

Midterm Exam II Chem 102 Prof. David Alvarez-Carbonell**Multiple Choice**

Identify the letter of the choice that best completes the statement or answers the question.

- _____ 1. Which statement about the expression $6 \text{C}_6\text{H}_{12}\text{O}_6$ is not true?
- There are 36 carbon atoms.
 - There are 144 total atoms.
 - There are 72 hydrogen atoms.
 - There are 6 oxygen atoms.
 - There are 6 molecules.
- _____ 2. In the reaction given below, how many grams of water are consumed if 4.0 g of hydrogen gas and 32.0 g of oxygen gas are produced?
- $$2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$$
- 2.0 g
 - 4.0 g
 - 18.0 g
 - 20.0 g
 - 36.0 g
- _____ 3. In the reaction given below, how many grams of sodium metal are consumed if 2.02 g of hydrogen gas are produced?
- $$2 \text{Na(s)} + 2 \text{H}_2\text{O(l)} \rightarrow 2 \text{NaOH(aq)} + \text{H}_2\text{(g)}$$
- 92.0 g
 - 5.75 g
 - 11.5 g
 - 23.0 g
 - 46.0 g
- _____ 4. Classify the following reaction.
- $$\text{Pt(s)} + 2 \text{F}_2\text{(g)} \rightarrow \text{PtF}_4\text{(l)}$$
- combustion
 - exchange
 - combination
 - decomposition
 - displacement
- _____ 5. Classify the following reaction.
- $$2 \text{Al(s)} + 3 \text{CuSO}_4\text{(aq)} \rightarrow \text{Al}_2\text{(SO}_4\text{)}_3\text{(aq)} + 3 \text{Cu(s)}$$
- combination
 - decomposition
 - combustion
 - exchange
 - displacement

- _____ 6. Classify the following reaction.
 $\text{MgSO}_3(\text{s}) \rightarrow \text{MgO}(\text{s}) + \text{SO}_2(\text{g})$
- combustion
 - exchange
 - combination
 - decomposition
 - displacement
- _____ 7. The Roman numerals in the reaction given represent the coefficients in the balanced chemical equation. What are the values of the coefficients?
 $\text{I MgCl}_2 + \text{II K}_3\text{PO}_4 \rightarrow \text{III Mg}_3(\text{PO}_4)_2 + \text{IV KCl}$
- | | I | II | III | IV |
|----|---|----|-----|----|
| a. | 3 | 2 | 3 | 6 |
| b. | 3 | 2 | 2 | 3 |
| c. | 1 | 1 | 1 | 3 |
| d. | 3 | 2 | 2 | 2 |
| e. | 3 | 2 | 1 | 6 |
- _____ 8. How many mol of ammonia will be formed from the complete reaction of 45.0 g of H_2 ?
 $\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$
- 11.1 mol
 - 14.9 mol
 - 16.7 mol
 - 7.43 mol
 - 22.3 mol
- _____ 9. How many grams of CuCl are formed from the complete reaction of 0.750 mol Cu ?
 $\text{Cu} + \text{Cl}_2 \rightarrow \text{CuCl}$
- 148.5 g
 - 101 g
 - 74.5 g
 - 43.6 g
 - 32.2 g
- _____ 10. How many grams of O_2 are formed by the complete reaction of 5.25 moles of KClO_3 ?
 $2 \text{KClO}_3 \rightarrow 2 \text{KCl} + 3 \text{O}_2$
- 112 g
 - 126 g
 - 252 g
 - 336 g
 - 504 g
- _____ 11. In the reaction given below, how many grams of $\text{C}_{14}\text{H}_9\text{Cl}_5$ will be produced by the reaction of 25.0 g of each of the starting materials?
 $\text{C}_2\text{HOCl}_3 + 2 \text{C}_6\text{H}_5\text{Cl} \rightarrow \text{C}_{14}\text{H}_9\text{Cl}_5 + \text{H}_2\text{O}$
- 39.4 g
 - 78.7 g
 - 121 g
 - 157 g
 - 354 g

