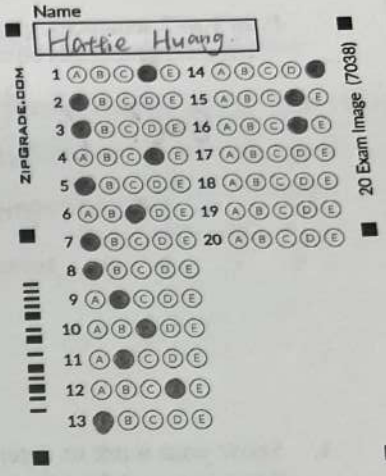
SCH3U Stoichiometry Unit Test **Level:** 3 **Name & I:** Hattie Huang {S25}

Expectations Assessed
• Understand the mole concept and complete related problems
• Investigate and communicate quantitative relationships in chemical reactions

Multiple Choice [Level 1 2 3]
DO NOT WRITE ON OR OVER THE MULTIPLE CHOICE AREA or BORDER BOXES EXCEPT FOR THE NAME BOX & FILLED IN CIRCLES



Short Answer:
- Read all parts of the question before beginning your answer.
- **Show all work, formulas and units as appropriate!!**
- Use point form and do NOT waste time rewording the question in your answer.
- DESCRIBE: Give detailed points showing you understand the pattern or process.
- EXPLAIN: Give detailed points further supported by reasons/relevance/effects/causes

1. Calculate the number of moles of silver present in 1.505×10^{23} atoms of Ca.
[Level 1 2 3] = equal.

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$$n_{Ca} = \frac{6.02 \times 10^{23}\ \text{atoms}}{1.505 \times 10^{23}\ \text{atoms/mol}} = 4\ \text{moles}$$

$$n = \frac{6.02 \times 10^{23}\ \text{atoms}}{\text{number of atoms}}$$

2. For 415.68g of ~~magnesium hydroxide~~, $Ca(OH)_2$, determine the following:
a) the **moles** of $Ca(OH)_2$

$$n = \frac{m}{mm} \qquad n_{Ca(OH)_2} = \frac{m_{Ca(OH)_2}}{m\ m_{Ca(OH)_2}}$$

$$= \frac{415.68\text{g}}{40.08 + [(16+1.01)\times 2]} = \frac{415.68\text{g}}{74.1\text{g/mol}} = 5.61\ \text{moles}$$

SF ✓

∴ —

b) **[Taking it Further]** Determine the **moles** of oxygen atoms from (a). In ONE (1) sentence explain your answer.
[Level 1 2 3 ~~4~~]

$$n = \frac{m}{mm}$$

$$5.61\ \text{moles} \times \frac{2\ \text{moles O}}{1\ \text{mol } Ca(OH)_2} = 11.22\ \text{moles}$$

∴ the moles of oxygen is 11.22 moles.

Because there 2 moles oxygen atoms in 1 mole $Ca(OH)_2$ atom, ✓

3. Show your understanding of unit concepts by answering the following.

a. In ONE (1) sentence, explain why the number 6.02×10^{23} represents a mole and not an easier number like 1×10^{20} ?

Because 6.02×10^{23} represents the number of atoms in 1 mole. ✗

b. In 1 to 2 sentences, **explain** why covalent molecules have may have molecular formulas that are different from their empirical formulas compared to ionic compounds which can **only** have empirical formulas. [Level 1 2 3]

Because covalent molecules is share bonding, and molecular formulas need to be balanced in the valency electron, so ionic compounds can only have empirical formulas.

4. Show your work to determine the empirical formula of a compound whose percentage composition is found to be 69.9% iron and 30.1% oxygen?

NOTE: You must show your work using this data to calculate the formula. Guessing a formula and trying to show it matches this data will not earn full marks. [Level 1 2 3]

$n = \frac{m}{mm}$

$n = \frac{6.02 \times 10^{23}\ \text{atoms}}{\text{number of atoms}}$

Set the compound is 100g.

