

# General Chemistry 1 (CHEM 1141)

Shawnee State University – Fall 2018

October 25, 2018

## Exam # 2D

Name KEY

Please write your full name, and the exam version (2D) that you have on the scantron sheet !  
(Bubble in the best answer choice for each question on the green & white scantron sheet in pencil !)

Please ☒ check the box next to your correct section number.

- Section #:**    ☐ 1. (Monday Lab, 10:00 AM – 12:53 PM)    ☐ 2. (Wednesday Lab, 10:00 AM – 12:53 PM)
- ☐ 3. (Monday Lab, 2:00 PM – 4:53 PM)    ☐ 4. (Wednesday Lab, 2:00 PM – 4:53 PM)
- ☐ 6. (Tuesday Lab, 12:30 PM – 3:23 PM)

**Multiple Choice:** \_\_\_\_\_ / 50

**Q21:** \_\_\_\_\_ / 10

**Q22:** \_\_\_\_\_ / 10

**Q23:** \_\_\_\_\_ / 10

**Q24:** \_\_\_\_\_ / 10

**Q25:** \_\_\_\_\_ / 10

**BONUS:** \_\_\_\_\_ / 5

**TOTAL:** \_\_\_\_\_ / 100

Each problem in this section (multiple choice) is worth 2.5 points !

Q1. The percentage (by mass) of carbon in  $C_3H_8O$  is:

- A) 8.33 %
- ☒ B) 60.0 %
- C) 38.5 %
- D) 52.1 %

$$\%C = \frac{3 \times C \times 100}{3 \times C + 8 \times H + 1 \times O} = \frac{3 \times 12.01 \times 100}{3 \times 12.01 + 8 \times 1.008 + 16.00} \times 100 = 60.0\%$$

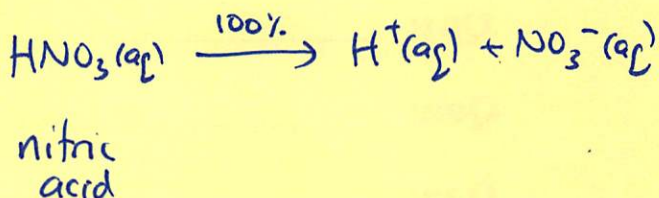
Q2. Calculate the number of  $CO_2$  molecules contained in 65.5 g of  $CO_2$  :

- ☒ A)  $8.96 \times 10^{23}$   $CO_2$  molecules
- B)  $1.71 \times 10^{24}$   $CO_2$  molecules
- C)  $4.04 \times 10^{24}$   $CO_2$  molecules
- D)  $1.92 \times 10^{24}$   $CO_2$  molecules

$$65.5g CO_2 \times \frac{1 \text{ mol } CO_2}{44.01g CO_2} \times \frac{6.022 \times 10^{23} \text{ molecules } CO_2}{1 \text{ mol } CO_2} = 8.96 \times 10^{23} \text{ molecules } CO_2$$

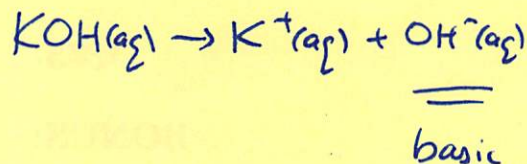
Q3. Identify the compound that would be classified as a **strong acid** as well as a **strong electrolyte**:

- A) HF
- ☒ B)  $HNO_3$
- C)  $CH_3COOH$
- D)  $HNO_2$



Q4. When dissolved in water, KOH behaves as:

- A) an acid that forms  $K^+$  and  $OH^-$  ions
- B) an acid that forms  $KO^-$  and  $H^+$  ions
- ☒ C) a base that forms  $K^+$  and  $OH^-$  ions
- D) a base that forms  $KO^-$  and  $H^+$  ions





Q5. The correct formula for the ammonium, bicarbonate, and sulfite ion (respectively) is:

- A)  $\text{NH}_3^+$ ,  $\text{CO}_3^{2-}$ , and  $\text{SO}_4^{2-}$
- B)  $\text{NH}_4^+$ ,  $\text{CO}_3^{2-}$ , and  $\text{SO}_4^{2-}$
- C)  $\text{NH}_3^+$ ,  $\text{HCO}_3^-$ , and  $\text{SO}_3^{2-}$
- ☒ D)  $\text{NH}_4^+$ ,  $\text{HCO}_3^-$ , and  $\text{SO}_3^{2-}$

Q6. The molecular formula of trinitrobenzene is  $\text{C}_6\text{H}_3\text{N}_3\text{O}_6$ . What is its empirical formula?

