

Before doing anything, fill in the following on your ParSCORE form:

- 1) Write your name
- 2) Bubble in **FORM A**
- 3) Bubble in your **PERM** number (7 digits only—no extra numbers)

Instructions: No hats or hoods allowed. No books or notes allowed. No sharing of calculators. Cell phones, iPods, headsets/headphones, and any other electronic devices must be turned off and put away.

There are a total of seven pages (18 questions) on the exam. All questions are equal in point value.

You may work out the problems and write your answers on this exam; however, you must completely fill in the appropriate bubble(s) on your ParSCORE form. Turn in the ParSCORE form only. Only the answers indicated on your ParSCORE will be graded, so please be very careful bubbling in your ParSCORE. No credit will be awarded for an incorrectly-bubbled answer. The correct answers to the exam will be posted on our course web page.

1. Element X forms a sulfate with the formula X_2SO_4 . If the ion of element X in this compound contains 23 electrons and 28 neutrons, which of the following symbols would represent X in this compound?

- ~~a)~~ ${}^{28}_{24}Cr^+$
~~b)~~ ${}^{53}_{25}Mn^{2+}$
c) ${}^{52}_{24}Cr^+$
~~d)~~ ${}^{28}_{22}Ti^+$
~~e)~~ ${}^{50}_{22}Ti^+$

C

X^H
P 24
 $24 + 28$

2. Determine how many of the following compounds are incorrectly named.

LiBr	lithium monobromide
HBrO ₂	bromic acid
Ca(NO ₃) ₂	calcium(II) nitrate
BrF	bromine monofluoride

X
✓
X
X

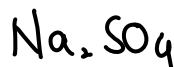
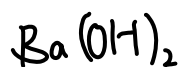
- a) 0 are incorrect
b) 1 is incorrect
c) 2 are incorrect
d) 3 are incorrect
e) 4 are incorrect

D

3. Which of the following is considered an ionic compound?

- a) NH_4F
- b) NO_2
- c) NaBr
- d) Both (a) and (b)
- e) Both (a) and (c)

E



4. What will happen when aqueous solutions of barium hydroxide and sodium sulfate are mixed together?

- a) no precipitate forms \times
- b) a precipitate containing the hydroxide ion forms \times
- c) a precipitate containing the sulfate ion forms \checkmark
- d) both (b) and (c) happen

C

5. Liquid bromine (Br_2) is considered:

- a) a compound
- b) an element
- c) both an element and a compound
- d) neither an element nor a compound

B

6. In an aqueous solution, NF_3 is considered:

- a) a strong electrolyte
- b) a weak electrolyte
- c) a nonelectrolyte

C

7. Which of the following has the highest mass percentage of carbon?

- ~~a)~~ CO₂
- b) CH₄O
- ~~c)~~ C₆H₁₂O₆
- d) C₅H₅N
- e) More than one of these

D

8. Consider the following (unbalanced) reaction: $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

The reaction has a percent yield of 85.0%. How many grams of ammonia would actually be obtained when 12 grams of H₂ reacts with excess N₂?

- a) 58 g
- ~~b)~~ 68 g
- c) 87 g
- d) 80 g
- e) 10 g

A

$$\frac{12}{2} = 6 \text{ mol}$$

$$\frac{6}{3} \times 2 = 4$$

$$4 \times 17 \times 85\% = 57.8$$

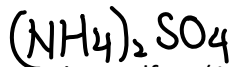
9. What volume of 1.5 M Na₃PO₄ solution can you make if you have 25 grams of solid Na₃PO₄ (164 g/mol) available?

- a) 102 mL
- b) 229 mL
- c) 9.8 mL
- d) 26 mL
- e) 420 mL

A

$$\frac{25}{164} = 1.5 \text{ V}$$

$$\text{V} = 0.1016$$



10. A stock solution is prepared by dissolving 60 g of ammonium sulfate (132 g/mol) in enough water to make 100 mL of the stock solution. A 10 mL sample of this stock solution is added to 75 mL of water, resulting in Solution B. Calculate the concentration of ammonium ions in Solution B.

- a) 5.2 M
- b) 4.5 M
- c) 0.53 M
- d) 1.1 M
- e) 9.1 M

$$\frac{\left[\left(\frac{60}{132} \right) \times \frac{10}{100} \right] \times 2}{(75 + 10) / 1000}$$

D

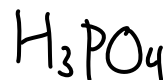
$$= 1.069$$

11. Natural copper is composed of the isotopes ^{63}Cu and ^{65}Cu . The ratio of atoms $^{63}\text{Cu}/^{65}\text{Cu}$ in a natural sample of copper is 2.244. Calculate the natural abundance of ^{65}Cu .

