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1. (5 pts) How many mL of 3.4 M HCl is required to make 600 mL of 1.3 M HCl?
   a) 6.37x10^-4 mL
   b) 229 mL
   c) 1569 mL
   d) 0.23 mL
   e) none of these

2. (5 pts) A solution of aluminum chloride reacts with a solution of potassium hydroxide. What is the net ionic equation for the reaction that takes place?
   a) \( K^+ (aq) + Cl^- (aq) \rightarrow KCl (s) \)
   b) \( Al^{3+} (aq) + 3 Cl^- (aq) \rightarrow AlCl_3 (s) \)
   c) \( Al^{3+} (aq) + 3 OH^- (aq) \rightarrow Al(OH)_3 (s) \)
   d) \( Al^{3+} (aq) + 3 OH^- (aq) + K^+ (aq) + Cl^- (aq) \rightarrow Al(OH)_3 (s) + KCl (s) \)
   e) There is no net ionic equation. All products and reactants are soluble.

3. (5 pts) You need to prepare 340 mL of a 0.47 M solution of iron (III) sulfate (molar mass = 399.7 g/mol). How many grams of iron (III) sulfate must be used?
   a) 553 g
   b) 289 g
   c) 64 g
   d) 42 g
   e) none of these

more questions --------->
4. (4 pts) Two isotopes of an element will have the same number of neutrons, but different numbers of protons.

a) True  b) False  c) More information is needed

5. (4 pts) Positively-charged ions are formed by removing electrons from an atom, while negatively-charged ions are formed by removing protons from an atom.

a) True  b) False  c) More information is needed

6. (5 pts) Which of the following atomic symbols is incorrect?

a) $^{28}_{14}$Si  b) $^{19}_{9}$F  c) $^{32}_{16}$S  d) $^{39}_{19}$K  e) $^{15}_{7}$O

7. (6 pts) 15.4 grams of sodium peroxide is equal to how many moles of sodium peroxide?

a) 0.124 moles  b) 0.248 moles  c) 0.197 moles  d) 0.280 moles  e) none of these

8. (6 pts) Which of the following compounds has the same mass percentage of carbon as the molecule $C_2H_2O$?

a) $C_3H_3O$  b) CHO  c) $C_2H_2O_2$  d) $C_4H_6O_3$  e) more than one of these has the same mass percentage of carbon as $C_2H_2O$

9. (6 pts) Consider the following reaction: $2 \text{B} + 3 \text{H}_2 \rightarrow 2 \text{BH}_3$

Above what mass of $\text{H}_2$ (in grams) will boron (B) be the limiting reagent for this reaction, given that you have 1.74 moles of B. Assume the reaction goes to completion.

a) 5.2 g  b) 2.6 g  c) 3.5 g  d) B will never be the limiting reagent  e) none of these

more questions -------
10. (6 pts) Calculate the number of sulfur atoms present in 52.4 g of aluminum sulfate (molar mass = 342.2 g/mol)

a) 9.22x10^{22} atoms  
b) 1.57x10^{24} atoms  
c) 1.84x10^{23} atoms  
d) 2.77x10^{23} atoms  
e) none of these

11. (6 pts) You have discovered a new element, Genchemium (Gc) which has an average mass of 422.933 amu.

Genchemium has two isotopes: \(^{418}\text{Gc}\) (mass = 417.905 amu) and \(^{427}\text{Gc}\) (mass = 426.868 amu). What is the natural abundance of the isotope \(^{427}\text{Gc}\)?

a) 56.1%  
b) 23.4%  
c) 76.6%  
d) 43.9%  
e) none of these

12. (6 pts) What is the concentration of chloride ions [Cl\(^-\)] when 76 mL of 1.3 M NaCl is added to 350 mL of 3.3 M AlCl\(_3\)?

a) 8.4 M  
b) 2.9 M  
c) 1.3 M  
d) 4.6 M  
e) 8.1 M

more questions --------->
13. (6 pts) 200 mL of a 0.8 M barium nitrate solution is added to 171 mL of a 2.3 M aluminum sulfate solution, resulting in the formation of a precipitate. The reaction goes to completion. What is the final concentration of $SO_4^{2-}$ ions in solution?

a) 0.0 M  
b) 2.7 M  
c) 1.1 M  
d) 0.6 M  
e) 2.3 M

14. (6 pts) Consider the following reaction:  
$$2 \text{Al} + 3 \text{MgCl}_2 \rightarrow 2 \text{AlCl}_3 + 3 \text{Mg}$$

