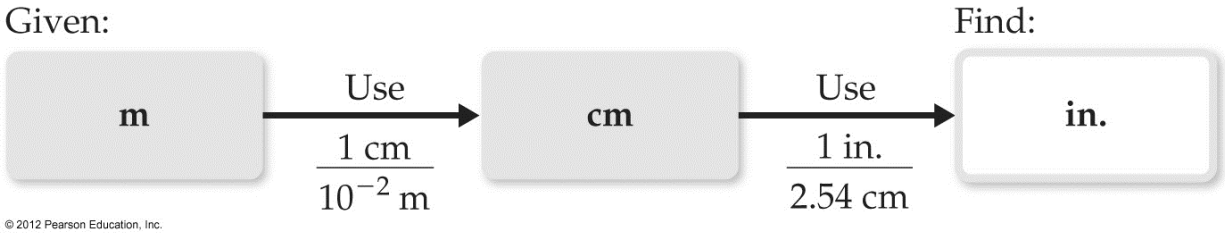
$\underline{200}. = 2.00 \times 10^{2}$

Accuracy versus Precision

- *When reporting measurements to their significant figure, be aware about the distinction between the following:*
  - **Accuracy** refers to the proximity of a measurement to the true value of a quantity.
  - **Precision** refers to the proximity of several measurements to each other.
    - What does significant figure relate to?

Dimensional Analysis

- We use **dimensional analysis** to convert one quantity to another.
- Most commonly, dimensional analysis utilizes **conversion factors** (e.g., 1 in. = 2.54 cm)



Use the form of the conversion factor that puts the sought-for unit in the numerator:

$$\cancel{\text{Given unit}} \times \frac{\text{desired unit}}{\cancel{\text{given unit}}} = \text{desired unit}$$

Conversion factor

- For example, to convert 8.00 m to inches,
  - convert m to cm
  - convert cm to in.

$$8.00 \cancel{\text{m}} \times \frac{100 \text{ cm}}{1 \cancel{\text{m}}} \quad \frac{1 \text{ in.}}{2.54 \text{ cm}} = 315 \text{ in.}$$

Sample Exercises – Use the following problems as a means of practicing concept application and content review for Chapter 1 notes. You will have a 20 question quiz on the same material, a week after school starts (we will be doing a laboratory over Lab separation techniques and significant figures and will start on Atomic structure, which is the 2nd unit). Please see me if you need clarification on any of these problems.

1) A combination of sand, salt, and water is an example of a _____.
A) homogeneous mixture
B) heterogeneous mixture
C) compound
D) pure substance
E) solid

Answer: B

2) A small amount of salt dissolved in water is an example of a _____.
A) homogeneous mixture
B) heterogeneous mixture
C) compound
D) pure substance
E) solid

Answer: A

3) Which one of the following is often easily separated into its components by simple techniques such as filtering or decanting?
A) heterogeneous mixture
B) compounds
C) homogeneous mixture
D) elements
E) solutions

Answer: A

4) An element cannot _____.
A) be part of a heterogeneous mixture
B) be part of a homogeneous mixture
C) be separated into other substances by chemical means
D) interact with other elements to form compounds
E) be a pure substance

Answer: C

5) In the following list, only _____ is <u>not</u> an example of a chemical reaction.
A) dissolution of a penny in nitric acid

B) the condensation of water vapor
C) a burning candle
D) the formation of polyethylene from ethylene
E) the rusting of iron
Answer: B

6) Gases and liquids share the property of _____.
A) compressibility
B) definite volume
C) incompressibility
D) indefinite shape
E) definite shape

Answer: D

7) Which of the following are chemical processes?
1. rusting of a nail
2. freezing of water
3. decomposition of water into hydrogen and oxygen gases
4. compression of oxygen gas
A) 2, 3, 4
B) 1, 3, 4
C) 1, 3
D) 1, 2
E) 1, 4

Answer: C

8) Which one of the following is the highest temperature?
A) 38 °C
B) 96 °F
C) 302 K
D) none of the above
E) the freezing point of water

Answer: A

You have to calculate the mass of a 30.0 mL liquid sample with density of 1.52 g/mL, but you have forgotten the formula. Which way of reasoning would help you in finding the correct mass?
A) If 1 mL of a liquid has the mass of 1.52 g, then 30.0 mL has the mass of _____ g.
B) If 1.52 mL of a liquid has the mass of 1 g, then 30.0 mL has the mass of _____ g.

Answer: A

9) Iron has a density of 7.9 g/cm^3. What is the mass of a cube of iron with the length of one side equal to 55.0 mm?
A) 2.1×10^4 g

B) 4.3×10^2 g
C) 1.3×10^3 g
D) 1.4 g
E) 2.3×10^{-2} g

Answer: C

10) Expressing a number in scientific notation _____.
A) changes its value
B) removes ambiguity as to the significant figures
C) removes significant zeros
D) allows to increase the number's precision
E) all of the above

Answer: B

11) In which one of the following numbers are all of the zeros significant?
A) 100.090090
B) 0.143290
C) 0.05843
D) 0.1000
E) 00.0030020

Answer: A

12) Round the number 0.007222 to three significant figures.
A) 0.007
B) 0.00722
C) 0.0072
D) 0.00723
E) 0.007225

Answer: B

13) The length of the side of a cube having a density of 12.6 g/ml and a mass of 7.65 g is _____ cm.
A) 3.20
B) 0.847
C) 1.02
D) 0.584
E) 1.32

Answer: B

14) Momentum is defined as the product of mass and velocity. The SI unit for momentum is _____.
A) $\frac{\text{kg} \cdot \text{m}}{\text{s}}$

B) $\frac{kg \cdot m}{hr}$

C) $\frac{g \cdot m}{s}$

D) $\frac{g \cdot km}{s}$

E) $\frac{kg \cdot km}{hr}$

Answer: A

15) 3.337 g/cm^3 = _____ kg/m^3

A) 3.337×10^{-9}

B) 3.337×10^{-5}

C) 3337

D) 0.3337

E) 333.7

Answer: C

16) The correct answer (reported to the proper number of significant figures) to the following is _____.

$12.75 \times 1.3621 =$ _____

A) 17.367

B) 17.40

C) 17.37

D) 17.4

E) 17.0

Answer: C

17) The correct result (indicating the proper number of significant figures) of the following addition is _____.

$$\begin{array}{r} 12 \\ 1.2 \\ 0.12 \\ +\ 0.012 \end{array}$$

A) 13

B) 13.3

C) 13.33

D) 13.332

E) none of the above

Answer: A

18) 1.55 kg/m^3 is equivalent to _____ g/L.
A) 3.58×10^{12}
B) 1.95×10^{3}
C) 6.83
D) 1.60×10^{9}
E) 1.55

Answer: E

19) A rectangular water tank is 14.5 cm long and 4.63 cm wide. If 368.5 g of water completely fills the tank, the height of the tank is _____ cm. (Assume the density of water is 1.000 g/ml.)
A) 6.45
B) 5.49
C) 14.0
D) 3.68
E) 4.62

Answer: B

20) A 4.369 g sample of metal is placed in a flask. Water is added to the flask and the total volume in the flask is read to be 126.4 ml. The mass of the water, flask, and metal is 268.5 g. If the mass of the flask is 139.3 g and the density of water is 1.000 g/mL, the density of the solid is _____ g/cm^3.
A) 0.366
B) 1.56
C) 0.641
D) 2.78
E) 3.21

Answer: D