

Chem 106 Final Study Questions

Not collected for credit.

1. A student finds that the weight of an empty beaker is 12.024 g. She places a solid in the beaker to give a combined mass of 12.108 g. To how many significant figures is the mass of the solid known?
A) 1
B) 2
C) 3
D) 4
E) 5
2. 9.5 milliseconds is equal to how many seconds?
A) 9.5×10^3 s
B) 9.5×10^2 s
C) 9.5×10^{-3} s
D) 9.5×10^{-2} s
E) 0.95 s
3. Convert 224.9 m to decimeters.
A) 2.249×10^4 dm
B) 22.49 dm
C) 2.249 dm
D) 2.249×10^3 dm
E) none of these
4. 235.0°F is equivalent to
A) 148.3°C
B) 112.8°C
C) 365.4°C
D) 480.6°C
E) 130.6°C
5. Convert: $-32.2^\circ\text{F} = \underline{\hspace{2cm}}$ °C.
A) -35.7°C
B) -0.1°C
C) -115.6°C
D) -0.4°C
E) 240.8°C

6. The number 2.00152 rounded to four significant figures is
- A) 2.002
 - B) 2.001
 - C) 2.000
 - D) 2.152
 - E) none of these
7. A graduated cylinder contains 20.0 mL of water. An irregularly shaped object is placed in the cylinder, and the water level rises to the 31.2-mL mark. If the object has a mass of 77.5 g, what is its density?
- A) 6.92 g/mL
 - B) 0.145 g/mL
 - C) 2.48 g/mL
 - D) 3.87 g/mL
 - E) none of these
8. An object is 112.3 inches in height. Express this height in centimeters.
- A) 44.21 cm
 - B) 0.02262 cm
 - C) 9.36 cm
 - D) 285.2 cm
 - E) 114.8 cm
9. Which of the following is a chemical change?
- A) Water condenses on a mirror.
 - B) A damp towel dries.
 - C) Peanuts are crushed.
 - D) A "tin" can rusts.
 - E) At least two of the above (a-d) exhibit a chemical change.
10. Which of the following is an element?
- A) air
 - B) water
 - C) salt
 - D) helium
 - E) sugar

11. Which is an example of a homogeneous mixture?
- A) vodka
 - B) oily water
 - C) soil (dust)
 - D) sodium chloride
 - E) aluminum
12. How many protons, electrons, and neutrons does the isotope ${}_{26}^{57}\text{Fe}^{3+}$ have?
13. Which pair have approximately the same mass?
- A) a hydrogen, ${}^1_1\text{H}$, and a deuterium, ${}^2_1\text{H}$, atom
 - B) a neutron and an electron
 - C) a proton and a neutron
 - D) an electron and a proton
14. Which of the following elements is an alkaline earth metal?
- A) Ca
 - B) Cu
 - C) Fe
 - D) Na
 - E) Sc
15. The total number of atoms indicated by the formula $\text{Ca}_3(\text{PO}_4)_3$ is
- A) 6
 - B) 10
 - C) 16
 - D) 18
 - E) 7
16. Which of the following is an **incorrect** name for an acid?
- A) hydrocarbonate acid
 - B) hydrocyanic acid
 - C) acetic acid
 - D) phosphoric acid
 - E) sulfurous acid
17. Give the formula for calcium hydrogen carbonate.

18. Write the correct formula for dinitrogen pentoxide.

19. The name for NO_3^- is _____.

20. Give the formula for carbon monoxide.

21. Give the formula for hypochlorous acid.

22. The name for $(\text{NH}_4)_2\text{SO}_4$ is _____.

23. The name for $\text{C}_2\text{H}_3\text{O}_2^-$ is _____.

24. Give the formula for hydrosulfuric acid.

25. The name for $(\text{NH}_4)_2\text{CO}_3$ is _____.

26. Give the formula for chromium(III) iodide.

27. The name for $\text{Zn}(\text{OH})_2$ is _____.

28. The binary compound PCl_3 is called

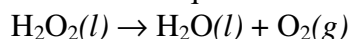
- A) phosphorus chloride
- B) triphosphorus chloride
- C) monophosphorus trichloride
- D) phosphorus trichloride
- E) none of these

29. When the following equation is balanced using the smallest possible integers, what is the number in front of the substance in bold type?