- _____ 12. How many grams of HCl are required to completely react with 25.0 g of aluminum?
$$2 \text{ Al} + 6 \text{ HCl} \rightarrow 2 \text{ AlCl}_3 + 3 \text{ H}_2$$
- 22.6 g
 - 67.5 g
 - 102 g
 - 136 g
 - 248 g
- _____ 13. How many grams of MgI_2 are produced by the reaction of 25.0 g of Mg with 25.0 g of I_2 ?
$$\text{Mg} + \text{I}_2 \rightarrow \text{MgI}_2$$
- 9.20 g
 - 18.4 g
 - 27.4 g
 - 49.0 g
 - 195 g
- _____ 14. If 70.9 g of chlorine reacts with sufficient cesium to produce cesium chloride, what is the theoretical yield?
$$2 \text{ Cs} + \text{Cl}_2 \rightarrow 2 \text{ CsCl}$$
- 70.9 g
 - 132.9 g
 - 146 g
 - 337 g
 - 285 g
- _____ 15. If 110.0 g of iron reacts with 64.0 g of oxygen, what is the theoretical yield of Fe_2O_3 ?
$$4 \text{ Fe} + 3 \text{ O}_2 \rightarrow 2 \text{ Fe}_2\text{O}_3$$
- 157.3 g
 - 212.9 g
 - 314.9 g
 - 319.4 g
 - 629.2 g
- _____ 16. If 365 g of magnesium reacts with excess oxygen to produce 326 g of magnesium oxide, what is the percent yield for the reaction?
$$2 \text{ Mg} + \text{O}_2 \rightarrow 2 \text{ MgO}$$
- 12.4%
 - 32.6%
 - 53.9%
 - 89.3%
 - 92.6%
- _____ 17. Which statement about the reaction below is true, given large amounts of reactants?
$$\text{Pb}(\text{NO}_3)_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{PbSO}_4 + 2\text{NaNO}_3$$
- PbSO_4 is insoluble in water and will precipitate.
 - NaNO_3 is insoluble in water and will precipitate.
 - $\text{Pb}(\text{NO}_3)_2$ is insoluble in water and no reaction will occur.
 - Both NaNO_3 and PbSO_4 are insoluble in water and will precipitate.
 - All compounds in the reaction are soluble in water and no reaction occurs.

Name: _____

ID: A

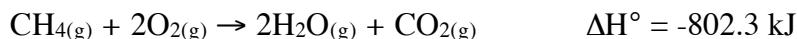
- _____ 18. What is the net ionic equation for the reaction of $\text{Pb}(\text{NO}_3)_2$ and KBr ?
- $\text{Pb}^+ + \text{Br}^- \rightarrow \text{PbBr}$
 - $\text{Pb}^{2+} + 2\text{Br}^- \rightarrow \text{PbBr}_2$
 - $\text{Pb}^{2+} + \text{Br}^{2-} \rightarrow \text{PbBr}$
 - $\text{K}^+ + \text{NO}_3^- \rightarrow \text{KNO}_3$
 - $\text{K}^{2+} + \text{NO}_3 \rightarrow \text{K}(\text{NO}_3)_2$
- _____ 19. What is the correct formula for the hydronium ion?
- OH^-
 - H_3O^+
 - H^+
 - H^-
 - NH_4^+
- _____ 20. What is the correct formula for the hydroxide ion?
- H_3O^+
 - OH^-
 - NH_4^+
 - H^+
 - H^-
- _____ 21. Which of the following represents an oxidation reaction?
- $\text{Al}^{3+} + 3 \text{e}^- \rightarrow \text{Al}$
 - $\text{O} + 2 \text{e}^- \rightarrow \text{O}^{2-}$
 - $\text{Mg} \rightarrow \text{Mg}^{2+} + 2 \text{e}^-$
 - $\text{Cu}^{2+} + \text{e}^- \rightarrow \text{Cu}$
 - $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$
- _____ 22. Which of the following represents a reduction half reaction?
- $\text{S} + 2 \text{e}^- \rightarrow \text{S}^{2-}$
 - $\text{K} \rightarrow \text{K}^+ + \text{e}^-$
 - $\text{Pb} \rightarrow \text{Pb}^{2+} + 2 \text{e}^-$
 - $\text{F}^- \rightarrow \text{F}_2 + 2 \text{e}^-$
 - $\text{Ni}^{2+} \rightarrow \text{Ni}^{3+} + \text{e}^-$
- _____ 23. What is the oxidation number of Mg in MgH_2 ?
- 1
 - +1
 - 0
 - +2
 - 2
- _____ 24. What is the oxidation number of P in PO_4^{3-} ?
- +5
 - +3
 - 2
 - 3
 - 5