- a) 69.2%
- b) 30.8%
- c) 50.0%
- d) 80.4%
- e) 19.6%

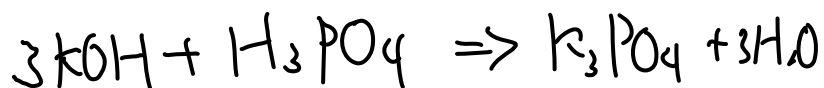
$$\frac{1}{2.244}$$

B



12. What volume of 0.35 M potassium hydroxide is required to react completely with 24 mL of 0.65 M phosphoric acid? Phosphoric acid has three acidic hydrogens.

- a) 52.0 mL
- b) 156 mL
- c) 44.6 mL
- d) 104 mL
- e) 134 mL



$$\frac{24 \times 0.65 \times 3}{0.35} = 133.7 \text{ mL}$$

E

13. A sample of the compound X_2O_3 weighs 33 grams and contains a total of 5.1×10^{23} atoms. What is the molar mass of element X?

- a) 73 g/mol
- b) 39 g/mol
- c) 146 g/mol
- d) 19 g/mol
- e) 194 g/mol

A

$$\frac{33}{m_v} \times 6.02 \times 10^{23} \times 5 = 5.1 \times 10^{23}$$

$$\frac{33}{m_v} = \frac{\text{atoms}}{Na \times 5}$$

$$\frac{33}{\text{atoms}/Na \times 5} = m_v$$

$$m_v = 194.8$$

$$\frac{194.8 - 16 \times 3}{2} = 73$$

Na

Cl₂

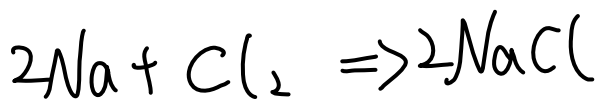
14. You add 30.0 g of sodium into a container filled with chlorine gas. The sodium and chlorine gas react to produce sodium chloride (58.4 g/mol). After the reaction goes to completion with 100% yield, you have produced 63.0 grams of sodium chloride. Which of the following statements is/are true?

- a) Sodium is the limiting reagent. ✗
- b) There are 24.8 grams of sodium left over. ✗
- c) There are 12.4 grams of sodium left over. ✗
- d) There are 5.2 grams of sodium left over.
- e) The initial mass of chlorine gas must be known in order to answer this question.

D

$$\frac{30}{23}$$

$$1.304 \text{ mol}$$



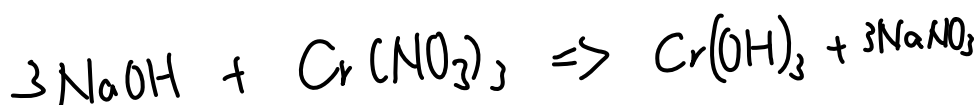
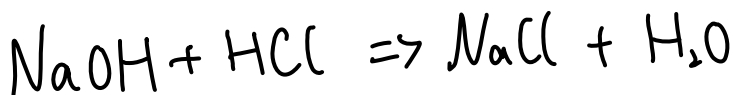
$$\frac{63}{58.4}$$

$$1.079 \text{ mol}$$

$$5.183 \text{ left}$$

15. A student added 50 mL of an NaOH solution to 100 mL of 0.5 M HCl. The solution was then treated with an excess of aqueous $\text{Cr}(\text{NO}_3)_3$, resulting in formation of 2.27 g of precipitate. Determine the concentration of the original NaOH solution.