When 43.3 grams of aluminum (molar mass = 26.98 g/mol) reacts with 113.0 grams of magnesium chloride (molar mass = 95.21 g/mol), which of the following statements is true? Assume the reaction goes to completion.

a) Al is the limiting reagent  
b) 213 g of $\text{AlCl}_3$ (molar mass = 133.3 g/mol) is formed  
c) 158 g of $\text{AlCl}_3$ (molar mass = 133.3 g/mol) is formed  
d) 22.0 g of Al remains after the reaction goes to completion  
e) None of the above statements are true.
15. (6 pts) 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 CO₂ and 2.617 grams of H₂O. 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

16. (6 pts) 1 mole of each of the following substances was added to 1 L of water. Which of the following will produce most total ions in aqueous solution?

a) ZnBr₂
b) NF₃
c) Cr₂(CO₃)₃
d) NaCl
e) More than one of these will produce the greatest number of total ions in aqueous solution.

more questions --------->
17. (6 pts) When 150 mL of 1.6 M NiCl₃ is added to 380 mL of 1.7 M Na₂CO₃, 19.1 g of precipitate is actually formed. What is the percent yield for the reaction?

a) 54 %
b) 27 %
c) 67 %
d) 30 %
e) none of these

18. (6 pts) Element “E” is a metal which forms a sulfide with the molecular formula ES₂. If 73.2 g of ES₂ contains 30.2 g of sulfur atoms, what is the identity of element E?

a) W
b) Sc
c) Os
d) Zr
e) none of these


more questions  -------->
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1. (5 pts) What is the concentration of carbonate ions in a 3.0 M solution of sodium carbonate?
   a) 3.0 M
   b) 1.5 M
   c) 6.0 M
   d) the volume of the solution is needed
   e) none of these

2. (5 pts) A solution of potassium bromide reacts with a solution of lead(II) acetate. What is the balanced net ionic equation for the reaction that takes place?
   a) Pb₂⁺ (aq) + 2 Br⁻ (aq) ---→ 2 PbBr (s)
   b) K⁺ (aq) + CH₃COO⁻ (aq) ---→ KCH₃COO (s)
   c) Pb²⁺ (aq) + 2 Br⁻ (aq) + K⁺ (aq) + CH₃COO⁻ (aq) ---→ PbBr₂ (s) + KCH₃COO (s)
   d) Pb²⁺ (aq) + 2 Br⁻ (aq) ---→ PbBr₂ (s)
   e) There is no net ionic equation. All products and reactants are soluble.

3. (5 pts) A solution is prepared by adding 23.6 grams of sodium phosphate to enough water to make 462 mL of solution. What is the molarity of the solution?
   a) 0.312 M
   b) 0.433 M
   c) 3.12x10⁻⁴ M
   d) 4.33x10⁻⁴ M
   e) 51.1 M

more questions ————>
4. (4 pts) The atomic number of an element depends on:
   a) only the number of neutrons it has
   b) only the number of protons it has
   c) both the number of protons and neutrons it has
   d) both the number of neutrons and electrons it has
   e) the number of protons, electrons, and neutrons it has

5. (4 pts) For a solution to be electrically conductive, it must contain a strong electrolyte.
   a) True
   b) False
   c) More information is needed

6. (5 pts) An element’s most stable ion forms an ionic compound with chlorine having the formula XCl_2. If the mass number of the ion is 24 and the ion in the compound has 10 electrons, what is the element and how many neutrons does it have?
   a) Mg, 12 neutrons
   b) Ne, 16 neutrons
   c) O, 16 neutrons
   d) Ne, 14 neutrons
   e) Na, 11 neutrons

7. (6 pts) 13.5 mL of water is added to 56.5 mL of a 1.5 M sodium sulfide solution. What is [Na^+] in the resulting solution?
   a) 6.3 M
   b) 1.2 M
   c) 0.62 M
   d) 2.4 M
   e) none of these