A)  $\text{C}_6\text{H}_3\text{N}_3\text{O}_6$

B)  $\text{C}_4\text{HNO}_4$

☒ C)  $\text{C}_2\text{HNO}_2$

D)  $\text{CHNO}$

$\frac{6}{3} \downarrow$

$\text{C}_2\text{H}_1\text{N}_1\text{O}_2$

Q7. An example of an element that exists as a diatomic molecule would be:

A) iron  $\text{Fe}(s)$

B) sulfur  $\text{S}_8(s)$

☒ C) iodine  $\text{I}_2(s)$

D) helium  $\text{He}(g)$

Q8. Calculate the molar mass of  $\text{Ca}_3(\text{PO}_4)_2$ .

A) 87.05 g/mol

B) 215.21 g/mol

☒ C) 310.18 g/mol

D) 279.21 g/mol

$$3 \times \text{Ca} = 3 \times 40.08$$

$$2 \times \text{P} = 2 \times 30.97$$

$$8 \times \text{O} = 8 \times 16.00$$

$$\underline{\hspace{1cm}} \\ 310.18 \text{ g/mol}$$

Q9. Determine the stoichiometric coefficient for oxygen when the following equation is balanced using the lowest, whole-number coefficients.



A) 9

B) 7

C) 5

☒ D) 3

C: 2

C: 2

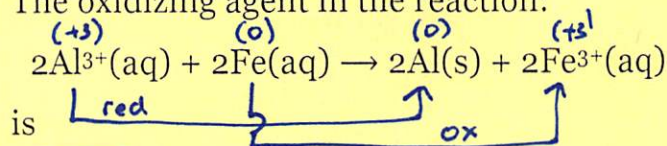
H: 8

H: 8

O: 8

O: 8

Q10. The oxidizing agent in the reaction:



- A)  $\text{Al}^{3+}$
- B) Fe
- C) Al
- D)  $\text{Fe}^{3+}$

$\text{Al}^{3+}$  "caused" Fe to be oxidized

Q11. Determine the concentration (in molarity, M) for a solution that contains 20.8 g of  $\text{CaCl}_2$  dissolved in 0.500 L of water.

- A) 0.167 M
- B) 0.375 M
- C) 0.667 M
- D) 1.50 M

$$[\text{CaCl}_2] = \frac{\# \text{mol CaCl}_2}{\# \text{L soln}} = \frac{20.8 \text{g CaCl}_2 \times \frac{1 \text{mol CaCl}_2}{110.98 \text{g CaCl}_2}}{0.500 \text{L}} = \frac{0.1874 \text{mol}}{0.500 \text{L}} = 0.375 \text{M}$$

Q12. Calculate the volume (in mL) needed to make 525 mL of a 1.20 M  $\text{NaNO}_3$  solution from a 6.00 M  $\text{NaNO}_3$  stock solution.

- A) 13.7 mL
- B) 87.5 mL
- C) 105 mL
- D) 2600 mL

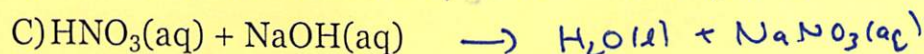
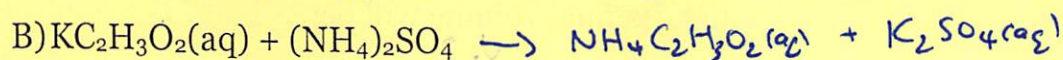
$$M_1 V_1 = M_2 V_2 \Rightarrow V_1 = \frac{M_2 V_2}{M_1} = \frac{1.20 \text{M} \times 525 \text{mL}}{6.00 \text{M}} = 105 \text{mL}$$

Q13. The gas law that states that pressure is inversely proportional to volume is:

- A) Avogadro's law
- B) Boyle's law
- C) Charles's law
- D) Torricelli's law



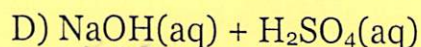
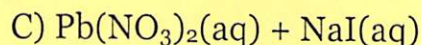
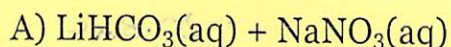
Q14. Which of the following solution combinations will form a precipitate when mixed?



