

Exam 2a

Chem 1141

Fall 2008

Name: _____ **KEY**

MULTIPLE CHOICE. [2 pts ea.]

Q1. The atomic mass unit (amu) is defined as exactly equal to:

- a) 1/12 mass of an atom of C-12 b) the mass of one atom of H-1
c) 1/16 the mass of an atom of O-16 d) one gram per mole
e) the mass of one proton

Q2. The (average) atomic mass of chlorine is:

- a) 12.01 b) 17 c) 18 d) 35 e) 35.45

Q3. The molar mass of H₂O (in g/mol) is:

- a) 1.00 b) 16.00 c) 17.01 d) 18.02 e) 21.03

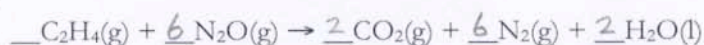
Q4. The number of moles of H₂ in a 3.40 g sample is:

- a) 1.00 b) 1.69 c) 3.40 d) 3.43 e) 6.85

Q5. A device used to *weigh* individual atom/molecules by measuring the deflection of a charged ion in a magnetic field:

- a) pipet b) mass spectrometer c) titration d) isotope
e) analytical balance

Q6. When the equation:



is balanced using the lowest set of whole number coefficients, the number written in front of N₂O is:

- a) 1 b) 2 c) 4 d) 5 e) 6

Q7. When the equation:



is balanced using the lowest set of whole number coefficients, the number written in front of CO₂ is:

- a) 1 b) 2 c) 4 d) 5 e) 6

Q8. A substance that dissolves in water to form a solution than conducts electricity is called a(n):

- a) electrolyte b) non-electrolyte c) precipitate d) molecule
e) conductor

Q9. The compound Mg(NO₃)₂ is soluble in water:

- a) TRUE b) FALSE

Q10. The compound Fe₂S₃ is soluble in water:

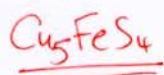
- a) TRUE b) FALSE

- Q11. An acid is a substance that:
- a) Forms OH^- ions when dissolved in water
 - c) Forms H^+ ions when dissolved in water**
 - e) Tastes bitter
 - b) Turns litmus blue
 - d) Forms NO_3^- ions when dissolved in water
- Q12. The oxidation number of the ^{sulfur} ~~oxygen~~ atom in the ion: SO_3^{2-} is:
- a) +1
 - b) +2
 - c) +3
 - d) +4**
 - e) +5
 - f) +6
- Q13. A substance that is oxidized:
- a) Reacts with hydrogen
 - b) dissolves well in water
 - c) burns in air
 - d) gains electrons
 - e) loses electrons**
- Q14. 100.0 mL of a solution that is 1.50 M HCl contains how many moles of HCl?
- a) 150
 - b) 15.0
 - c) 1.50
 - d) 0.150**
 - e) 0.0150
- Q15. What volume of 2.0 M NaCl contains 0.10 mol NaCl?
- a) 20.0 L
 - b) 2.0 L
 - c) 0.20 L
 - d) 0.020L
 - e) 0.050 L**
- Q16. The molar concentration of a sample of NaOH that has 0.25 mol of NaOH in 125 mL of solution is:
- a) 0.00200 M
 - b) 0.25 M
 - c) 2.0 M**
 - d) 31 M
 - e) 500 M
- Q17. Water is added to a 10. mL sample of 15.0 M HNO_3 until the final volume is 100. mL. What is the molar concentration of the HNO_3 ?
- a) 0.015 M
 - b) 0.15 M
 - c) 1.5 M**
 - d) 15 M
 - e) 150 M
- Q18. What type of equation is represented below:
- $$\text{Mg}^{2+}(\text{aq}) + 2\text{NO}_3^-(\text{aq}) + 2\text{Na}^+(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Mg}(\text{OH})_2(\text{s}) + 2\text{Na}^+(\text{aq}) + 2\text{NO}_3^-(\text{aq})$$
- a) Net ionic
 - b) Full ionic**
 - c) Molecular
 - d) Spectator
 - e) Redox

Short Response.

Show ALL work to receive credit. Use the conversion factor method for all problems to receive full credit.

- Q19. [9 pts.] Bornite is an important copper mineral with the chemical formula Cu_5FeS_4 . Its nickname is *peacock copper* due to its purple/bronze iridescent color. Calculate the percent composition by mass of each element in Bornite.



$$\begin{aligned} 5 \times \text{Cu} &= 5 \times 63.55 = 317.8 \\ 1 \times \text{Fe} &= 1 \times 55.85 = 55.85 \\ 4 \times \text{S} &= 4 \times 32.07 = 128.3 \\ &\hline &= 501.95 \\ &= 502.0 \end{aligned}$$

$$\% \text{Cu} = \frac{317.8}{502.0} \times 100\% = 63.31\%$$

$$\% \text{Fe} = \frac{55.85}{502.0} \times 100\% = 11.13\%$$

$$\% \text{S} = \frac{128.3}{502.0} \times 100\% = 25.56\%$$



Q20. [15 pts.] Write the **balanced** molecular, full-ionic, and net-ionic chemical equations for the reaction between aqueous hydrochloric acid, $\text{HCl}(\text{aq})$ and aqueous sodium carbonate, $\text{Na}_2\text{CO}_3(\text{aq})$. Be sure to include **all state symbols and charges**.

a) MOLECULAR



b) FULL-IONIC



c) NET-IONIC



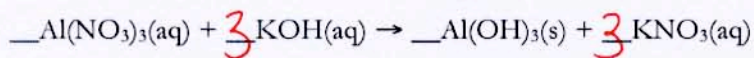
Q21. [4 pts.] Name the following compounds:

