

Chem 101A Final Study Questions Fall 2018
Chapters 1-8 (some taken from prior study questions)

This is not collected for credit.

All Useful Information on Exams 1-4 will be provided on Final Exam.

1. Manganese makes up 1.3×10^{-4} percent by mass of the elements found in a normal healthy body. How many grams of manganese would be found in the body of a person weighing 224 lb?
 - A) 0.64 g
 - B) 0.13 g
 - C) 13 g
 - D) 64 g
 - E) 1.3×10^{-4} g

2. A 20.0 mL sample of glycerol has a mass of 25.2 grams. What is the mass of a 58-mL sample of glycerol?
 - A) 8.7 g
 - B) 46 g
 - C) 2.9×10^4 g
 - D) 73 g
 - E) 73.1 g

3. Convert 2090.5 g to mg.
 - A) 2.0905 mg
 - B) 20.905 mg
 - C) 209.05 mg
 - D) 2.0905e3 mg
 - E) 2.0905e6 mg

4. 2.7 kilogram(s) contains this many grams:
 - A) 2.72
 - B) 2.7×10^3
 - C) 27
 - D) 0.27
 - E) 2.7×10^{-3}

5. In 1928, rhenium cost \$10,000/kg. It now costs \$40/troy ounce. What is the present cost of a gram of rhenium? (1 troy ounce = 31.10 g)
- A) less than \$1.00
 - B) between \$1.00 and \$10
 - C) between \$10 and \$50
 - D) between \$50 and \$100
 - E) over \$100
6. 407 Kelvin equals
- A) 134 °F
 - B) 273 °F
 - C) 680 °F
 - D) 134 °C
 - E) 680 °C
7. The statement “The total mass of materials is not affected by a chemical change in those materials” is called a(n)
- A) observation.
 - B) measurement.
 - C) theory.
 - D) natural law.
 - E) experiment.
8. You are given a compound with the formula MCl_2 , in which M is a metal. You are told that the metal ion has 26 electrons. What is the identity of the metal?
- A) Co
 - B) Al
 - C) Fe
 - D) Cr
 - E) Ni
9. Write the names of the following compounds:
- a) $FeSO_4$ _____
 - b) $NaC_2H_3O_2$ _____
 - c) KNO_2 _____
 - d) $Ca(OH)_2$ _____
 - e) $NiCO_3$ _____

10. Which of the following name(s) is(are) correct?
1. sulfide S^{2-}
 2. ammonium chloride NH_4Cl
 3. acetic acid $HC_2H_3O_2$
 4. barium oxide BaO
- A) all
B) none
C) 1, 2
D) 3, 4
E) 1, 3, 4

Use the following to answer question 11:

Write the formula for:

11. hydrosulfuric acid

Use the following to answer questions 12-13:

Name the following compounds:

12. $CaSO_4$

13. N_2O_3

14. When the equation $C_6H_{14} + O_2 \rightarrow CO_2 + H_2O$ is balanced with the smallest set of integers, the sum of the coefficients is
- A) 4
B) 47
C) 15
D) 27
E) 34

15. In order to determine the molecular formula from the empirical formula, we must know the _____.

16. The limiting reactant in a reaction
- A) has the lowest coefficient in a balanced equation
 - B) is the reactant for which you have the fewest number of moles
 - C) has the lowest ratio of moles available/coefficient in the balanced equation
 - D) has the lowest ratio of coefficient in the balanced equation/moles available
 - E) none of these
17. A 0.4002-g sample of a compound known to contain only carbon, hydrogen, and oxygen was burned in oxygen to yield 0.7436 g of CO_2 and 0.1522 g of H_2O . What is the empirical formula of the compound?
- A) CHO
 - B) $\text{C}_2\text{H}_2\text{O}$
 - C) $\text{C}_3\text{H}_3\text{O}_2$
 - D) $\text{C}_6\text{H}_3\text{O}_2$
 - E) $\text{C}_3\text{H}_6\text{O}_2$
18. What is the mass of a 9.372-mol sample of sodium hydroxide?
- A) 40.00 g
 - B) 374.9 g
 - C) 224.9 g
 - D) 4.268 g
 - E) 0.2343 g
19. A substance contains 35.0 g nitrogen, 5.05 g hydrogen, and 60.0 g of oxygen. How many grams of hydrogen are there in a 146-g sample of this substance?
- A) 7.37 g
 - B) 731 g
 - C) 14.7 g
 - D) 5.05 g
 - E) 28.9 g
20. Ammonium chromate, $(\text{NH}_4)_2\text{CrO}_4$, contains what percent nitrogen by mass?
- A) 36.8%
 - B) 9.2%
 - C) 18.4%
 - D) 11.9%
 - E) none of these