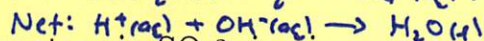
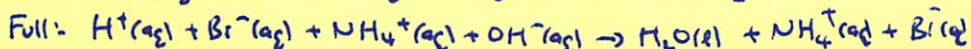
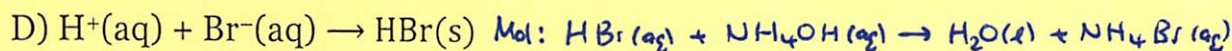
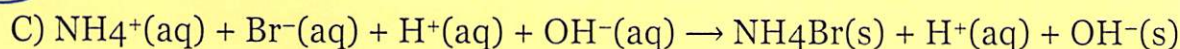
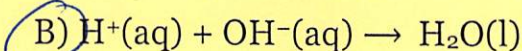
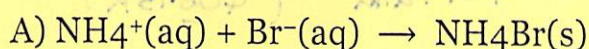
(unbalanced)



Q15. Which of the following solution combinations will form a gas when mixed?



Q16. For the reaction that occurs between  $\text{HBr}(\text{aq})$  and  $\text{NH}_4\text{OH}(\text{aq})$  identify the equation shown below that correctly identifies the net-ionic equation.



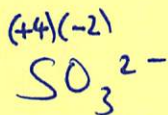
Q17. The oxidation state of the sulfur atom in  $\text{SO}_3^{2-}$  ion is:

A) -2

B) +2

C) +4

D) +6



$\sum \text{ox. state} = \text{charge}$

$\text{O} = -2$  in most cnds

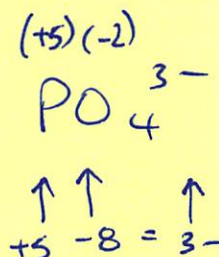
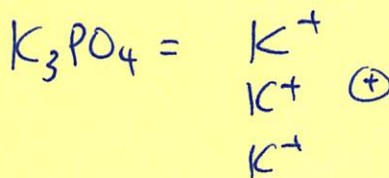
Q18. The oxidation state of the phosphorus atom in  $\text{K}_3\text{PO}_4$  is:

A) +5

B) -5

C) +3

D) -3



Q19. A sample of gas with a volume of 25.0 mL at a temperature of 25°C is cooled down to -25°C. Assuming no change in pressure, its final volume will be:

- 248K  $T_2$
- A) -25.0 mL  
 B) 20.8 mL  
 C) 18.4 mL  
 D) 27.3 mL

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow V_2 = \frac{V_1 \times T_2}{T_1}$$

$$= \frac{25.0 \text{ mL} \times 248 \text{ K}}{298 \text{ K}} = 20.8 \text{ mL}$$

Q20. The pressure of 0.500 mol of He(g) at a temperature of 133°C, and a volume of 4.00 L is predicted to be:

- A) 2.45 atm  
 B) 3.95 atm  
 C) 4.17 atm  
 D) 0.953 atm

$$PV = nRT$$

$$\Rightarrow P = \frac{nRT}{V} = \frac{0.500 \text{ mol} \times 0.08206 \frac{\text{atm} \cdot \text{L}}{\text{mol} \cdot \text{K}} \times 406 \text{ K}}{4.00 \text{ L}}$$

$$= 4.17 \text{ atm} \quad (406.15 \text{ K})$$



Each problem in this section (short answer) is worth 10 points !

All work must be show in order to receive credit !

You must use the factor-label (conversion-factor) method for all conversions !

Be sure to include units where applicable !

All numeric answers must be rounded to the correct number of significant figures !

Q21. The reaction between  $\text{C}_3\text{H}_6(\text{g})$  and  $\text{O}_2(\text{g})$  forms  $\text{CO}_2(\text{g})$  and  $\text{H}_2\text{O}(\text{g})$ .

A) Write out a balanced chemical equation for this reaction, using the lowest set of whole number coefficients.  $2\text{C}_3\text{H}_6(\text{g}) + 9\text{O}_2(\text{g}) \rightarrow 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$

B) Predict the mass of  $\text{H}_2\text{O}(\text{g})$  formed from the complete reaction of 14.0 g  $\text{C}_3\text{H}_6(\text{g})$  and 18.0 g  $\text{O}_2(\text{g})$

$$\textcircled{\text{XS}} \quad 14.0\text{g C}_3\text{H}_6 \times \frac{1\text{mol C}_3\text{H}_6}{42.08\text{g C}_3\text{H}_6} \times \frac{6\text{mol H}_2\text{O}}{2\text{mol C}_3\text{H}_6} \times \frac{18.02\text{g H}_2\text{O}}{1\text{mol H}_2\text{O}} = 18.0\text{g H}_2\text{O}$$

