

**Avogadro's Number,  $N_A = 6.022 \times 10^{23}$**

**1. [7 points]** Given the following mathematical expression:

$$(15.111 - 15.0) / (2.154 \times 10^3)$$

How many significant figures should the answer contain?

- (a) 1
- (b) 2
- (c) 3
- (d) 4
- (e) 5

**2. [7 points]** What is the empirical formula of lead (IV) sulfide?

- (a)  $\text{Pb}_4\text{S}$
- (b)  $\text{LaS}_2$
- (c)  $\text{PbS}_2$
- (d)  $\text{Pb}(\text{SO}_4)_2$
- (e)  $\text{PbS}_4$

**3. [7 points]** Which of the following pairs of atoms (ions) have the same number of electrons?

- (a)  $^{65}\text{Zn}^{2+}$  and  $^{67}\text{Ge}$
- (b)  $^{87}\text{Sr}^{2+}$  and  $^{83}\text{Kr}$
- (c)  $^{16}\text{O}^{2-}$  and  $^{19}\text{F}$
- (d)  $^{57}\text{Fe}^{3+}$  and  $^{57}\text{Fe}^{2+}$
- (e) None of the above pairs have the same number of electrons

**4. [7 points]** What is the empirical formula of lithium carbonate?

- (b)  $\text{LiCO}_2$
- (c)  $\text{Li}_2\text{CO}_3$
- (d)  $\text{Li}(\text{CO}_3)_2$
- (e)  $\text{Li}_2\text{CO}_2$

**5. [7 points]** What is the mass of 0.200 gallons (a fifth) of pure ethanol (density = 0.789 g/cm<sup>3</sup>)? [1 gallon = 3.785 Liters]

- (a)  $9.60 \times 10^2$  g
- (b) 651 g
- (c) 96 g

- (d) 0.597 g
- (e) 597 g

6. [7 points] Which of the following pure substances would you expect to be the best conductor of electricity?

- (a) Silicon dioxide
- (b) Dihydrogen sulfide
- (c) Tungsten
- (d) Magnesium chloride
- (e) Silicon

7. [7 points] Which of the following statements is false?

- (a) The elements in group 17 are collectively referred to as the halides
- (b) It's possible for two compounds with different empirical formulas to have the same molecular formula
- (c) Indium is a metal
- (d)  $^{55}\text{Mn}$  has more neutrons than protons
- (e) If two atoms are isotopes of each other they must have the same number of protons

8. [7 points] What is the mass of 0.075 moles of silver nitrate?

- (a) 2.3 kg
- (b) 13 g
- (c) 17 g
- (d) 21 g
- (e) none of the above

9. [7 points] Compositional analysis of an iron pyrite (fool's gold) sample reveals that this compound is 46.5% iron and 53.4% sulfur by mass. What is the empirical formula of iron pyrite?

- (a) FeS
- (b)  $\text{Fe}_2\text{S}_3$
- (c)  $\text{FeS}_2$
- (d)  $\text{Fe}_2\text{S}$
- (e)  $\text{FeS}_3$

10. [7 points] A gaseous sample weighing 0.625 g and containing only carbon and hydrogen was subjected to combustion analysis. The analysis yielded 1.89 g of  $\text{CO}_2$  and 0.969 g of  $\text{H}_2\text{O}$ . What is the empirical formula of this compound?

- (a)  $\text{C}_2\text{H}$
- (b)  $\text{CH}_4$

- (c)  $C_4H_5$
- (d)  $CH_3$
- (e)  $C_2H_5$

**11. [7 points]** Which of the following is the balanced chemical equation that describes the reaction between iron (III) hydroxide and perchloric acid?

- (a)  $2Fe(OH)_3(s) + 3H_2ClO_4(aq) \rightleftharpoons Fe_2(ClO_4)_3(aq) + 6H_2O(l)$
- (b)  $Fe_3OH(s) + HClO_3(aq) \rightleftharpoons Fe_3ClO_3(aq) + H_2O(l)$
- (c)  $Fe(OH)_3(s) + 3HClO_3(aq) \rightleftharpoons Fe(ClO_3)_3(aq) + 3H_2O(l)$
- (d)  $Fe(OH)_3(s) + HClO_4(aq) \rightleftharpoons Fe(ClO_4)_3(aq) + H_2O(l)$
- (e)  $Fe(OH)_3(s) + 3HClO_4(aq) \rightleftharpoons Fe(ClO_4)_3(aq) + 3H_2O(l)$

**12. [7 points]** Given the following balanced chemical equation:



Consider the reaction between 16 ammonia ( $NH_3$ ) molecules and 25 oxygen molecules. What molecules will remain after the reaction is complete, assuming the reaction goes to completion.

- (a) 4 molecules  $NH_3$  + 20 molecules  $NO$  + 30 molecules  $H_2O$
- (b) 5 molecules  $O_2$  + 16 molecules  $NO$  + 24 molecules  $H_2O$
- (c) 20 molecules  $O_2$  + 16 molecules  $NO$  + 24 molecules  $H_2O$
- (d) 16 molecules  $NO$  + 24 molecules  $H_2O$
- (e) 20 molecules  $NO$  + 30 molecules  $H_2O$

**13. [7 points]** A 1.32 g sample of calcium carbonate reacts with an excess of hydrochloric acid to form calcium chloride, carbon dioxide and water. The  $CO_2$  produced in this reaction is collected and its weight is found to be 0.534 g. What is the percent yield of carbon dioxide?