- A) 10
- B) 6
- C) 4
- D) 2
- E) 1

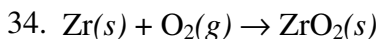
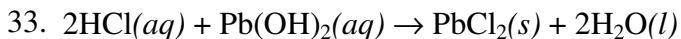
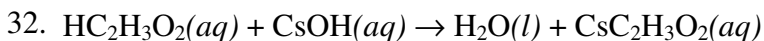
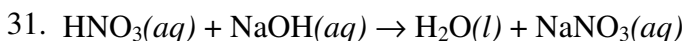
30. Balance the equation



Use the following to answer questions 31-34:

Use the following choices to classify each reaction given below (more than one choice may apply).

- a. oxidation-reduction
- b. acid-base
- c. precipitation



Use the following to answer questions 35-37:

Use the following choices to classify each reaction given below (more than one choice may apply).

- a. oxidation-reduction
- b. combustion
- c. synthesis
- d. decomposition

35. $2\text{Na}(s) + \text{H}_2(g) \rightarrow 2\text{NaH}(s)$
36. $\text{C}_3\text{H}_8(g) + 5\text{O}_2(g) \rightarrow 3\text{CO}_2(g) + 4\text{H}_2\text{O}(g)$
37. $2\text{GaN}(s) \rightarrow 2\text{Ga}(s) + \text{N}_2(g)$
38. True or false? The formula of a compound that expresses the smallest whole-number ratio of the atoms present is called the empirical formula.
A) True
B) False
39. Which represents the greatest number of atoms?
A) 50.0 g Al
B) 50.0 g Cu
C) 50.0 g Zn
D) 50.0 g Fe
E) all the same
40. How many atoms of calcium are present in 60.5 g of calcium?
A) 2.51×10^{-24}
B) 3.64×10^{25}
C) 6.02×10^{23}
D) 9.09×10^{23}
E) none of these
41. Calculate the mass of 15.1 moles of He.
A) 19.1
B) 3.77
C) 9.09×10^{24}
D) 60.4
E) 6.02×10^{23}

42. How many moles of Ca atoms are in 890.0 g Ca?
- A) 4.503×10^{-2} mol
 - B) 22.21 mol
 - C) 3.567×10^4 mol
 - D) 44.41 mol
 - E) 890.0 mol
43. Calculate the mass of 1.99×10^{19} molecules of HCl.
- A) 1.20×10^{-3} g
 - B) 3.30×10^{-5} g
 - C) 1.20×10^{43} g
 - D) 9.06×10^{-7} g
 - E) none of these
44. A 21.9-mol sample of Co represents how many atoms?
- A) 3.64×10^{-23} atoms
 - B) 2.75×10^{22} atoms
 - C) 7.77×10^{26} atoms
 - D) 6.72×10^2 atoms
 - E) 1.32×10^{25} atoms
45. 12.9 g of Cu represents how many moles?
- A) 8.20×10^2 mol
 - B) 4.93 mol
 - C) 0.203 mol
 - D) 7.77×10^{24} mol
 - E) none of these
46. What is the molar mass of nitroglycerin, $C_3H_5(NO_3)_3$?
- A) 179 g/mol
 - B) 227 g/mol
 - C) 199 g/mol
 - D) 185 g/mol
 - E) none of these

47. Calculate the mass of 0.486 mol of H_2SO_4 .
- A) 2.02×10^2 g
 - B) 47.7 g
 - C) 4.95×10^{-3} g
 - D) 2.93×10^{23} g
 - E) 2.87×10^{25} g
48. A gaseous compound containing carbon and hydrogen was analyzed and found to consist of 83.65% carbon by mass. What is the empirical formula of the compound?
- A) CH_2
 - B) CH_3
 - C) C_7H_{16}
 - D) CH
 - E) C_3H_7
49. Determine the percentage composition (by mass) of oxygen in H_2SO_4 .
- A) 16.31 %
 - B) 31.95 %
 - C) 65.25 %
 - D) 23.48 %
 - E) 78.25 %
50. Choose the pair of compounds with the same empirical formula.
- A) C_2H_2 and C_6H_6
 - B) NaHCO_3 and Na_2CO_3
 - C) K_2CrO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$
 - D) H_2O and H_2O_2
51. A compound contains 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen (by mass). Calculate the empirical formula.
- A) CH_2O
 - B) $\text{C}_2\text{H}_2\text{O}$
 - C) CH_4O
 - D) $\text{C}_3\text{H}_6\text{O}_3$
 - E) C_2HO_2
52. A compound has 40.68% carbon, 5.12% hydrogen, and 54.20% oxygen (by mass). Calculate its empirical formula.