- _____ 25. Determine the ammonium ion concentration of a solution that results when 4.53 g of $(\text{NH}_4)_2\text{SO}_4$ is dissolved in water and diluted to exactly 100.0 mL.
- 0.343 M
 - 0.686 M
 - 1.03 M
 - 1.37 M
 - 2.51 M
- _____ 26. In what volume of water must 25.0 g of BaCl_2 be dissolved to yield a solution that is 0.600 M?
200. mL
 240. mL
 400. mL
 480. mL
 800. mL
- _____ 27. How many grams of KCl are in 125.0 mL of 0.375 M KCl?
- 3.49 g
 - 0.0469 g
 - 3.49×10^{-3} g
 - 46.9 g
 - 0.938 g
- _____ 28. How many moles of ions are in 285 mL of 0.0150 M MgCl_2 ?
- 4.128×10^{-3} mol
 - 5.26×10^{-2} mol
 - 1.28×10^{-2} mol
 - 1.05×10^{-1} mol
 - 5.26×10^{-1} mol
- _____ 29. Hydrochloric acid solutions are often standardized by the reaction below. How many grams of CaCO_3 are required to exactly react with 50.0 mL of 0.155 M HCl?
- $$\text{CaCO}_3(\text{s}) + 2 \text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$$
- 0.194 g
 - 0.283 g
 - 0.341 g
 - 0.387 g
 - 0.566 g
- _____ 30. Oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$, reacts with $\text{Y}(\text{NO}_3)_3$ as shown by the equation below. What weight of yttrium oxalate is produced from 50.0 mL of 0.265 M $\text{Y}(\text{NO}_3)_3$ and excess oxalic acid? Assume that *all* of the yttrium oxalate is insoluble.
- $$2 \text{Y}(\text{NO}_3)_3(\text{aq}) + 3 \text{H}_2\text{C}_2\text{O}_4(\text{aq}) \rightarrow \text{Y}_2(\text{C}_2\text{O}_4)_3(\text{s}) + 6 \text{HNO}_3(\text{aq})$$
- 1.46 g
 - 1.82 g
 - 2.93 g
 - 3.64 g
 - 5.85 g

- _____ 31. A 25.00 mL sample of HCl solution is neutralized by exactly 41.63 mL of 0.1363 M NaOH. What is the molarity of the HCl solution?
- 0.2270 M
 - 0.2726 M
 - 0.06815 M
 - 0.1135 M
 - 0.05675 M
- _____ 32. A 25.00 mL sample of H₃PO₄ solution is neutralized by exactly 54.93 mL of 0.04345 M Ca(OH)₂. What is the molarity of the H₃PO₄ solution?
- 0.0636 M
 - 0.09546 M
 - 0.1432 M
 - 0.2148 M
 - 0.2897 M
- _____ 33. A 64.05 mL sample of 0.250 M CH₃COOH is to be exactly neutralized with 0.500 M KOH. How many milliliters of KOH will be required?
- 64.1 mL
 - 32.0 mL
 - 128 mL
 - 16.0 mL
 - 8.01 mL
- _____ 34. Determine the incorrect relationship given below.
- $1 \mu\text{J} = 1 \times 10^{-6} \text{ J}$
 - $1000 \text{ cal} = 1 \text{ kcal}$
 - $44.0 \text{ kJ} = 1.05 \times 10^4 \text{ cal}$
 - $1000 \text{ J} = 1 \text{ kJ}$
 - $80.0 \text{ cal/g} = 312 \text{ J/g}$
- _____ 35. If heat is transferred from the system to the surroundings then
- q_{system} is positive
 - q_{system} is negative
 - the system is doing work
 - the surroundings are doing work
 - Both a and c.
- _____ 36. If a 10.0 g sample of each substance below has 250 J applied to it, which substance will have the greatest increase in temperature?
- iron (specific heat = 0.46 J/g)
 - water (specific heat = 4.184 J/g)
 - copper (specific heat = 0.39 J/g)
 - aluminum (specific heat = 0.92 J/g)
 - Not enough information to determine.
- _____ 37. How much energy is required to raise the temperature of 200.0 g of water by 25.0°C?
- 20.9 kJ
 - 9.36 kJ
 - 10.5 kJ
 - 210 kJ
 - 1200 kJ

