

Midterm Exam II Make-up 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 term refers to a quantity of heat transferred at constant pressure?
- work
 - specific heat capacity
 - expansion
 - entropy
 - enthalpy
- _____ 2. Which statement regarding the complete combustion of a carbon compound is incorrect?
- Oxygen is the fuel in combustion reactions.
 - Heat is given off by combustion reactions but need not be considered to obtain a balanced equation.
 - The chemical formulas for the products are CO₂ and H₂O.
 - Balancing the equation does not depend on whether the products are gases or liquids.
 - The reaction will produce carbon dioxide and water.
- _____ 3. Which of the following cannot be determined from a balanced chemical equation?
- The relative mass of each reactant and product.
 - The number of moles of reactants and products.
 - The number of molecules of reactants and products.
 - The number of atoms of each element reacting.
 - Whether the reaction will proceed as written.
- _____ 4. In the reaction shown below, which substances are dissolved in water?
 $\text{Cu(s)} + \text{H}_2\text{SO}_4\text{(aq)} \rightarrow \text{CuSO}_4\text{(aq)} + \text{H}_2\text{(g)}$
- H₂SO₄ and CuSO₄
 - Cu and CuSO₄
 - Cu
 - H₂ and H₂SO₄
 - H₂ and Cu
- _____ 5. Classify the following reaction.
 $\text{CaCl}_2\text{(aq)} + \text{H}_2\text{SO}_4\text{(aq)} \rightarrow \text{CaSO}_4\text{(s)} + 2\text{HCl(aq)}$
- combustion
 - exchange
 - combination
 - decomposition
 - displacement
- _____ 6. Classify the following reaction.
 $2\text{Al(s)} + 3\text{Cl}_2\text{(g)} \rightarrow 2\text{AlCl}_3\text{(s)}$
- combustion
 - exchange
 - combination
 - decomposition
 - displacement

- _____ 7. Classify the following reaction.
 $\text{CuSO}_4(\text{aq}) + \text{Fe}(\text{s}) \rightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$
a. combustion
b. exchange
c. combination
d. decomposition
e. displacement
- _____ 8. The Roman numerals in the reaction given represent the coefficients in the balanced chemical equation. What are the values of the coefficients?
 $\text{I CH}_3\text{CH}_2\text{OH} + \text{II O}_2 \rightarrow \text{III CO}_2 + \text{IV H}_2\text{O}$
- | | I | II | III | IV |
|----|---|----|-----|----|
| a. | 1 | 3 | 2 | 3 |
| b. | 1 | 7 | 6 | 4 |
| c. | 1 | 7 | 2 | 4 |
| d. | 1 | 5 | 3 | 4 |
| e. | 2 | 6 | 4 | 6 |
- _____ 9. The Roman numerals in the reaction given represent the coefficients in the balanced chemical equation. What are the values of the coefficients?
 $\text{I KO}_2 + \text{II H}_2\text{O} \rightarrow \text{III KOH} + \text{IV O}_2$
- | | I | II | III | IV |
|----|---|----|-----|----|
| a. | 2 | 1 | 2 | 1 |
| b. | 2 | 2 | 4 | 3 |
| c. | 1 | 1 | 1 | 1 |
| d. | 4 | 2 | 4 | 3 |
| e. | 8 | 4 | 8 | 6 |
- _____ 10. The Roman numerals in the reaction given represent the coefficients in the balanced chemical equation. What are the values of the coefficients?
 $\text{I CO} + \text{II NO} \rightarrow \text{III CO}_2 + \text{IV N}_2$
- | | I | II | III | IV |
|----|---|----|-----|----|
| a. | 2 | 2 | 2 | 3 |
| b. | 2 | 2 | 2 | 1 |
| c. | 1 | 1 | 1 | 2 |
| d. | 2 | 1 | 2 | 1 |
| e. | 1 | 2 | 2 | 1 |
- _____ 11. How many grams of Fe_2O_3 are formed by the complete reaction of 6.75 moles of iron?
 $4 \text{Fe} + 3 \text{O}_2 \rightarrow 2 \text{Fe}_2\text{O}_3$
a. 242 g
b. 350. g
c. 539 g
d. 701 g
e. 1080 g