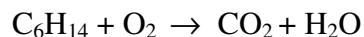
53. A 5.2-mol sample of KClO_3 was decomposed according to the equation



How many moles of O_2 are formed assuming 100% yield?

- A) 3.5 mol
- B) 4.3 mol
- C) 5.2 mol
- D) 2.6 mol
- E) 7.8 mol

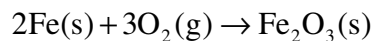
54. Refer to the following **unbalanced** equation:



What mass of carbon dioxide (CO_2) can be produced from 23.5 g of C_6H_{14} and excess oxygen?

- A) 6.21×10^3 g
- B) 12.0 g
- C) 72.0 g
- D) 36.0 g
- E) 0.273 g

55. Consider the reaction



If 10.2 g of iron(III) oxide (rust) is produced from a certain amount of iron, how many grams of oxygen are needed for this reaction?

- A) 3.07 g
- B) 6.13 g
- C) 1.36 g
- D) 2.04 g
- E) none of these

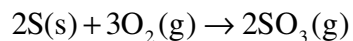
56. For the reaction



how many grams of CaCl_2 can be obtained if 15.4 g HCl is allowed to react with excess CaCO_3 ?

- A) 47 g CaCl_2
- B) 94 g CaCl_2
- C) 0.211 g CaCl_2
- D) 23.4 g CaCl_2
- E) none of these

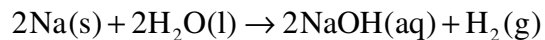
57. For the reaction



if 5.82 g of S is reacted with 10.0 g of O_2 , how many grams of SO_3 will be produced?

- A) 29.1 g
- B) 7.27 g
- C) 16.7 g
- D) 14.5 g
- E) none of these

58. Sodium and water react according to the equation



What number of moles of H_2 will be produced when 4.0 mol Na is added to 2.3 mol H_2O ?

- A) 1.2 mol
- B) 4.6 mol
- C) 2.0 mol
- D) 2.3 mol
- E) 8.0 mol

59. Consider the following **unbalanced** equation: $\text{C}_2\text{H}_5\text{OH}(g) + \text{O}_2(g) \rightarrow \text{CO}_2(g) + \text{H}_2\text{O}(l)$

If 2.39 g of ethanol reacts with 10.1 g of oxygen, how many moles of water are produced?

- A) 0.0519 mol
B) 0.156 mol
C) 0.0173 mol
D) 0.316 mol
E) 0.631 mol
60. True or false? The frequency of the wave is the distance between two consecutive wave peaks.
A) True
B) False
61. The form of EMR that has less energy per photon than infrared rays but more energy per photon than radio waves is
A) microwaves
B) untraviolet
C) gamma rays
D) X rays
E) none of these
62. Which color of visible light has the least amount of energy per photon?
A) violet
B) blue
C) green
D) yellow
E) red
63. As the principal energy level increases in an atom's orbitals, the average distance of an electron energy level from the nucleus _____.
A) increases
B) decreases
C) stays the same
D) varies
E) none of these

64. A given set of f orbitals consists of _____ orbital(s).
- A) 1
 - B) 3
 - C) 5
 - D) 7
 - E) 9
65. The maximum electron capacity of an f sublevel is
- A) 18
 - B) 14
 - C) 10
 - D) 6
 - E) 2
66. The maximum number of electrons allowed in the p sublevel of the third principal level is
- A) 1
 - B) 2
 - C) 3
 - D) 6
 - E) 8
67. The maximum number of electrons allowed in the fourth energy level is
- A) 2
 - B) 4
 - C) 8
 - D) 18
 - E) 32
68. The number of d orbitals in the second principal energy level is
- A) 2
 - B) 6
 - C) 10
 - D) 14
 - E) none of these

69. The number of unpaired electrons in a nitrogen atom is
- A) 1
 - B) 2
 - C) 3
 - D) 4
 - E) 5
70. Choose the correct ground-state electron configuration for oxygen.
- A) $[\text{He}]2s^22p^4$
 - B) $[\text{He}]2s^22p^6$
 - C) $[\text{Ne}]2s^22p^4$
 - D) $[\text{He}]3s^23p^4$
 - E) $[\text{He}]1s^22p^6$
71. The alkaline earth metals have how many valence electrons?
- A) 8
 - B) 7
 - C) 3
 - D) 2
 - E) 1
72. When moving down a group (family) in the periodic table, the number of valence electrons
- A) remains constant
 - B) increases by 2 then 8 then 18 then 32
 - C) doubles with each move
 - D) decreases regularly
 - E) changes in an unpredictable manner
73. Which of the following atoms has the electron configuration $1s^22s^22p^63s^23p^64s^23d^1$?
- A) Sc
 - B) Ca
 - C) Sr
 - D) Ar
 - E) none of these