8. (6 pts) Which substance contains the highest total number of atoms in a 50.0 gram sample?
   a) H_2O (molar mass = 18.0 g/mol)
   b) NaCl (molar mass = 58.4 g/mol)
   c) Ca_3(PO_4)_2 (molar mass = 310.2 g/mol)
   d) He (molar mass = 4.0 g/mol)
   e) BeH_2 (molar mass = 11.0 g/mol)
9. (6 pts) Consider the following reaction: \( \text{Zn (s)} + 2 \text{CuNO}_3 \text{(aq)} \rightarrow \text{Zn(NO}_3)_2 \text{(aq)} + 2 \text{Cu (s)} \)

What is the minimum volume of 1.6 M CuNO\(_3\) required to fully react 9.7 g of Zn (molar mass = 65.39 g/mol)?

a) 92.7 mL  
b) 475 mL  
c) 185 mL  
d) 297 mL  
e) none of these

10. (6 pts) A mixture consisting of MgCl\(_2\) (molar mass = 95.2 g/mol) and NaCl (molar mass = 58.44 g/mol) is prepared. The mixture is 34.9% MgCl\(_2\) by mass and has a total mass of 7.7 grams. How many total chlorine atoms are present in the sample?

a) \(9.7 \times 10^{22}\) Cl atoms  
b) \(3.4 \times 10^{22}\) Cl atoms  
c) \(6.9 \times 10^{22}\) Cl atoms  
d) \(8.6 \times 10^{22}\) Cl atoms  
e) none of these

11. (6 pts) Calculate the number of moles of precipitate formed when 120 mL of 1.6 M NiCl\(_3\) reacts with 380 mL of 1.5 M Na\(_2\)CO\(_3\). Assume the reaction goes to completion.

a) 0.19 mol  
b) 0.12 mol  
c) 0.096 mol  
d) 0.047 mol  
e) none of these
12. (6 pts) How many moles of solid Ba(NO₃)₂ should be added to 300. milliliters of 0.20 M Fe(NO₃)₃ to increase the concentration of the NO₃⁻ ion to 1.0 M? (Assume that the volume of the solution remains constant.)

a) 0.060 moles  
b) 0.12 moles  
c) 0.24 moles  
d) 0.30 moles  
e) 0.40 moles

13. (6 pts) 200 mL of a 0.8 M calcium nitrate solution is added to 171 mL of a 2.3 M sodium phosphate solution, resulting in the formation of a precipitate. The reaction goes to completion. What is the final concentration of PO₄³⁻ ions in solution?

a) 0.0 M  
b) 0.77 M  
c) 0.92 M  
d) 0.27 M  
e) none of these

14. (6 pts) Rank the following aqueous solutions in order from the solution containing the lowest total number of ions to the solution containing the highest number of total ions. Assume all solutes are soluble in water.

I. 100. mL of 1.0 M iron (III) nitrate  
II. 100. mL of 4.5 M phosphorous pentachloride  
III. 100. mL of 1.5 M lithium chloride

a) I. < III. < II.  
b) II. < I. < III.  
c) III. < I. < II.  
d) II. < III. < I.  
e) III. < II. < I.
15. (6 pts) Elemental analysis of a compound shows that it is 53.3% carbon, 15.6% hydrogen, and 31.1% nitrogen by mass. What is the empirical formula of the compound?

a) $C_7H_{10}N_2$
b) CHN
c) $C_2H_3N_4$
d) $C_2H_2N$
e) none of these

16. (6 pts) Element “E” is a metal which forms a sulfate with the molecular formula $E_2(SO_4)_3$. If the compound $E_2(SO_4)_3$ is 26.1% $E$ by mass, what is the identity of element $E$?

a) Al
b) Se
c) V
d) Ru
e) none of these
17. (6 pts) Consider the following reaction: \[ 2 \text{Al} + 3 \text{MgCl}_2 \rightarrow 2 \text{AlCl}_3 + 3 \text{Mg} \]

How many grams of Al are used up if 54.5 g of Al (molar mass = 26.98 g/mol) reacts with 188.4 g of MgCl\(_2\) (molar mass = 95.2 g/mol)? The reaction has a 62.9% yield.

a) 20.2 g  
b) 22.4 g  
c) 34.3 g  
d) 0.830 g  
e) none of these

18. (6 pts) A sample contains a mixture of aluminum metal (molar mass = 26.98 g/mol) and magnesium metal (molar mass = 24.30 g/mol). The total mass of the sample is 3.50 g. When the magnesium and aluminum in the sample react with excess HCl according to the equations below, a total of 0.317 g of H\(_2\) is produced. The reaction goes to completion. What was the mass of aluminum in the original mixture?