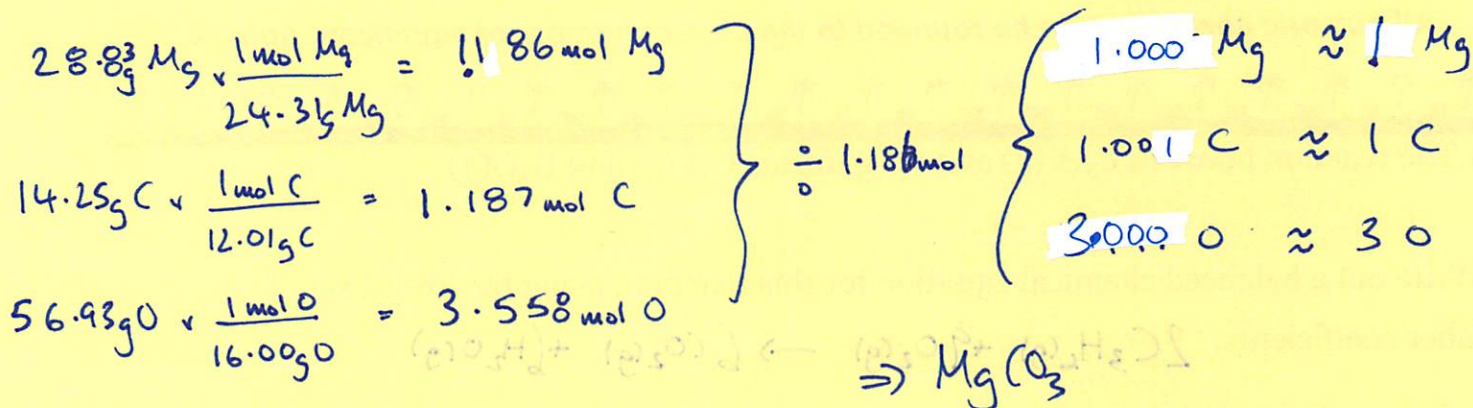
$$\textcircled{\text{LR}} \quad 18.0\text{g O}_2 \times \frac{1\text{mol O}_2}{32.00\text{g O}_2} \times \frac{6\text{mol H}_2\text{O}}{9\text{mol O}_2} \times \frac{18.02\text{g H}_2\text{O}}{1\text{mol H}_2\text{O}} = 6.76\text{g H}_2\text{O} \quad \textcircled{\text{X}} \quad \text{Theoretical yield}$$

C) If the actual mass of  $\text{H}_2\text{O}(\text{g})$  formed was 5.40 g, then calculate the <sup>percent</sup> ~~theoretical~~ yield of this reaction.

$$\% \text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100 = \frac{5.40\text{g}}{6.76\text{g}} \times 100 = 79.9\%$$

Q22. One of the ingredients in Bufferin tablets is composed of 28.83 % Mg, 14.25 % C, and 56.93% O (percentages are by mass). Show how to determine (by calculation) the empirical formula for this compound and then provide the correct name of this compound.

Assume 100.g



magnesium carbonate!

Q23. Provide the correct name or formula for each of the following compounds.

A)  $\text{O}_3\text{F}_2$  trioxygen difluoride

B)  $\text{Fe}(\text{NO}_3)_3 \cdot 9 \text{H}_2\text{O}$  iron(III) nitrate nonahydrate

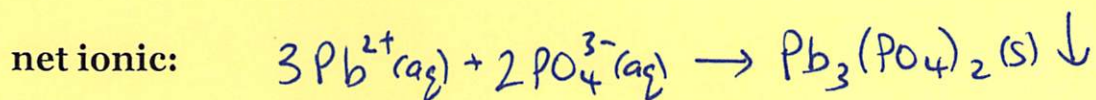
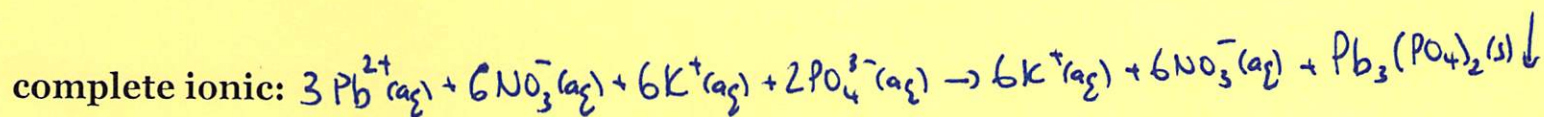
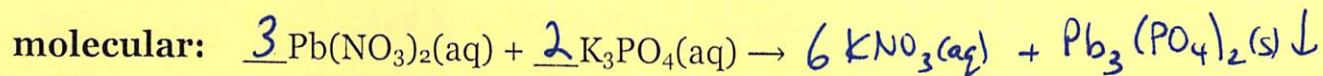
C) sodium bicarbonate  $\text{NaHCO}_3$

