Dr. Zellmer | Chemistry 1250 | T, R
Time: 7 PM Sun. | Spring Semester 2022 | January 23, 2022
40 min | Quiz I

Name KEY Rec. TA/time _____

1. (3 pts) Which of the following statements is **INCORRECT**?

a) Pure substances must be uniform throughout.
b) Some pure substances can be decomposed into simpler pure substances.
c) Heterogeneous mixtures can contain elements.
d)* Every compound is a homogeneous mixture.
e) A heterogeneous mixture must contain at least two different substances.

Mixtures must contain **two** or **more different** substances. These substances can be **elements** (atomic or molecular) or **compounds**. There are essentially two types of mixtures, homogeneous and heterogeneous. The substances in a mixture can be separated into pure substances by physical means. Solutions exist in all phases (states).

Homogeneous mixtures are **uniform** throughout and have the same physical and chemical properties throughout. These are often referred to as **solutions**. Gases dissolve in each other to form solutions and gases dissolve in liquids to form solutions.

Heterogeneous mixtures have physical and chemical **properties** that are **NOT uniform** throughout the sample. Heterogeneous mixtures may contain elements and compounds and must contain 2 or more substances.

Pure substances are not mixtures. They are **elements** or **compounds**. They can not be separated into simpler substances through **physical** means but can be chemically decomposed into simpler pure substances. A pure substance can contain more than one type of atom. Table salt (NaCl) is a pure compound. **Compounds** are always composed of **two** or **more different elements**, chemically combined, in fixed proportion by mass. If only one substance is present the material is a pure substance and the material must be uniform throughout (homogeneous). Both pure substances and solutions have properties that are uniform throughout.

2. (3 pts) Choose from the following list those properties that are **physical** properties of the red-brown liquid **bromine**?

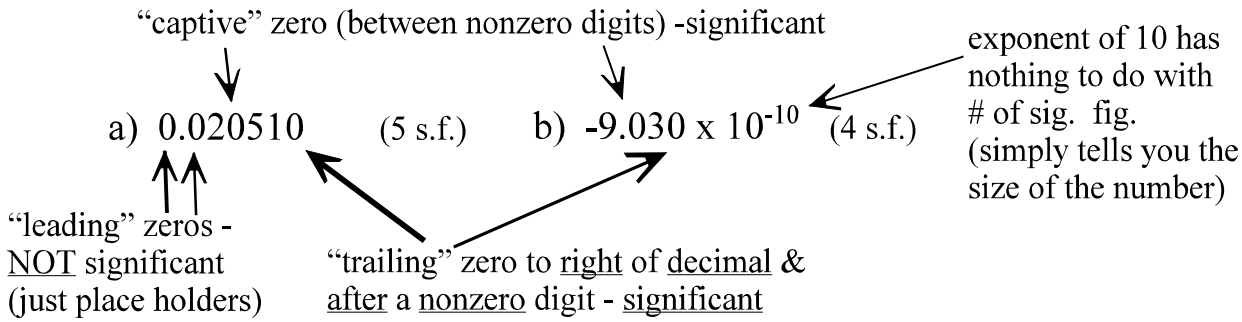
Physical properties of Bromine (Br):

A. Its density is 3.12 g/cm^3.
C. It freezes to form an orange solid.
D. It boils at 58.8°C.

Physical properties depend only on the substance itself and are properties that can be measured **without changing** the **chemical identity** of the substance.

Chemical properties **describe** how a substance **changes during** a chemical **reaction** (i.e. How it reacts or what it reacts with.)

3. (3 pts) Indicate the number of **significant figures** for each of the following numbers.



4. (4 pts) Do the indicated arithmetic and give the answer to the correct number of significant figures.

$$(14.9 \times 0.049) - (3.53 \div 0.0840) + 101.600$$

$(14.9 \times 0.049) = 0.7\underline{3}01$ (2 s.f.) (3 s.f. 2 s.f.) $(3.53 \div 0.0840) = \mathbf{42.}\underline{\mathbf{0}}238$ (3 s.f.) (3 s.f. 3 s.f.) $\mathbf{101.60}\underline{\mathbf{0}}$ (6 s.f.)

$$\begin{array}{r} 0.7\underline{3}01 \\ -\ \mathbf{42.}\underline{\mathbf{0}}238 \\ +\ \mathbf{101.60}\underline{\mathbf{0}} \\ \hline \mathbf{60.}\underline{\mathbf{3}}062 \end{array}$$

Multiplication and **division** rule: answer has same # s.f. as the number with the least # s.f.
Addition and **subtraction** rule: last place in answer is the same as the last significant place common to all numbers. Line up the decimals. You can gain or lose s.f. in addition and subtraction.

$$0.7\underline{3}01 - \mathbf{42.}\underline{\mathbf{0}}238 + \mathbf{101.60}\underline{\mathbf{0}} = 60.\underline{3}062 = \mathbf{60.3}$$

Can only know the final number to the tenths place since that is all **42.0**238 is known to.

5. (4 pts) Perform the following mathematical operations and report your answer to the **correct number of significant figures**. Report your answer in **scientific notation**. Include **units**..

NOT on quiz but good for practice.

$$\frac{(6.115 \times 10^4\ m^2)\ (36.76\ kg - 29.018\ kg)}{0.0045231\ s}$$

(4 s.f.) 7.7**4**2 (3 s.f.) (5 s.f.)

$= 1.0\underline{4}6678826 \times 10^8\ m^2 \bullet kg/s$

$= 1.05 \times 10^8\ m^2 \bullet kg/s$ (3 s.f.)

(mult/div - same # s.f. as # with least # s.f.)