- a) 2.0 M
- b) 2.3 M
- c) 1.0 M
- d) 0.44 M
- e) 1.3 M



B

$$52 + 17 \times 3 = 103 \text{ g/mol}$$

$$\frac{2.27}{103} = 0.022 \text{ mol}$$

0.066 NaOH left

$$0.1 \times 0.5 = 0.05 \text{ mol NaOH reacted}$$

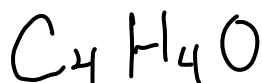
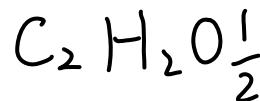
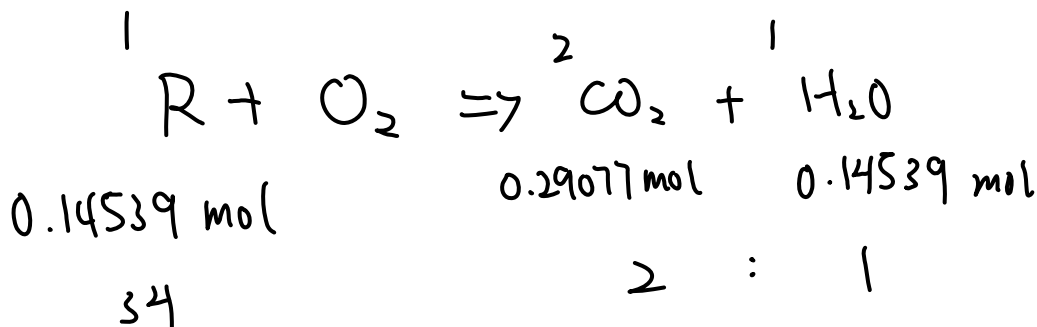
$$0.116 \text{ mol}$$

$$\frac{0.116}{0.05} = 2.3$$

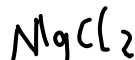
16. An experiment is performed to determine the molecular formula for an unknown compound by combustion analysis. The unknown compound contains only C, H, and O. You completely combust 4.9432 grams of the unknown compound and form 12.794 grams of CO_2 (44 g/mol) and 2.617 grams of H_2O (18 g/mol). In a different experiment, it was found that 1 mole of the compound weighs 272 grams. Which of the following statements is true?

- a) The molar mass for the molecular formula is 2 times the molar mass for the empirical formula
- b) The molar mass for the molecular formula is 4 times the molar mass for the empirical formula
- c) The molar mass for the molecular formula is 6 times the molar mass for the empirical formula
- d) The molar mass for the molecular formula is half the molar mass for the empirical formula
- e) None of these

B



$$\Rightarrow 68$$

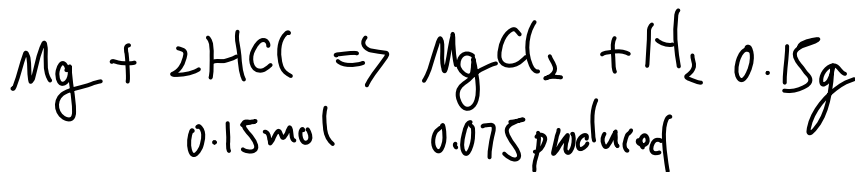


17. Magnesium metal reacts with hydrochloric acid to form aqueous magnesium chloride and hydrogen gas.

When 2.65 g of magnesium is added to 50.0 mL of 3.00 M hydrochloric acid, what mass of hydrogen is produced?

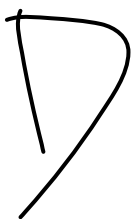
Assume the reaction goes to completion.

- a) 0.302 g
- b) 0.246 g
- c) 0.123 g
- d) 0.150 g
- e) 0.218 g



$$\frac{2.65}{24.3} = 0.109 \text{ mol}$$

HCl limiting

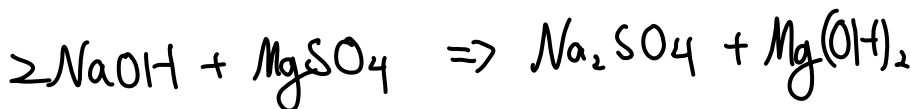


2.25 mol

0.676 mol

18. 500 mL of a 4.5 M NaOH solution is added to 520 mL of a 1.3 M MgSO₄ solution. What concentration of which ion is present after the reaction goes to completion? Assume the volumes of the solutions are additive.

- a) 0.7 M Mg²⁺ ✗
- b) 1.6 M OH⁻ ✗
- c) 0.5 M Mg²⁺ ✗
- d) 0.0 M OH⁻ ✗
- e) 0.9 M OH⁻ ✓



$$\frac{2.25}{2} = 1.125 > 0.676$$

MgSO₄ limiting
and used up

$$2.25 - 0.676 \times 2 = 0.898 \text{ left}$$

$$\frac{0.898}{1020/1000} = 0.88 \text{ M OH}^-$$

E

Answers:	1) C	2) D	3) E	4) C	5) B	6) C
	7) D	8) A	9) A	10) D	11) B	12) E
	13) A	14) D	15) B	16) B	17) D	18) E

Notes: Question 10 is based on book problem 4.28; Question 11 is based on book problem 3.107;

Question 12 is based on book problem 4.61; Question 15 is based on book problem 4.99;

Question 16 is based on book problem 3.60; Question 18 is based on book problem 4.45

Many of these questions are also based on ALEKS problems and problems done in class.