- _____ 12. How many grams of Al_2O_3 are formed by the complete reaction of 48.5 g of Fe_2O_3 ?
$$\text{Fe}_2\text{O}_3 + 2 \text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2 \text{Fe}$$
- 26.1 g
 - 31.0g
 - 37.7 g
 - 62.4 g
 - 139 g
- _____ 13. How many grams of N_2O are formed by the complete reaction of 57.0 g of O_2 ?
$$2 \text{N}_2 + \text{O}_2 \rightarrow 2 \text{N}_2\text{O}$$
- 78.6 g
 - 157 g
 - 224 g
 - 448 g
 610. g
- _____ 14. In the reaction below, 8.0 g of H_2 react with 9.0 g of O_2 . Which of the following statements is true?
$$2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$$
- The equation is not balanced.
 - The H_2 is the limiting reactant.
 - The O_2 is the limiting reactant.
 - 2.0 moles of H_2O would be produced.
 - 36 grams of H_2O would be produced.
- _____ 15. What is the maximum possible quantity of product obtained from a chemical reaction called?
- percent yield
 - molecular weight of the product
 - stoichiometric coefficients
 - limiting reactant
 - theoretical yield
- _____ 16. The efficiency of a particular synthesis method is evaluated by determining the:
- molecular weight of the product.
 - stoichiometric coefficients.
 - limiting reactant.
 - theoretical yield.
 - percent yield.
- _____ 17. If 225 g of carbon reacts with excess sulfur dioxide to produce 195 g of carbon disulfide, what is the percent yield for the reaction?
$$5 \text{C} + 2 \text{SO}_2 \rightarrow \text{CS}_2 + 4 \text{CO}$$
- 78.9%
 - 68.4%
 - 22.5%
 - 19.5%
 - 15.7%

- _____ 18. The complete reaction of 16.12 g of titanium with 23.88 g of chlorine (Cl_2) produces a compound with the formula Ti_xCl_y . What is the empirical formula of the compound?
- TiCl
 - Ti_2Cl
 - Ti_4Cl
 - TiCl_2
 - TiCl_4
- _____ 19. Which compound will not dissolve in water in large amounts?
- KNO_3
 - NH_4Cl
 - $\text{Ca}(\text{OH})_2$
 - AgCl
 - Ag_2SO_4
- _____ 20. Which compounds will not dissolve in water in large amounts at 20°C ?
- | | | | |
|-----------------|----------------|--------------|-----------------|
| CaSO_4 | KNO_3 | KBr | PbCl_2 |
| I | II | III | IV |
- I & II
 - I & IV
 - II & III
 - III & IV
 - III & IV
- _____ 21. What is the net ionic equation for the reaction of AlCl_3 and NaOH ?
- $\text{Na}^+ + \text{Cl}^- \rightarrow \text{NaCl}$
 - $\text{Al}^+ + \text{OH}^- \rightarrow \text{AlOH}$
 - $\text{Al}^{3+} + 3\text{OH}^- \rightarrow \text{Al}(\text{OH})_3$
 - $\text{Al}^{3+} + \text{OH}^{3-} \rightarrow \text{AlOH}$
 - $\text{Na}^{3+} + 3\text{Cl}^- \rightarrow \text{NaCl}_3$
- _____ 22. Which of the following is not a property of acids?
- Acids form precipitates on reaction with metals.
 - Acids produce gas bubbles when reacting with limestone.
 - Acids neutralize bases.
 - Acids increase the hydrogen ion concentration of water when dissolved in it.
 - Acids taste sour.
- _____ 23. What species is the reducing agent in the reaction below?
- $$\text{Zn}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}(\text{s})$$
- Zn
 - Cu^{2+}
 - CuSO_4
 - Zn^{2+}
 - SO_4^{2-}