Hint: make a system of two equations and two unknowns. Let “x” = the mass of Al; let “y” = the mass of Mg.

\[ 2 \text{Al} + 6 \text{HCl} \rightarrow 2 \text{AlCl}_3 + 3 \text{H}_2 \]
\[ \text{Mg} + 2 \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2 \]

a) 1.4 g  
b) 1.0 g  
c) 2.5 g  
d) 12 g  
e) none of these

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

more questions --------
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1. **(4 pts)** All chlorine atoms contain the same number of protons.
   a) True
   b) False

2. **(4 pts)** All chlorine atoms contain the same number of neutrons.
   a) True
   b) False

3. **(5 pts)** Calcium reacts with a polyatomic ion to form the compound Ca₃(X)₂. What would be the most likely formula for a compound formed when sodium combines with the polyatomic ion X?
   a) NaX
   b) Na₂X
   c) Na₃(X)₂
   d) Na₃X
   e) Na₅(X)₂

4. **(5 pts)** When sodium fluoride is added to an aqueous solution containing an unknown solute, a precipitate forms. Which of the following could have been the identity of the unknown solute?
   a) KCl
   b) AgNO₃
   c) CaBr₂
   d) Na₃PO₄
   e) More than one of these
5. (6 pts) An aqueous solution of aluminum sulfate reacts with an aqueous solution of sodium phosphate. What is the balanced net ionic equation, with appropriate phase designators, for the reaction takes place?

   a) $\text{AlSO}_4 \ (\text{aq}) + \text{NaPO}_4 \ (\text{aq}) \longrightarrow \text{AlPO}_4 \ (\text{s}) + \text{NaSO}_4 \ (\text{aq})$
   
   b) $2 \text{Na}^+ \ (\text{aq}) + \text{SO}_4^{2-} \ (\text{aq}) \longrightarrow \text{Na}_2\text{SO}_4 \ (\text{s})$
   
   c) $\text{Al}_2(\text{SO}_4)_3 \ (\text{aq}) + 2 \text{Na}_2\text{PO}_4 \ (\text{aq}) \longrightarrow 2 \text{AlPO}_4 \ (\text{s}) + 3 \text{Na}_2\text{SO}_4 \ (\text{aq})$
   
   d) $\text{Al}^{3+} \ (\text{aq}) + \text{PO}_4^{3-} \ (\text{aq}) \longrightarrow \text{AlPO}_4 \ (\text{s})$
   
   e) $2 \text{Al}^{3+} \ (\text{aq}) + 3 \text{SO}_4^{2-} \ (\text{aq}) + 6 \text{Na}^+ \ (\text{aq}) + 2 \text{PO}_4^{3-} \ (\text{aq}) \longrightarrow 2 \text{AlPO}_4 \ (\text{aq}) + 6 \text{Na}^+ \ (\text{aq}) + 3 \text{SO}_4^{2-} \ (\text{aq})$

6. (5 pts) Compound A and Compound B have the same empirical formula but different molecular formulas. Compound A and Compound B consist of only nitrogen and oxygen. Which of the following statements is true:

   a) Compound A and Compound B have the same molar mass
   
   b) The mass percentage of oxygen in Compound A is the same as the mass percentage of oxygen in Compound B
   
   c) Compound A and Compound B have the same chemical properties
   
   d) One mole of Compound A contains the same number of nitrogen atoms as one mole of Compound B
   
   e) More than one of these statements is true

7. (5 pts) Which of the following compounds is/are named incorrectly?

   I. $\text{IBr}$ iodine monobromide
   II. $\text{Fe(CN)}_2$ iron(II) cyanide
   III. $\text{H}_3\text{PO}_4$ trihydrogen phosphate

   a) I. only
   b) II. only
   c) III. only
   d) I. and III. only
   e) II. and III. only

8. (5 pts) Calculate the mass percentage of O in $\text{Cr}_2(\text{SO}_4)_3$

   a) 49%
   b) 16%
   c) 4.1%
   d) 32%
   e) 71%
9. (5 pts) Determine the total number of atoms in 65 grams of barium phosphate (molar mass = 601.93 g).
   a) $3.9 \times 10^{23}$
   b) $8.5 \times 10^{23}$
   c) $2.8 \times 10^{24}$
   d) $1.1 \times 10^{24}$
   e) $6.5 \times 10^{22}$

