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Student Exploration: Stoichiometry

Summary Stoichiometry involves balancing chemical equations, using coefficients to determine the relative amounts of reactants and products, and calculating the mass of reactants and products.

Prior Knowledge Questions (Before we begin, answer the following questions.)

1. A certain mass of sugar also contains 10 parts of sugar. How many sugar that amount the (certain) parts of sugar? (Fig)
2. If you have 100 grams of sugar in a container, how much sugar will a certain mass (certain) of sugar?

Warm-up

Write the balanced equation for the reaction between hydrogen and oxygen to form water.

Activity A: Balancing Chemical Equations

1. Look at the **unbalanced** equation for the reaction between hydrogen and oxygen to form water. The numbers in front of the molecules are called **coefficients**. For the equation to be balanced, the number of atoms of each element must be the same on both sides of the equation.

2. Balance the equation by changing the coefficients.

3. Check that the equation is balanced.

4. Look at the **unbalanced** equation for the reaction between hydrogen and oxygen to form water. The numbers in front of the molecules are called **coefficients**. For the equation to be balanced, the number of atoms of each element must be the same on both sides of the equation.

5. Balance the equation by changing the coefficients.

6. Check that the equation is balanced.

Name _____ Date _____ Per _____

Mole to Grams, Grams to Moles Conversions Worksheet

To find moles divide by molar mass To find grams multiply by molar mass

What are the molar masses of the following compounds? ****Round to 2 decimal places****

- 1) NaOH
- 2) H₃PO₄
- 3) H₂O
- 4) Mn₂Se₇
- 5) MgCl₂
- 6) (NH₄)₂SO₄

There are three definitions (equalities) of mole. They are:

- 1 mole = 6.02 x 10²³ particles
- 1 mole = molar mass (could be atomic mass from periodic table or molecular mass)
- 1 mole = 22.4 L of a gas at STP

Each definition can be written as a set of two conversion factors. They are:

1 mole = molar mass(g) can be written as $\left(\frac{1 \text{ mole}}{\text{molar mass (g)}} \right)$ OR $\left(\frac{\text{molar mass (g)}}{1 \text{ mole}} \right)$

1 mole = 6.02 x 10²³ particles can be written as $\left(\frac{1 \text{ mole}}{6.02 \times 10^{23}} \right)$ OR $\left(\frac{6.02 \times 10^{23}}{1 \text{ mole}} \right)$

Solve the following: ****Round to 1 decimal place****

- 1) How many moles are in 15 grams of lithium? (molar mass of lithium is 7 g/mole)
 $15 \text{ grams} \times \frac{1 \text{ mole}}{7 \text{ g/mole}} = 2.14 \text{ moles lithium}$ OR $(15/7 \text{ g} = 2.14 \text{ moles})$
- 2) How many grams are in 2.4 moles of sulfur? (molar mass of sulfur is 32 g/ mole)
 $2.4 \text{ moles} \times \frac{32 \text{ grams}}{1 \text{ mole}} = 76.8 \text{ grams sulfur}$ OR $2.4 \text{ moles} \times 32 \text{ g} = 77 \text{ g}$
- 3) How many moles are in 22 grams of argon?
- 4) How many grams are in 88.1 moles of magnesium?
- 5) How many moles are in 2.3 grams of phosphorus?
- 6) How many grams are in 11.9 moles of chromium?

Human Computer Interaction

1. **Lecture #1-2 2 hrs. (24.07.12)**

1. Critique the products/systems. Identify your liking and disliking.
2. Motivation and artefacts
(Ref: Ping Zhang, Motivational Affordances: Reasons for ICT Design and Use, Communications of the ACM, Nov 2008, pp 145-147).
3. Maslow (1940 onwards): Hierarchy of human needs (8 levels).
4. Deci and Ryan (1985 onwards): Intrinsic needs – Autonomy, Competence, Relatedness.
5. Map your findings of (1) to these models.
(Ref: a. Richard M. Ryan, Veronika Huta and Edward L. Deci, Living well: a self-determination theory perspective on eudaimonia, Journal of Happiness Studies, Volume 9, Number 1, Springer Netherlands, pp 139-170, January, 2008.
b. Edward L. Deci and Richard M. Ryan, Hedonia, eudaimonia, and well-being: an introduction, Volume 9, Number 1, Springer Netherlands, pp 1-11 January, 2008.
c. Deci, E. L., & Ryan, R. M. Intrinsic motivation and self-determination in human behavior, 1985, New York: Plenum).
6. Creating vision statement for improvising a product/service/system through enhancing its response to selected human needs from these two models.
7. Assignments:
 - i. Refine your vision (6) and create three alternate solution approaches.
 - ii. Learn to use few software prototyping tools.