- _____ 24. What species is the reducing agent in the reaction below?
 $2 \text{Ca} + \text{O}_2 \rightarrow 2 \text{CaO}$
- Ca
 - Ca and O_2
 - O_2
 - O_2 and CaO
 - CaO
- _____ 25. Which of the following is a reducing agent?
- I_2
 - Na
 - O_2
 - F_2
 - Br_2
- _____ 26. Which substance is oxidized in the reaction below?
 $\text{NaNO}_3 + \text{Pb} \rightarrow \text{NaNO}_2 + \text{PbO}$
- Na^+
 - PbO
 - NaNO_3
 - NaNO_2
 - none of the above
- _____ 27. What is the oxidation number of O in Fe_2O_3 ?
- +2
 - 2
 - 3
 - 5
 - +5
- _____ 28. What is the oxidation number of N in NH_4^+ ?
- 3
 - 1
 - 0
 - +1
 - +3
- _____ 29. A 50.0 mL sample of 0.108 M H_2SO_4 is diluted to 250.0 mL. What is its new molarity?
- 0.0216 M
 - 0.108 M
 - 0.184 M
 - 0.461 M
 - 0.542 M
- _____ 30. To which volume should a 25.0 mL sample of 1.50 M Na_2SO_4 be diluted to yield a final solution that is 0.300 M in sodium ions?
- 4.95 mL
 - 125 mL
 - 250 mL
 - 375 mL
 - 4950 mL

- _____ 31. A solution is made by dissolving 12.5 g of LiCl in enough water to make 500.0 mL of solution. How many moles are in 35.0 mL of solution?
- 0.0103 mol
 - 0.0206 mol
 - 0.295 mol
 - 0.438 mol
 - 0.590 mol
- _____ 32. A solution is made by dissolving 60.0 g of AlCl₃ in enough water to make 250.0 mL of solution. How many moles of ions are in 5.00 mL of solution?
- 3.60×10^{-2} mol
 - 1.01×10^{-3} mol
 - 1.25×10^{-3} mol
 - 5.00×10^{-3} mol
 - 9.00×10^{-3} mol
- _____ 33. How many grams of AgCl will precipitate from the reaction of 37.0 mL of 0.280 M AgNO₃ with excess NaCl solution? Assume that *all* of the AgCl is insoluble.
- 0.60 g
 - 1.49 g
 - 1.89 g
 - 149 g
 - 189 g
- _____ 34. Determine the mass of BaSO₄ that is produced by the reaction of 45.0 mL of 0.155 M H₂SO₄ and 60.0 mL of 0.125 M BaCl₂. Assume that BaSO₄ is totally insoluble.
- $$\text{BaCl}_2(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{HCl}(\text{aq})$$
- 1.45 g
 - 1.62 g
 - 1.79 g
 - 3.24 g
 - 0.775 g
- _____ 35. Ammonia and sulfuric acid react according to the equation given below. How many milliliters of 0.110 M sulfuric acid are required to exactly neutralize 25.0 mL of 0.0840 M NH₃ solution?
- $$2 \text{NH}_3(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow (\text{NH}_4)_2\text{SO}_4(\text{aq})$$
- 1.46 mL
 - 1.82 mL
 - 3.64 mL
 - 5.85 mL
 - 9.55 mL
- _____ 36. A 25.00 mL sample of HCl solution is neutralized by exactly 31.22 mL of 0.08152 M Ca(OH)₂. What is the molarity of the HCl solution?
- 0.08152 M
 - 0.1018 M
 - 0.2036 M
 - 0.1021 M
 - 0.09453 M

- _____ 37. A 35.00 mL sample of HNO_3 solution is neutralized by exactly 42.63 mL of 0.4153 M KOH. What is the molarity of the HNO_3 solution?
- 0.5058 M
 - 0.1265 M
 - 0.2529 M
 - 0.2077 M
 - 1.012 M
- _____ 38. Which of the following is not an example of kinetic energy?
- the motion of a molecule
 - a golf ball sitting on a tee
 - the vibration of an object
 - a brick falling from the top of a building
 - the motion of electrons through a wire
- _____ 39. How many joules are there in one glass of milk containing 110 Calories?
- 4.6×10^5 kJ
 - 460 kJ
 - 2.6×10^4 kJ
 - 26 kJ
 - 0.46 kJ
- _____ 40. The First Law of Thermodynamics states that:
- Molecules move faster as temperature increases.
 - The total entropy of the universe is increasing.
 - Energy transfers from hotter objects to cooler objects.
 - Samples with different temperatures that come in contact with one another will reach thermal equilibrium.
 - None of the above.
- _____ 41. The temperature of a 21.6 g sample of a metal rises 6.04°C when 60.0 J of energy is applied to it. What is the identity of the metal?
- silver (specific heat = $0.23 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$)
 - copper (specific heat = $0.39 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$)
 - iron (specific heat = $0.46 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$)
 - lead (specific heat = $0.13 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$)
 - aluminum (specific heat = $0.92 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$)
- _____ 42. What is the molar heat capacity of aluminum (specific heat = $0.92 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$)?
- $0.034 \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
 - $24.8 \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
 - $29.3 \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
 - $120 \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
 - $1.5 \times 10^{25} \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
- _____ 43. What is the molar heat capacity of table salt, NaCl (specific heat = $0.88 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$)?
- $5.30 \times 10^{22} \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
 - $24.6 \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
 - $51.4 \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
 - $117 \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$
 - $245 \text{ J mol}^{-1} \text{ }^\circ\text{C}^{-1}$