10. (5 pts) What is the concentration of lithium ions in a 0.50 M solution of lithium carbonate?
    a) 0.25 M
    b) 0.50 M
    c) 1.0 M
    d) 1.5 M
    e) 0.17 M

11. (6 pts) If you have 31 grams of KCl (74.55 g/mol), what volume of 0.46 M KCl solution can you make?
    a) 1.1 L
    b) 0.90 L
    c) 0.45 L
    d) 0.93 L
    e) 0.19 L
12. (6 pts) Consider the following reaction: \[ \text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3 \]

How many grams of \( \text{H}_2 \) must react with excess \( \text{N}_2 \) to actually yield 242 grams of \( \text{NH}_3 \) if the reaction has a percent yield of 76%?

a) 43 g  
b) 56 g  
c) 80 g  
d) 37 g  
e) 28 g

13. (6 pts) You are given a stock solution with \([\text{NaCl}] = 3.9 \text{ M}\). A 70 mL sample of the stock solution is diluted to 450 mL to make Solution A. Then, 150 mL of Solution A is removed to a separate beaker and diluted to make 830 mL of Solution B. What is \([\text{NaCl}] \) in Solution B?

a) 0.33 M  
b) 1.82 M  
c) 0.0040 M  
d) 0.61 M  
e) 0.11 M

14. (6 pts) A 7.7 gram sample of \( \text{Cr} \) metal is reacted with excess \( \text{HCl} \) to produce 0.59 grams of \( \text{H}_2 \) gas and the compound \( \text{CrCl}_x \). What is the value of “\( x \)” in the formula \( \text{CrCl}_x \) ?

a) 3  
b) 2  
c) 4  
d) 5  
e) 6
15. (7 pts) A 7.46 gram sample of an unknown compound containing C, H, and O is combusted in excess oxygen to produce 13.31 grams of CO₂ and 5.44 grams of H₂O. What is the empirical formula of the unknown compound?

a) C₃H₅O₂  
b) C₃H₅O₂  
c) C₂H₆O  
d) C₃H₅O₂  
e) C₂H₅O

16. (6 pts) Rhenium (Re) has two stable isotopes: ¹⁸⁵Re which has a mass of 184.953 amu and ¹⁸⁷Re which has a mass of 186.956 amu. If the average mass of Re is 186.207 amu, what is the natural abundance of ¹⁸⁵Re?

a) 37.40%  
b) 76.48%  
c) 62.60%  
d) 23.52%  
e) 50.00%
17. (7 pts) 330 mL of a 2.8 M CaBr$_2$ solution is added to 420 mL of a 3.9 M AgNO$_3$ solution. What concentration of which ion is present after the reaction goes to completion? Assume the volumes of the solutions are additive.

a) 0.3 M Br$^-$
b) 1.2 M Br$^-$
c) 3.1 M Ag$^+$
d) 2.2 M Ag$^+$
e) 0.0 M Br$^-$

18. (7 pts) A 2.44 gram sample of a compound with formula M$_2$SO$_4$ was dissolved in water and reacted with excess aqueous CaCl$_2$, resulting in the formation of a precipitate determined to be pure CaSO$_4$. The precipitate weighed 1.36 g. What is the molar mass of M?

a) 46 g/mol
b) 74 g/mol
c) 244 g/mol
d) 91 g/mol
e) 148 g/mol

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1. (4 pts) NH₄Cl is an ionic compound.
   a) True  
   b) False

2. (4 pts) Non electrolytes are insoluble in water.
   a) True  
   b) False

3. (5 pts) Which atom has the smallest number of neutrons?
   a) $^{14}_6$C  
   b) $^{14}_7$N  
   c) $^{16}_8$O  
   d) $^{19}_9$F  
   e) $^{20}_{10}$Ne

4. (5 pts) When ammonium sulfate is added to an aqueous solution containing an unknown solute, a precipitate forms. Which of the following could have been the identity of the unknown solute?
   a) Ba(OH)₂  
   b) Li₃PO₄  
   c) Na₂CO₃  
   d) Fe(NO₃)₃  
   e) More than one of these
5. (6 pts) An aqueous solution of aluminum sulfate reacts with an aqueous solution of sodium phosphate. What is the balanced molecular equation, with appropriate phase designators, for the reaction takes place?