- (a) 92.1%
- (b) 46.0%
- (c) 40.4%
- (d) 86.5%
- (e) 109%

**14. [7 points]** What is the molarity of the solution formed when 9.5 g of potassium chloride is dissolved in water to make 250 mL of solution?

- (a) 0.13 M
- (b) 0.51 M
- (c) 0.031 M
- (d) 38 M
- (e) 0.57 M

15. [7 points] What is the concentration of the solution which results when 60.0 mL of 0.84 M KI solution is mixed with 30.0 mL of 1.44 M KI solution?

- (a) 1.36 M
- (b) 0.844 M
- (c) 1.04 M
- (d) 1.24 M
- (e) 0.995 M

16. [7 points] What is the oxidation state (oxidation number) of chlorine in sodium hypochlorite?

- (a) +3
- (b) -1
- (c) +7
- (d) +5
- (e) +1

17. [7 points] Which of the following substances is a weak electrolyte?

- (a)  $CO_2$
- (b)  $Zn(NO_3)_2$
- (c)  $H_2SO_4$
- (d)  $NH_3$
- (e) None of the above substances are weak electrolytes.

18. [7 points] Which of the following metals will be oxidized by hydrochloric acid?

- (a) zinc
- (b) nickel
- (c) silver
- (d) both (a) zinc and (b) nickel will be oxidized by hydrochloric acid
- (e) none of the above metals will be oxidized by hydrochloric acid

19. [7 points] What will be the outcome of the following two steps:

I. First 5.0 L of 1.0 M barium hydroxide solution and 8.0 L of 1.0 M hydrochloric acid solution are mixed in beaker A.

II. Next 12.0 L of 1.0 M zinc nitrate solution is added to beaker A.

- (a) No precipitate will form, but the solution will be strongly acidic
- (b) No precipitate will form, but the solution will be strongly basic
- (c) A white precipitate will form, and the solution will be neutral
- (d) A white precipitate will form, and the solution will be strongly acidic
- (e) A white precipitate will form, and the solution will be strongly basic

For the next three problems consider the two solutions (A and B) below.

**Solution A**

Solute = Silver Nitrate

Volume = 50.0 mL

Concentration = 1.50 M

**Solution B**

Solute = Sodium Carbonate

Volume = 85.0 mL

Concentration = 1.00 M

**20. [7 points]** If solutions A and B are mixed together what is the identity of the precipitate that forms?

- (a)  $\text{AgNO}_3$
- (b)  $\text{NaNO}_3$
- (c)  $\text{Ag}_2\text{CO}_3$
- (d)  $\text{AgCO}_3$
- (e) No precipitate is formed

**21. [7 points]** If you mix the two solutions together what is the theoretical yield of the precipitate?

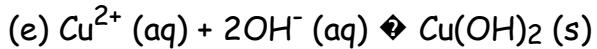
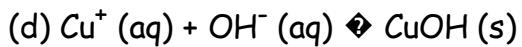
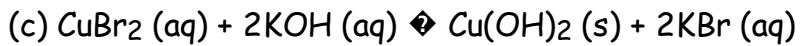
- (a) 10.3 g
- (b) 23.4 g
- (c) 20.6 g
- (d) 103 g
- (e) No precipitate is formed

**22. [7 points]** After mixing the two solutions together and removing the precipitate which ions are still present in solution?

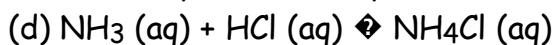
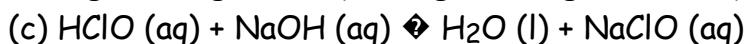
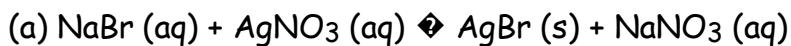
- (a)  $\text{Ag}^+$ ,  $\text{Na}^+$  and  $\text{NO}_3^-$
- (b)  $\text{Na}^+$  and  $\text{NO}_3^-$
- (c)  $\text{CO}_3^{2-}$ ,  $\text{Na}^+$  and  $\text{NO}_3^-$
- (d)  $\text{Ag}^+$ ,  $\text{CO}_3^{2-}$ ,  $\text{Na}^+$  and  $\text{NO}_3^-$
- (e) No ions remain in solution

**23. [7 points]** Which of the following equations is the correct balanced net ionic equation for the reaction between copper (II) bromide solution and potassium hydroxide solution.

- (a)  $\text{Cu}_2\text{Br}(\text{aq}) + \text{KOH}(\text{aq}) \rightleftharpoons \text{Cu}_2\text{OH}(\text{s}) + \text{KBr}(\text{aq})$
- (b)  $\text{CuBr}(\text{aq}) + \text{KOH}(\text{aq}) \rightleftharpoons \text{CuOH}(\text{s}) + \text{KBr}(\text{aq})$



24. [7 points] Which of the following reactions is an example of an oxidation-reduction reaction?



(e) None of the above reactions are oxidation-reduction reactions

25. [7 points] How many protons are found in a  $^{23}\text{Na}^+$  ion?

(a) 10

(b) 11

(c) 12

(d) 23

(e) none of the above