- i) CuCl copper(I) chloride
- ii) N_7F_9 heptanitrogen nonafluoride
- iii) KHCO_3 potassium bicarbonate
- iv) FeCl_2 iron(II) chloride

Q22. [4 pts.] Write formulas for the following compounds:

- i) sodium phosphate Na_3PO_4
- ii) copper(II) nitrate $\text{Cu}(\text{NO}_3)_2$
- iii) trisulfur pentoxide S_3O_5
- iv) calcium sulfate pentahydrate $\text{CaSO}_4 \cdot 5\text{H}_2\text{O}$

Q23. [16 pts.] Given the following unbalanced chemical equation:



a) Balance the equation (Write in the coefficients)

b) Calculate the number of moles of $\text{Al}(\text{OH})_3$ that can be formed from the complete reaction of 0.40 mol KOH.

$$\frac{0.40 \text{ mol KOH}}{3 \text{ mol KOH}} \left| \frac{1 \text{ mol Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} \right| = 0.13 \text{ mol Al}(\text{OH})_3$$

c) Predict the mass of $\text{Al}(\text{OH})_3$ that can be made from mixing 20.0 mL of 1.00 M $\text{Al}(\text{NO}_3)_3(\text{aq})$ and 15.0 mL of 1.60 M KOH(aq).

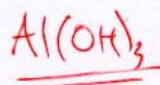
$$\frac{20.0 \text{ mL}}{\text{mL}} \left| \frac{10^{-3} \text{ L}}{\text{L}} \right| \left| \frac{1.00 \text{ mol Al}(\text{NO}_3)_3}{1 \text{ L}} \right| \left| \frac{1 \text{ mol Al}(\text{OH})_3}{1 \text{ mol Al}(\text{NO}_3)_3} \right| \left| \frac{78.01 \text{ g Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} \right| = 1.56 \text{ g Al}(\text{OH})_3$$

$$\frac{15.0 \text{ mL}}{\text{mL}} \left| \frac{10^{-3} \text{ L}}{\text{L}} \right| \left| \frac{1.60 \text{ mol KOH}}{1 \text{ L}} \right| \left| \frac{1 \text{ mol Al}(\text{OH})_3}{3 \text{ mol KOH}} \right| \left| \frac{78.01 \text{ g Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} \right| = 0.624 \text{ g Al}(\text{OH})_3$$

\Rightarrow 0.624 g $\text{Al}(\text{OH})_3$ is formed.

d) If 0.402 g of $\text{Al}(\text{OH})_3$ are formed in the reaction described in part (c), then what is the percent yield?

$$\% \text{ yield} = \frac{0.402 \text{ g}}{0.624 \text{ g}} \times 100\% = 64.4\%$$



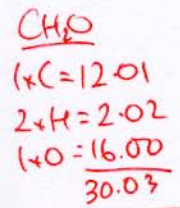
$$1 \times \text{Al} = 1 \times 26.98$$

$$3 \times \text{O} = 3 \times 16.00$$

$$3 \times \text{H} = 3 \times 1.01$$

$$\underline{\underline{78.01}}$$

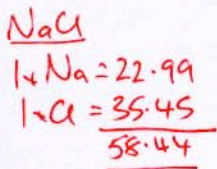
Q24. [16 pts.] How many moles do the following contain:



a) 4.50 g of CH₂O

$$\frac{4.50 \text{ g CH}_2\text{O}}{30.03 \text{ g CH}_2\text{O}} \times \frac{1 \text{ mol CH}_2\text{O}}{1} = 0.150 \text{ mol CH}_2\text{O} \quad (3 \text{ sf})$$

b) 12.3 g of NaCl



$$\frac{12.3 \text{ g NaCl}}{58.44 \text{ g NaCl}} \times \frac{1 \text{ mol NaCl}}{1} = 0.210 \text{ mol NaCl} \quad (3 \text{ sf})$$

c) 22.0 mL of 0.331 M MgCl₂

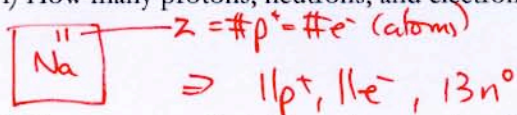
$$\frac{22.0 \text{ mL} \times 10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{0.331 \text{ mol MgCl}_2}{1 \text{ L}} = 0.00728 \text{ mol MgCl}_2 \quad (3 \text{ sf})$$

d) 135 mL of 0.25 M CH₂O

$$\frac{135 \text{ mL} \times 10^{-3} \text{ L}}{1 \text{ mL}} \times \frac{0.25 \text{ mol CH}_2\text{O}}{1 \text{ L}} = 0.034 \text{ mol CH}_2\text{O} \quad (2 \text{ sf})$$

BONUS:

i) How many protons, neutrons, and electrons are there in an atom of sodium-24?



mass # (A)
 #p⁺ + #n⁰
 " "
 24 = 11p⁺ + 13n⁰

ii) Convert a speed of 3.4 nm/ms to units of pm/ns.

nm = 10⁻⁹ m
 ms = 10⁻³ s
 pm = 10⁻¹² m
 ns = 10⁻⁹ s

$$\frac{3.4 \text{ nm}}{\text{ms}} \times \frac{10^{-9} \text{ m}}{1 \text{ nm}} \times \frac{1 \text{ ms}}{10^{-3} \text{ s}} \times \frac{1 \text{ pm}}{10^{-12} \text{ m}} \times \frac{10^{-9} \text{ s}}{1 \text{ ns}} = 3.4 \times \frac{10^{-9} \times 10^{-9}}{10^{-15}} \text{ pm/ns}$$

$$= 3.4 \times 10^{-3} \text{ pm/ns}$$