a) $\text{AlSO}_4$ (aq) + $\text{NaPO}_4$ (aq) $\rightarrow$ $\text{AlPO}_4$ (s) + $\text{NaSO}_4$ (aq)

b) $\text{Al}_2(\text{SO}_4)_3$ (aq) + 2 $\text{Na}_3\text{PO}_4$ (aq) $\rightarrow$ 2 $\text{AlPO}_4$ (s) + 3 $\text{Na}_2\text{SO}_4$ (aq)

c) $\text{Al}^3+$ (aq) + $\text{PO}_4^{3-}$ (aq) $\rightarrow$ $\text{AlPO}_4$ (s)

d) $\text{Al}_2(\text{SO}_4)_3$ (aq) + 2 $\text{Na}_3\text{PO}_4$ (aq) $\rightarrow$ 2 $\text{AlPO}_4$ (aq) + 3 $\text{Na}_2\text{SO}_4$ (aq)

e) $\text{Al}_2(\text{SO}_4)_3$ (aq) + $\text{Na}_3\text{PO}_4$ (aq) $\rightarrow$ $\text{AlPO}_4$ (aq) + $\text{Na}_2\text{SO}_4$ (aq)

6. (5 pts) Which of the following is the empirical formula of $\text{C}_6\text{H}_8\text{N}_2$?

a) $\text{C}_6\text{H}_8\text{N}$

b) $\text{C}_3\text{H}_4\text{N}_2$

c) $\text{C}_{12}\text{H}_{16}\text{N}_4$

d) $\text{CHN}$

e) $\text{C}_3\text{H}_4\text{N}$

7. (5 pts) Which of the following compounds is/are named incorrectly?

I. $\text{N}_2\text{O}_5$ nitrogen(V) oxide

II. $\text{H}_2\text{SO}_3$ hydrosulfurous acid

III. $\text{SrS}$ strontium sulfide

a) I. only

b) II. only

c) III. only

d) I. and II. only

e) II. and III. only

8. (5 pts) How many grams of sulfur are there in 44 grams of $\text{Cr}_2(\text{SO}_4)_3$? The molar mass of $\text{Cr}_2(\text{SO}_4)_3$ is 392.2 g/mol.

a) 3.6 g

b) 7.8 g

c) 11 g

d) 17 g

e) 5.4 g
9. (5 pts) Rank the following gas samples in order of increasing number of total atoms present.

I. 20 grams of oxygen gas
II. 10 grams of helium gas
III. 22 grams of carbon dioxide gas

a) II. < I. < III.
b) III. < I. < II.
c) I. < III. < II.
d) II. < III. < I.
e) III. < II. < I.

10. (5 pts) How many grams of Ba(OH)$_2$ (171.3 g/mol) must be added to 150 mL of water to prepare a solution with [OH$^-$_] = 1.9 M? Assume the volume of the solid Ba(OH)$_2$ is negligible.

a) 49 g
b) 98 g
c) 34 g
d) 24 g
e) 49000 g

11. (6 pts) An element M forms a stable ionic compound with the formula M(SO$_4$)$_2$. If the ion of element M contains 18 electrons, what is the identity of the element?

a) Ar
b) Si
c) Ti
d) Ca
e) S
12. (6 pts) You are given a stock solution with $[\text{NaCl}] = 4.3 \text{ M}$. A 190 mL sample of the stock solution is diluted to 390 mL to make Solution A. Then, 120 mL of Solution A is removed to a separate beaker and diluted to make 840 mL of Solution B. What is $[\text{NaCl}]$ in Solution B?

a) 0.018 M  
b) 0.39 M  
c) 2.09 M  
d) 1.28 M  
e) 6.81 M

13. (6 pts) Consider the following reaction:  $\text{N}_2 + 2 \text{O}_2 \rightarrow 2 \text{NO}_2$

How many grams of $\text{N}_2$ must react with excess $\text{O}_2$ to actually yield 148 grams of $\text{NO}_2$ if the reaction has a percent yield of 59%?

a) 45 g  
b) 153 g  
c) 108 g  
d) 76 g  
e) 90 g

14. (6 pts) A 8.3 gram sample of Mo metal is reacted with excess $\text{HCl}$ to produce 0.17 grams of $\text{H}_2$ gas and the compound $\text{MoCl}_x$. What is the value of “$x$” in the formula $\text{MoCl}_x$?