74. Which electron configuration indicates a transitional element?
- $1s^2 2s^2 2p^6 3s^1 3p^6$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$
 - $1s^2 2s^2 2p^5$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^2$
 - none of these
75. How many of the following electron configurations for the species in their ground state are correct?
- Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
 - Mg: $1s^2 2s^2 2p^6 3s^1$
 - V: $[\text{Ar}] 3s^2 3d^3$
 - As: $[\text{Ar}] 4s^2 3d^{10} 4p^3$
 - P: $1s^2 2s^2 2p^6 3p^5$
- 1
 - 2
 - 3
 - 4
 - 5
76. Write the electron configuration for Cd.
77. Write the electron configuration for Cl.
78. Which of the following is ranked in order of **largest to smallest** atomic radius?
- Rb > Mn > S > Ge > F
 - F > S > Ge > Mn > Rb
 - Mn > Rb > F > S > Ge
 - Rb > Ge > Mn > F > S
 - Rb > Mn > Ge > S > F
79. Which of the following atoms has the highest ionization energy?
- Al
 - Si
 - P
 - As
 - Sb

80. True or false: Covalent bonding occurs when electrons are shared by nuclei.
A) True
B) False
81. True or false? The greater the difference in electronegativity between two bonded atoms, the more polar the bond.
A) True
B) False
82. True or false? N_2 is an example of a covalent bond.
A) True
B) False
83. The most electronegative element of those listed is
A) Rb
B) Cs
C) Fr
D) K
E) Li
84. Which of the following has nonpolar bonds?
A) H_2S
B) HCl
C) Br_2
D) OF_2
E) All are nonpolar.
85. The number of polar covalent bonds in NH_3 is
A) 1
B) 2
C) 3
D) 4
E) none of these
86. Draw the Lewis electron structure for the sulfur atom.
87. Draw the Lewis structure for SiH_4 .

88. Draw the Lewis structure for CO.

89. Which of the following has a double bond?

- A) H₂O
- B) NH₃
- C) O₂
- D) CO
- E) H₂S

Use the following to answer questions 90-91:

Use the following choices to describe the molecular structure of each of the following molecules or ions.

- a. linear
- b. trigonal planar
- c. tetrahedral
- d. pyramidal
- e. Bent (V-shaped)

90. CH₄

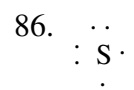
91. PF₃

92. Which of the following molecules has at least one 120° bond angle? (Check all that apply.)

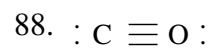
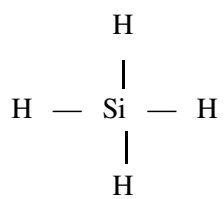
- A) HBr
- B) NO₃⁻
- C) H₂O
- D) SF₄
- E) KrCl₄
- F) I₃⁻

Answer Key

1. B
2. C
3. D
4. B
5. A
6. A
7. A
8. D
9. D
10. D
11. A
12. The isotope contains 26 protons, 23 electrons, and 31 neutrons.
13. C
14. A
15. D
16. A
17. $\text{Ca}(\text{HCO}_3)_2$
18. N_2O_5
19. nitrate ion
20. CO
21. HClO
22. ammonium sulfate
23. acetate ion
24. H_2S
25. ammonium carbonate
26. CrI_3
27. zinc hydroxide
28. D
29. E
30. $2\text{H}_2\text{O}_2(l) \rightarrow 2\text{H}_2\text{O}(l) + \text{O}_2(g)$
31. b
32. b
33. b; c
34. a
35. a; c
36. a; b
37. a; d
38. A
39. A
40. D
41. D
42. B
43. A
44. E
45. C
46. B
47. B
48. E
49. C
50. A
51. A
52. $\text{C}_2\text{H}_3\text{O}_2$
53. E
54. C
55. B
56. D
57. D
58. A
59. B
60. B
61. A
62. E
63. A
64. D
65. B
66. D
67. E
68. E
69. C
70. A
71. D
72. A
73. A
74. B
75. B
76. $[\text{Kr}] 5s^2 4d^{10}$
77. $[\text{Ne}] 3s^2 3p^5$
78. E
79. C
80. A
81. A
82. A
83. E
84. C
85. C



87.



89. C

90. c

91. d

92. B, D