- _____ 38. How much heat is required to raise the temperature of 25.0 g of aluminum (specific heat = 0.92 J/g°C) from 22.0°C to 48.5°C?
- 0.610 kJ
 - 6.54 kJ
 - 0.975 J
 - 373 J
 - 3940 J
- _____ 39. How much heat is required to melt 125 g of ice at 0°C?
- 0.375 J
 - 41.6 kJ
 - 283 kJ
 - 333 J
 - 523 J
- _____ 40. Which process is exothermic?
- freezing rain drops
 - evaporating alcohol
 - defrosting frozen food
 - warming milk
 - subliming dry ice
- _____ 41. Which term refers to a quantity of heat transferred at constant pressure?
- work
 - specific heat capacity
 - expansion
 - entropy
 - enthalpy
- _____ 42. What is the enthalpy change when 22.5 g of CH₄ are burned in excess O₂?
- $$\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) \quad \Delta H^\circ = -890 \text{ kJ}$$
- 39.5 kJ
 - 890 kJ
 - 1250 kJ
 - +890 kJ
 - +1250 kJ
- _____ 43. What is the enthalpy change for the combustion of 4.73 g C₄H₁₀ in excess oxygen?
- $$\text{C}_4\text{H}_{10}(\text{g}) + 13/2\text{O}_2(\text{g}) \rightarrow 4\text{CO}_2(\text{g}) + 5\text{H}_2\text{O}(\text{g}) \quad \Delta H^\circ = -1895 \text{ kJ}$$
- 23200 kJ
 - 8960 kJ
 - 401 kJ
 - 155 kJ
 - 32.7 kJ
- _____ 44. The complete combustion of 1.47 g of methanol produces 29.3 kJ of heat. Determine the ΔH° for the reaction and its sign.
- $$\text{CH}_3\text{OH}(\text{l}) + 3/2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$$
- 938 kJ
 - 638 kJ
 - 1.35 kJ
 - +638 kJ
 - +938 kJ

- _____ 45. When does an endothermic reaction occur?
- when bonds are broken
 - when bonds are formed
 - when the energy of bonds breaking is greater than the energy of bonds formed
 - when the energy of bonds breaking is less than the energy of bonds formed
 - when stronger bonds are formed and weaker bonds are broken
- _____ 46. A bomb calorimeter has a heat capacity of $783 \text{ J/}^\circ\text{C}$ and contains 254 g of water. How much energy is evolved or absorbed when the temperature of the calorimeter goes from 23.73°C to 26.01°C ?
- 1.78 kJ evolved
 - 2.42 kJ evolved
 - 4.21 kJ evolved
 - 2420 kJ absorbed
 - 4210 kJ evolved
- _____ 47. A 0.100 mole sample of CH_4 reacts completely in a calorimeter having a heat capacity of $783 \text{ J/}^\circ\text{C}$. The calorimeter contains 254 g of water. Determine the temperature increase of the calorimeter.



- $4.35 \times 10^{-3}^\circ\text{C}$
 - 7.56°C
 - 10.2°C
 - 31.6°C
 - 43.5°C
- _____ 48. How many grams of PH_3 are formed by the complete reaction of 52.5 g of H_2 ?
- $$2 \text{ P} + 3 \text{ H}_2 \rightarrow 2 \text{ PH}_3$$
- 885 g
 - 590 g
 - 17.4 g
 - 8.68 g
 - 0.843 g
- _____ 49. Which statement about the reaction below is true, given large amounts of reactants?
- $$\text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl}$$
- NaNO_3 is insoluble in water and will precipitate.
 - AgCl is insoluble in water and will precipitate.
 - Both NaNO_3 and AgCl are insoluble in water and will precipitate.
 - AgNO_3 is insoluble in water and no reaction will occur.
 - All compounds in the reaction are soluble in water and no reaction occurs.
- _____ 50. Which compound will dissolve in water in large amounts?
- AgCl
 - $\text{Al}(\text{OH})_3$
 - Na_2SO_4
 - BaSO_4
 - MgS

Midterm Exam II Chem 102 Prof. David Alvarez-Carbonell
Answer Section**MULTIPLE CHOICE**