a) 3  
b) 4  
c) 5  
d) 2  
e) 6
15. (7 pts) 250 mL of a 2.8 M CaBr₂ solution is added to 480 mL of a 3.6 M AgNO₃ solution. What concentration of which ion is present after the reaction goes to completion? Assume the volumes of the solutions are additive.

   a) 1.0 M Br⁻
   b) 0.4 M Ag⁺
   c) 3.3 M Br⁻
   d) 2.4 M Ag⁺
   e) 0.0 M Ag⁺

16. (7 pts) A 6.54 gram sample of an unknown compound containing C, H, and O is combusted in excess oxygen to produce 16.44 grams of CO₂ and 5.05 grams of H₂O. What is the empirical formula of the unknown compound?

   a) C₄H₆O
   b) C₃H₅O₂
   c) C₂H₄O
   d) C₃H₅O₂
   e) C₂H₄O
17. (6 pts) Europium (Eu) has two stable isotopes: $^{151}$Eu which has a mass of 150.9196 amu and $^{153}$Eu which has a mass of 152.9209 amu. If the average mass of Eu is 151.96 amu, what is the natural abundance of $^{153}$Eu?

a) 37.4%

b) 62.6%

c) 52.0%

d) 48.0%

e) 56.8%

18. (7 pts) Element M forms a chloride with the formula MCl$_3$. If this compound is 37.1% M by mass, what is the molar mass of M?

a) 106 g/mol

b) 20.9 g/mol

c) 89.7 g/mol

d) 151 g/mol

e) 62.7 g/mol

Answers:

1) A

2) A and B were accepted

3) B

4) A

5) B

6) E

7) D

8) C

9) C

10) D

11) C (book problem #2.65 & class notes 10/8)

12) B (book problem #4.26)

13) D (book problem #3.83)

14) D (book problem #3.112)

15) B (similar to #4.39 and class notes 10/24)

16) A (class notes 10/20)

17) C (class notes 10/13)

18) E
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 7 pages (18 questions) on the exam. Not every question is worth the same number of points—point values are indicated for each question. 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. Keep the exam so you can check your work and your answers. If you are concerned that you might make bubbling errors on your ParSCORE form, you may choose to turn in your quiz. Answers will be posted on our course web page.

1. (5 pts) Which of the following is named correctly:

   I. CaH₂ is called calcium hydride
   II. SO₂ is called monosulfur dioxide
   III. Fe(SCN)₃ is called iron thiocyanide

   a) I. only
   b) II. only
   c) I. and II. only
   d) I. and III. only
   e) none of these is named correctly

2. (5 pts) Element X forms a stable compound with the formula X₂(SO₄)₃. In this compound, the ion of element X contains 43 electrons and 60 neutrons. Determine the mass number for element X.

   a) 149
   b) 100
   c) 106
   d) 103
   e) 105
3. (5 pts) Which of these is a strong electrolyte?
   a) CoBr$_3$
   b) NBr$_3$
   c) Both CoBr$_3$ and NBr$_3$
   d) Neither CoBr$_3$ nor NBr$_3$

4. (5 pts) When an unknown substance is added to a solution of FeCl$_3$, a precipitate forms. When the same unknown substance is added to a solution of K$_2$SO$_4$, no precipitate forms. Which of the following could be the identity of the unknown substance?
   a) AlCH$_3$COO
   b) Na$_3$PO$_4$
   c) BaS
   d) More than one of these
   e) None of these

5. (5 pts) Elements X, Y, and Z combine to form the following compounds: XO, X$_3$Z$_2$, and YBr. What formula would you predict for the compound formed between Y and Z?
   a) YZ
   b) Y$_3$Z$_2$
   c) Y$_2$Z$_3$
   d) Y$_3$Z
   e) YZ$_3$

6. (5 pts) Aqueous solutions of (NH$_4$)$_2$PO$_4$ and Co(NO$_3$)$_2$ are combined to form a precipitate. Which ion(s) is/are spectator ions in this reaction?
   a) NO$_3^-$ and PO$_4^{3-}$
   b) NH$_4^+$ and Co$^{2+}$
   c) NH$_4^+$ and NO$_3^-$
   d) Co$^{2+}$ and PO$_4^{3-}$
   e) There are no spectator ions in this reaction.
7. (5 pts) Which of these pairs contains two species with the same number of electrons?