$m_{Fe} = 69.9\% \times 100g = 69.9g$

$m_O = 30.1\% \times 100g = 30.1g$

$n_{Fe} = \frac{m_{Fe}}{mm_{Fe}} = \frac{69.9g}{55.85\ g/mol} = 1.25\ mol$

$n_O = \frac{m_O}{mm_O} = \frac{30.1g}{16\ g/mol} = 1.88\ mol$

$Fe : O = 1 : 25 : 1.88$

$= 1 : 1.5$

$= 2 : 3$

∴ the empirical formula of a compound is 2:3.

∴ Fe_2O_3

5. Determine the mass of magnesium chloride produced when 10.00 moles of HCl is combined with excess $Mg(OH)_2$ in the following reaction (Hint: check for balancing first): [Level 1 2 3]

$$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$$

$n = \frac{m}{mm}$

$n_{MgCl_2} = 10\ moles \times \frac{1\ MgCl_2}{2\ HCl} = 5\ moles$

$m_{MgCl_2} = mm_{MgCl_2} \times n_{MgCl_2}$

$= (24.31\ g/mol + 35.45\ g/mol \times 2) \times 5\ moles$

$= 476.05g$

∴ —.

6. A student conducted an experiment for which the theoretical yield of product was 1.7g. Upon completion, the student reported an actual yield of 1.2g. [Level 1 2 3]

a) Determine the percentage yield.

percentage yield = $\frac{\text{Actual yield}}{\text{theoritical yield}} \times 100\%$

Percentage yield = $\frac{1.2g}{1.7g} \times 100\% = 70.59\%$ ✓

SF ✓

b) Is the student's actual yield possible? Justify your answer, including an explanation of how this result may have been obtained in **1-3 lines**.

The student's actual yield is possible, because the percentage yield is less than 100%. In real, when we conducted an experiment, it will be different condition, such as the reaction not finished exatcly, the product have the side reaction and the reagent not uses up it will cause it.

7. A new employee is asked to make $Al(OH)_3$ using the following **balanced** reaction: [Level 1 2 3 4]

$Al_2S_3 + 6H_2O \rightarrow 2Al(OH)_3 + 3H_2S$.

The employee decides to use 270.2g of Al_2S_3 and 151.2g grams of H_2O

a) Determine the limiting reactant

$n = \frac{m}{mm}$

$n_{Al_2S_3} = \frac{m_{Al_2S_3}}{mm_{Al_2S_3}} = \frac{270.2g}{150.14g/mol} = 1.80\ mol$

$n_{H_2O} = \frac{m_{H_2O}}{mm_{H_2O}} = \frac{151.2g}{18.02g/mol} = 8.39\ mol$

TC? $= 8.39 \times \frac{1\ mol\ Al_2O_3}{6\ mol\ H_2O} = 1.40\ mol$

$\therefore 1.40\ mol < 1.80\ mol$ of?

$\therefore H_2O$ is the limiting reactant. ✓ TC

b) **[Taking it Further]** Determine the mass of the **excess reactant** that will be left over (**unreacted**)?

$n = \frac{m}{mm}$

$m_{Al_2S_3} = n_{H_2O} \times mm_{Al_2S_3}$

$= 1.40\ mol \times 150.14g/mol$

$= 210.2g$

TC of the excess

? $= 270.2g - 210.2g = 60g$ ✓

$\therefore$ the mass of reactant that will be left over is 60.0g.

c) **[Taking it Further]** **In 1-2 sentences**, explain why the employee's supervisor was NOT pleased with this work and how the employee can improve their work next time (hint: which reactant should get used up?).

Because both reactant need to be used up, and the Al_2S_3 still have 60.0g not used up, it will cause higher cost, so the employee's supervisor was not pleased with this work.

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8. **[Taking it Further]** Briefly explain two reasons why stoichiometry is significant in industry.
[Level 1 2 3 4]

① Stoichiometry can help industry make products in less cost. how?

② Stoichiometry can help industry make produce more fast? how?
and easily.

9. **Bonus:** Write two questions you still have (related to topics in unit) that were not answered during this unit.

① Why the side reaction can make the percentage lower or higher?

ok

② How can make the percentage yield close 100% ?