2. **Lecture #3 1 hrs. (27.07.12)**

1. Sharing of vision statements and proposed solution approaches.
2. Ryff and Singer (2008): Knowing Thyself – 6 basic needs for psychological well being – Self acceptance, autonomy, control of environment, positive relations with others, purpose in life, personal growth.
(Ref: Carol D. Ryff and Burton H. Singer, Know thyself and become what you are: a Eudaimonic approach to psychological well-being, Journal of Happiness Studies, Jan 2006, Springer Netherlands, pp 13-39).
3. Reiss (2000): 16 Basic desires – eating, physical exercise, romance, family, saving, acceptance, social contact, independence, curiosity, order, power, status, vengeance, honour, idealism, tranquility.
(Ref: a. Steven Reiss, Multifaceted Nature of Intrinsic Motivation: The Theory of 16 Basic Desires, Review of General Psychology, Educational Publishing Foundation, Vol. 8, No. 3, 179-193, 2004.
b. Steven Reiss, Who Am I?: The 16 Basic Desires That Motivate Our Behavior and Define Our Personality, Tarcher, 2000).
4. An understanding of human needs through these models helps in clarifying the purpose of all technological, business/economic, political, social, and even ritual constructs.
5. Assignments: Complete the pending assignment

3. **Lecture #4-5 2 hrs. (31.07.12)**

1. Artefacts/Technology help humans modify their environment.
2. Levels of Technology
 - a. Human \leftrightarrow Technology/Artefact \leftrightarrow World
 - b. Human \leftrightarrow [Technology/Artefact \leftrightarrow World]
 - c. [Human \leftrightarrow Technology/Artefact] \leftrightarrow World
 - d. [Human \leftrightarrow Technology/Artefact] \leftrightarrow [Virtual world \leftrightarrow World]
3. New artefacts help in modifying processes.
4. Aspects of human activities:
 - a. Physical
 - b. Cognitive
 - c. Emotional
5. When the point of contact between the product and the people become the point of friction, then the industrial designer has failed. – Dreyfuss in Designing for People, 1955.
6. Evolution of Human's role in production process and designer's challenge:

Activity B: Determining concentration	Get the Gizmo ready: <ul style="list-style-type: none"> • Click Reset. Select 1.00 M NaOH for the Burette and Mystery H₂SO₄ for the Flask. • Select Bromthymol blue for the Indicator.
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Introduction: Adding a drop of strong acid or base into a neutralized solution is similar to adding a drop of strong acid or base to water—it causes an abrupt change in pH. By using an appropriate indicator, a chemist can tell when a solution is neutralized by monitoring its color.

Question: How is titration used to determine an unknown concentration?

1. **Measure:** Titrate the sulfuric acid analyte (H₂SO₄) with the sodium hydroxide titrant (NaOH).
How much 1.00 M NaOH is needed to neutralize the H₂SO₄ solution?
21.6 mL H₂SO₄
2. **Interpret:** The balanced equation for the reaction of H₂SO₄ and NaOH is given at bottom right. Based on this equation, how many moles of NaOH react with 1 mole of H₂SO₄? 2 mol
3. **Manipulate:** Recall that molarity is equal to the number of moles of a substance dissolved in one liter of solution: molarity = moles ÷ volume.
 - A. Write an equation for determining the number of moles of NaOH that are added to the flask based on [NaOH] and volume of NaOH titrant (mL NaOH):
Moles NaOH = [NaOH] · Vol NaOH
 - B. Write a similar expression for the number of moles of H₂SO₄ in the flask based on [H₂SO₄] and the volume of H₂SO₄ (mL).
Moles H₂SO₄ = [H₂SO₄] · Vol H₂SO₄
 - C. Because there are twice as many moles of NaOH as moles of H₂SO₄ in this reaction, you can say:
Moles NaOH = 2 · Moles H₂SO₄

Substitute your expressions from 3A and 3B into this equation and solve for [H₂SO₄]:

D. Now calculate [H₂SO₄] based on the data from the Gizmo. [H₂SO₄] = _____

(Activity B continued on next page)

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