- _____ 44. How much energy is required to melt 10.0 g of ice at 0.0°C, warm it to 100.0°C and completely vaporize the sample?
- 30100 J
 - 22600 J
 - 4180 J
 - 3330 J
 - 343 J
- _____ 45. Which statement is true?
- A positive change in enthalpy occurs with exothermic processes.
 - A negative change in enthalpy occurs with exothermic processes.
 - A positive change in enthalpy occurs when work is done on the surroundings.
 - A negative change in enthalpy occurs when work is done by the system.
 - A positive change in enthalpy occurs when a process is endothermic and does work on the surroundings.
- _____ 46. Which statement about the reaction below is incorrect?
- $$\text{H}_2\text{O}_{(l)} \rightarrow \text{H}_2\text{O}_{(g)} \quad \Delta H^\circ = +44.0 \text{ kJ}$$
- The value for the solid to liquid transformation is the same.
 - The liquid must absorb heat from the surroundings to evaporate.
 - The reaction is endothermic.
 - The above data does not give any information about the solid to liquid transformation.
 - The value for the gas to liquid value has the reverse sign.
- _____ 47. What is the enthalpy change when 225 g of C₂H₂ are burned in excess O₂?
- $$\text{C}_2\text{H}_2(g) + 5/2\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + \text{H}_2\text{O}(l) \quad \Delta H^\circ = -1300 \text{ kJ}$$
- $-1.1 \times 10^4 \text{ kJ}$
 - $-3.39 \times 10^4 \text{ kJ}$
 - $-2.93 \times 10^5 \text{ kJ}$
 - $+1.1 \times 10^4 \text{ kJ}$
 - $+2.93 \times 10^5 \text{ kJ}$
- _____ 48. The temperature of 3.50 kg of water is raised by 1.17°C when 1.00 g of hydrazine N₂H₄ is burned in a bomb calorimeter. The calorimeter has a heat capacity of 883 J/°C. How much heat is given off by the sample?
- 0.944 kJ
 - 16.3 kJ
 - 17.1 kJ
 - 18.2 kJ
 - 21.5 kJ
- _____ 49. A bomb calorimeter has a heat capacity of 843 J/°C and contains 473 g of water. If the combustion of 0.500 mole of a hydrocarbon increases the temperature of the calorimeter from 22.73°C to 26.95°C, determine the heat evolved per mole of hydrocarbon.
- 8.38 kJ
 - 23.8 kJ
 - 76.0 kJ
 - 95.9 kJ
 - 8380 kJ

Name: _____

ID: A

- _____ 50. If heat is transferred from the system to the surroundings then
- a. q_{system} is positive
 - b. q_{system} is negative
 - c. the system is doing work
 - d. the surroundings are doing work
 - e. Both a and c.

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

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

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| 39. ANS: A | OBJ: 06-1 The Nature of Energy |
| 40. ANS: E | OBJ: 06-2 Conservation of Energy |
| 41. ANS: C | OBJ: 06-3 Heat Capacity |
| 42. ANS: B | OBJ: 06-3 Heat Capacity |
| 43. ANS: C | OBJ: 06-3 Heat Capacity |
| 44. ANS: A | OBJ: 06-4 Energy and Enthalpy |
| 45. ANS: B | OBJ: 06-4 Energy and Enthalpy |
| 46. ANS: A | OBJ: 06-5 Thermochemical Equations |
| 47. ANS: A | OBJ: 06-6 Enthalpy Changes for Chemical Reactions |
| 48. ANS: D | OBJ: 06-8 Measuring Enthalpy Changes: Calorimetry |
| 49. ANS: B | OBJ: 06-8 Measuring Enthalpy Changes: Calorimetry |
| 50. ANS: B | OBJ: 06-2 Conservation of Energy |