a) \( \frac{32}{26}Fe^{2+} \) and \( \frac{56}{26}Fe^{3+} \)

b) \( \frac{28}{14}Si \) and \( \frac{27}{13}Al^{3+} \)

c) \( \frac{16}{8}O \) and \( \frac{19}{9}F^- \)

d) \( \frac{121}{51}Sb^{2+} \) and \( \frac{119}{50}Sn^+ \)

e) More than one of these answers is correct

8. (5 pts) Which of these has the largest mass percentage of carbon?

a) \( C_6H_{12}O_6 \) (180 g/mol)

b) \( CO_2 \) (44 g/mol)

c) \( CH_4 \) (16 g/mol)

d) \( C_2H_5OH \) (46 g/mol)

e) More than of these has the largest mass percentage of carbon

9. (6 pts) Consider the following unbalanced reaction: \( Al_2O_3 + C \rightarrow Al + CO_2 \)

What will be the limiting reactant when 70 grams of \( Al_2O_3 \) (molar mass = 101.96 g/mol) reacts with 10 grams of C?

a) \( Al_2O_3 \)

b) C

c) There is no limiting reactant
10. (6 pts) How many oxygen atoms are there in 76 grams of oxygen gas?

a) $7.1\times10^{23}$
b) $2.9\times10^{24}$
c) $4.6\times10^{25}$
d) $9.2\times10^{25}$
e) $1.4\times10^{24}$

11. (6 pts) Consider the following reaction: $S_8 (s) + 24 F_2 (g) \rightarrow 8 SF_6 (g)$

When 10.0 grams of $S_8$ is reacted with 30.0 grams of $F_2$, you actually produce 18.3 grams of $SF_6$. Calculate the percent yield for this reaction.

a) 40.2%
b) 27.6%
c) 54.6%
d) 61.0%
e) 47.6%

12. (6 pts) How many mL of water should be added to 66 mL of 5.7 M CaBr$_2$ in order to prepare a solution with [Br$^-$] = 1.3 M?

a) 289 mL
b) 579 mL
c) 223 mL
d) 820 mL
e) 513 mL
13. (6 pts) A 6.43 gram sample of an unknown compound containing C, H, and O is combusted in excess oxygen to produce 14.15 grams of CO₂ and 4.63 grams of H₂O. What is the empirical formula of the unknown compound?

a) C₃H₄O₂
b) C₃H₅O₂
c) C₄H₄O
d) C₅H₆O₂
e) C₇H₈O

14. (6 pts) We have been given three solutions that all have the same mass of solute in 100 mL of solution. Which has the highest [Cl⁻]?

a) NaCl
b) KCl
c) NH₄Cl
d) All of these have the same [Cl⁻]
15. (6 pts) 470 mL of a 4.3 M NaOH solution is added to 460 mL of a 1.4 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) 0.8 M OH⁻
b) 0.7 M Mg²⁺
c) 0.4 M OH⁻
d) 1.2 M Mg²⁺
e) 0.0 M OH⁻

16. (6 pts) Determine how many mL of 2.5 M HCl are required to dissolve 12 grams of Mg according to the following balanced reaction (assume the reaction goes to completion):

\[ \text{Mg (s) + 2 HCl (aq) \rightarrow MgCl}_2 \text{ (aq) + H}_2 \text{ (g)} \]

a) 198 mL
b) 47 mL
c) 395 mL
d) 119 mL
e) 2469 mL

2 more questions on the last page
17. (6 pts) A 6.48 gram sample consisting of a mixture of silver nitrate and sodium nitrate is dissolved in water. This aqueous mixture then reacts with excess aqueous barium chloride to form 4.35 grams of silver chloride. Calculate the percent (by mass) of silver nitrate in the original mixture.

a) 79.6%
b) 56.6%
c) 51.6%
d) 54.8%
e) 97.5%

18. (6 pts) Consider the following reaction: \(4 \text{NH}_3 + 7 \text{O}_2 \rightarrow 4 \text{NO}_2 + 6 \text{H}_2\text{O}\)

In an experiment, \(\text{NH}_3\) is reacted with excess oxygen. After the reaction has gone to completion, you find that the reaction produced 35.1 grams of water, and 13.6 grams of \(\text{NH}_3\) is left over. Calculate the initial mass of \(\text{NH}_3\).

a) 22.1 g 
b) 48.7 g 
c) 75.2 g 
d) 35.7 g 
e) 54.1 g