- | | |
|------------|--|
| 1. ANS: D | OBJ: 04-1 Chemical Equations |
| 2. ANS: E | OBJ: 04-1 Chemical Equations |
| 3. ANS: E | OBJ: 04-1 Chemical Equations |
| 4. ANS: C | OBJ: 04-2 Patterns of Chemical Reactions |
| 5. ANS: E | OBJ: 04-2 Patterns of Chemical Reactions |
| 6. ANS: D | OBJ: 04-2 Patterns of Chemical Reactions |
| 7. ANS: E | OBJ: 04-3 Balancing Chemical Equations |
| 8. ANS: B | OBJ: 04-4 The Mole and Chemical Reactions: The Macro-Nano Connection |
| 9. ANS: C | OBJ: 04-4 The Mole and Chemical Reactions: The Macro-Nano Connection |
| 10. ANS: C | OBJ: 04-4 The Mole and Chemical Reactions: The Macro-Nano Connection |
| 11. ANS: A | OBJ: 04-5 Reactions with One Reactant in Limited Supply |
| 12. ANS: C | OBJ: 04-5 Reactions with One Reactant in Limited Supply |
| 13. ANS: C | OBJ: 04-5 Reactions with One Reactant in Limited Supply |
| 14. ANS: D | OBJ: 04-6 Evaluation the Success of a Synthesis: Percent Yield |
| 15. ANS: A | OBJ: 04-6 Evaluation the Success of a Synthesis: Percent Yield |
| 16. ANS: C | OBJ: 04-6 Evaluation the Success of a Synthesis: Percent Yield |
| 17. ANS: A | OBJ: 05-1 Exchange Reactions: Precipitation and Net Ionic Equations |
| 18. ANS: B | OBJ: 05-1 Exchange Reactions: Precipitation and Net Ionic Equations |
| 19. ANS: B | OBJ: 05-2 Acids, Bases, and Acid-Base Exchange Reactions |
| 20. ANS: B | OBJ: 05-2 Acids, Bases, and Acid-Base Exchange Reactions |
| 21. ANS: C | OBJ: 05-3 Oxidation-Reduction Reactions |
| 22. ANS: A | OBJ: 05-3 Oxidation-Reduction Reactions |
| 23. ANS: D | OBJ: 05-4 Oxidation Numbers and Redox Reactions |
| 24. ANS: A | OBJ: 05-4 Oxidation Numbers and Redox Reactions |
| 25. ANS: B | OBJ: 05-6 Solution Concentration |
| 26. ANS: A | OBJ: 05-6 Solution Concentration |
| 27. ANS: A | OBJ: 05-7 Molarity and Reactions in Aqueous Media |
| 28. ANS: C | OBJ: 05-7 Molarity and Reactions in Aqueous Media |
| 29. ANS: D | OBJ: 05-7 Molarity and Reactions in Aqueous Media |
| 30. ANS: C | OBJ: 05-7 Molarity and Reactions in Aqueous Media |
| 31. ANS: A | OBJ: 05-8 Aqueous Solution Titrations |
| 32. ANS: A | OBJ: 05-8 Aqueous Solution Titrations |
| 33. ANS: B | OBJ: 05-8 Aqueous Solution Titrations |
| 34. ANS: E | OBJ: 06-1 The Nature of Energy |
| 35. ANS: B | OBJ: 06-2 Conservation of Energy |
| 36. ANS: C | OBJ: 06-3 Heat Capacity |
| 37. ANS: A | OBJ: 06-3 Heat Capacity |
| 38. ANS: A | OBJ: 06-3 Heat Capacity |

39. ANS: B OBJ: 06-4 Energy and Enthalpy
40. ANS: A OBJ: 06-4 Energy and Enthalpy
41. ANS: E OBJ: 06-4 Energy and Enthalpy
42. ANS: C OBJ: 06-6 Enthalpy Changes for Chemical Reactions
43. ANS: D OBJ: 06-6 Enthalpy Changes for Chemical Reactions
44. ANS: B OBJ: 06-6 Enthalpy Changes for Chemical Reactions
45. ANS: C OBJ: 06-7 Where Does the Energy Come From?
46. ANS: C OBJ: 06-8 Measuring Enthalpy Changes: Calorimetry
47. ANS: E OBJ: 06-8 Measuring Enthalpy Changes: Calorimetry
48. ANS: B OBJ: 04-4 The Mole and Chemical Reactions: The Macro-Nano Connection
49. ANS: B OBJ: 05-1 Exchange Reactions: Precipitation and Net Ionic Equations
50. ANS: C OBJ: 05-1 Exchange Reactions: Precipitation and Net Ionic Equations