D) chromium (III) sulfate  $\text{Cr}_2(\text{SO}_4)_3$

E)  $(\text{NH}_4)_2\text{CO}_3$  ammonium carbonate



Q24. Write correctly the balanced molecular, complete ionic, and net ionic equation for the reaction:



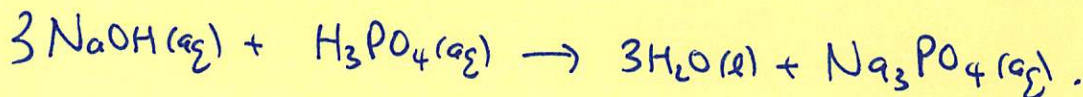
$$\frac{3 \times 630.03 \text{ g/mol}}{1000 \text{ mL}} = \frac{1890.09 \text{ g}}{1000 \text{ mL}} = 1.89009 \text{ g/mL}$$

$$\frac{1.89009 \text{ g/mL} \times 1000 \text{ mL}}{1000 \text{ g}} = 1.89009 \text{ g/g}$$

$$1.89009 \text{ g/g} = \frac{1.89009 \text{ g}}{1000 \text{ g}} = 0.00189009$$

$$(2.22) \text{ M} \times 150.0 \text{ mL} = \frac{1.89009 \text{ g}}{1000 \text{ g}} \times 630.03 \text{ g/mol} = 0.00189009 \text{ g/g}$$

Q25. In a titration, it is found that 43.0 mL of 0.100 M NaOH(aq) is required to fully neutralize 20.00 mL of a sample of  $\text{H}_3\text{PO}_4$ (aq) (phosphoric acid) of unknown concentration. What must the molar concentration of this sample of phosphoric acid be?



$$[\text{H}_3\text{PO}_4] = \frac{\# \text{mol H}_3\text{PO}_4}{\# \text{L H}_3\text{PO}_4 \text{ sol}^n}$$

$\swarrow 43.0 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} \times \frac{0.100 \text{ mol NaOH}}{1 \text{ L}} \times \frac{1 \text{ mol H}_3\text{PO}_4}{3 \text{ mol NaOH}} = 1.43 \times 10^{-3} \text{ mol H}_3\text{PO}_4$

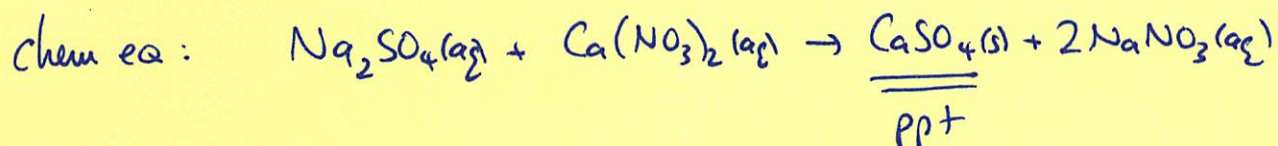
$\uparrow 20.00 \text{ mL} \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.02000 \text{ L}$

$$\Rightarrow [\text{H}_3\text{PO}_4] = \frac{1.43 \times 10^{-3} \text{ mol}}{0.02000 \text{ L}} = 0.0717 \text{ M (3 s.f.)}$$



### 5 Point Bonus Question

15.0 mL of 1.25 M sodium sulfate(aq) is mixed with 25.0 mL of 3.20 M calcium nitrate(aq). Predict the mass of the precipitate that is expected to form.



(LR)  $15.0\text{mL} \times \frac{1\text{L}}{1000\text{mL}} \times \frac{1.25\text{mol Na}_2\text{SO}_4}{1\text{L}} \times \frac{1\text{mol CaSO}_4}{1\text{mol Na}_2\text{SO}_4} \times \frac{136.15\text{g CaSO}_4}{1\text{mol CaSO}_4} = 2.55\text{g CaSO}_4$   
(\*) theoretical yield.

$25.0\text{mL} \times \frac{1\text{L}}{1000\text{mL}} \times \frac{3.20\text{mol Ca}(\text{NO}_3)_2}{1\text{L}} \times \frac{1\text{mol CaSO}_4}{1\text{mol Ca}(\text{NO}_3)_2} \times \frac{136.15\text{g CaSO}_4}{1\text{mol CaSO}_4} = 10.9\text{g CaSO}_4$

(XS)