36.76
- 29.018

7.7**4**2 => 7.74 (3 s.f.)

use add/subt rule followed by mult/div rule

This number has only 3 s.f. However, do NOT round until you get the final answer. Do this just to determine the # s.f., but use 7.742 in the rest of the calc.

NOTE: The book or Mastering Chem do not use the round-even rule.

6. (5 pts) A crucible is known to weigh 24.3162 g. Three students in the class determine the weight of the crucible by repeated measurements on a simple balance. Which of the conclusions summarizes the data?

	trial 1	trial 2	trial 3	trial 4	trial 5
Student A	24.8	24.9	24.7	24.9	24.8
Student B	24.6	24.0	24.2	24.1	24.3
Student C	24.5	24.1	24.5	24.1	24.3

A. student B has done the most precise work and student C the most accurate
B. student B has done the most precise work and student A the most accurate
C. student C has done the most precise work and student B the most accurate
D. student C has done the most precise work and student A the most accurate
E. student A has done the most precise work and student C the most accurate

Remember, **precision** means the **degree of reproducibility** (how close the measurements are to each other and how close each measurement is to the average). **Accuracy** is how close the **average** is to the **true value** of what is measured. To determine precision and accuracy, you should determine the averages of the five trials.

The crucible weighs 24.3162 grams

Student A's average 24.82
Students B's average 24.24
Student C's average 24.3

Student **C** has done the most **accurate** work because the average mass of 24.3 grams is closest to the true mass of (24.3162 grams).
Student **A** has done the most **precise** work because the repeated measurements are within 0.2 g of each other and 0.12 g of the average.

7. (4 pts) A 27.40-g sample of a metal is placed in a graduated cylinder containing 30.00 mL of water and the water level rises to 31.22 mL. What is the **density** (in **g/cm^3**) of the sample of metal?

$$D = \frac{27.40 \text{ grams}}{(31.22-30.00) \text{ ml}} = \mathbf{22.4}59 \quad \text{3 s.f.}$$

$$\begin{array}{r} 31.22 \\ -\ 30.00 \\ \hline 1.22 \end{array} \quad \text{3 s.f. (lose a s.f.)}$$

$D = 22.5 \text{ g/mL} = 22.5 \text{ g/cm}^3$

8. (5 pts) Socrates (469 - 399 B.C.) was made to drink hemlock, which contains the poison coniine. The lethal dose of the drug coniine taken orally is 7.00 mg per kilogram of body weight in mice. Calculate the lethal dose in **grams** for a 90.0 lb person, assuming that a human functions the way mice do. (1 lb = 453.6 g)

(con = coniine, bw = body weight)

$$\text{? g con} = 90.0 \text{ lb bw} \times \frac{453.59 \text{ g bw}}{1 \text{ lb bw}} \times \frac{1 \text{ kg bw}}{10^3 \text{ g bw}} \times \frac{7.00 \text{ mg con}}{1 \text{ kg bw}} \times \frac{10^{-3} \text{ g con}}{1 \text{ mg con}} = 0.28\mathbf{5}7 \text{ g} = 0.286 \text{ g}$$

(3 s.f.)

9. (7 pts) The amount of mercury, Hg, in the air on a particular day is 1.50×10^{-10} lb/ft^3. What volume of air (in **m^3**) contains 9.13×10^{-9} kg of mercury? (1.000 lb = 453.6 g, 1 in = 2.54 cm) You **MUST** use **dimensional analysis** (factor unit method) to receive **full** credit!

$$? \text{ m}^3 = 9.13 \times 10^{-9} \text{ kg} \times \frac{10^3 \text{ g}}{1 \text{ kg}} \times \frac{1.000 \text{ lb}}{453.6 \text{ g}} \times \frac{1 \text{ ft}^3}{1.50 \times 10^{-10} \text{ lb}} \times \frac{(12 \text{ in})^3}{(1 \text{ ft})^3} \times \frac{(2.54 \text{ cm})^3}{(1 \text{ in})^3} \times \frac{(10^{-2} \text{ m})^3}{(1 \text{ cm})^3}$$

$$\text{kg} \Longrightarrow \text{g} \Longrightarrow \text{lb} \Longrightarrow \text{ft}^3 \Longrightarrow \text{in}^3 \Longrightarrow \text{cm}^3 \Longrightarrow \text{m}^3$$

$$? \text{ m}^3 = 9.13 \times 10^{-9} \text{ kg} \times \frac{10^3 \text{ g}}{1 \text{ kg}} \times \frac{1.000 \text{ lb}}{453.6 \text{ g}} \times \frac{1 \text{ ft}^3}{1.50 \times 10^{-10} \text{ lb}} \times \frac{(12)^3 \text{ in}^3}{1 \text{ ft}^3} \times \frac{(2.54)^3 \text{ cm}^3}{1 \text{ in}^3} \times \frac{(10^{-2})^3 \text{ m}^3}{1 \text{ cm}^3}$$

$= 3.7\underline{9}971 \text{ m}^3 = 3.80 \text{ m}^3$ (3 s.f.)

There are 3 s.f. in 9.13×10^{-9} kg and 1.50×10^{-10} lb/ft^3 and 4 s.f. in 453.6 g and the other conversions are exact so the answer has 3 s.f.

10. (2 pts) Which of the following statements is **TRUE**?

a) A hypothesis is speculation that is difficult to test.
b) An observation explains why nature does something.
c) A scientific law is fact.
d)* A scientific law summarizes a series of related observations.
e) Once a theory is constructed, it is considered fact.

A scientific law summarizes a series of related observations and facts but itself is not a fact. It is a statement of what happens, to the best of our knowledge, at the time the law is stated. If at some point new investigations and observations contradict the current scientific law it is changed to include the new observations. It can be in the form of an equation.