21. The man who discovered the essential nature of acids through solution conductivity studies is
- A) Priestly
 - B) Boyle
 - C) Einstein
 - D) Mendeleev
 - E) Arrhenius
22. When solutions of acetic acid and sodium hydroxide react, which of the following are NOT present in the *net ionic equation*?
- I. hydrogen ion
 - II. acetate ion
 - III. sodium ion
 - IV. hydroxide ion
- A) I and II
 - B) I, II, and III
 - C) I and IV
 - D) I and III
 - E) II and III
23. Oxidation is the gain of electrons.
- A) True
 - B) False

Use the following to answer questions 24-25:

Write balanced equations for each of the processes, choosing from the following substances as reactants:

BaCl ₂	O ₂	H ₂ SO ₄	HNO ₃
C ₂ H ₅ OH	H ₂ O	Ca(OH) ₂	K
Na ₂ CrO ₄	KOH	Pb(NO ₃) ₂	

24. Precipitation of BaSO₄ from solution

25. Combustion reaction

26. Which of the following is a strong acid?
- A) HF
 - B) KOH
 - C) HClO_4
 - D) HClO
 - E) HBrO
27. The net ionic equation for the reaction of calcium bromide and sodium phosphate contains which of the following species?
- A) $2\text{Br}^-(aq)$
 - B) $\text{PO}_4^{3-}(aq)$
 - C) $2\text{Ca}_3(\text{PO}_4)_2(s)$
 - D) $6\text{NaBr}(aq)$
 - E) $3\text{Ca}^{2+}(aq)$
28. How many of the following salts are expected to be insoluble in water?
- | | |
|------------------|---------------------|
| sodium sulfide | barium nitrate |
| ammonium sulfate | potassium phosphate |
- A) none
 - B) 1
 - C) 2
 - D) 3
 - E) 4
29. A gas sample is held at constant pressure. The gas occupies 3.62 L of volume when the temperature is 21.6°C . Determine the temperature at which the volume of the gas is 3.52 L.
- A) 303 K
 - B) 287 K
 - C) 21.0 K
 - D) 295 K
 - E) 560 K

30. Boyle's law states that:
- A) Equal amounts of gases occupy the same volume at constant temperature and pressure.
 - B) The volume of a fixed amount of gas is inversely proportional to its pressure at constant temperature.
 - C) The volume of a fixed amount of gas is directly proportional to its temperature in Kelvin at constant pressure.
 - D) The total pressure of a mixture of gases is the simple sum of the partial pressure of all of the gaseous compounds.
 - E) The rates of effusion of gases are inversely proportional to the square roots of their molar masses.

31. Given the equation:



A 3.00-g sample of KClO_3 is decomposed and the oxygen at 24.0°C and 0.843 atm is collected. What volume of oxygen gas will be collected assuming 100% yield?

- A) $7.08 \times 10^2\text{ mL}$
 - B) $8.58 \times 10^1\text{ mL}$
 - C) $1.06 \times 10^3\text{ mL}$
 - D) $4.72 \times 10^2\text{ mL}$
 - E) none of these
32. You have a certain mass of helium gas (He) in a rigid steel container. You add the same mass of neon gas (Ne) to this container. Which of the following best describes what happens? Assume the temperature is constant.
- A) The pressure in the container doubles.
 - B) The pressure in the container increases but does not double.
 - C) The pressure in the container more than doubles.
 - D) The volume of the container doubles.
 - E) The volume of the container more than doubles.
33. What volume of carbon dioxide measured at STP will be formed by the reaction of 1.41 mol of oxygen with 0.900 mol of ethyl alcohol, $\text{CH}_3\text{CH}_2\text{OH}$? Recall that a complete combustion results in all conversion of carbon to CO_2 .
- A) 40.3 mL
 - B) 21.1 L
 - C) 31.6 L
 - D) 47.4 L
 - E) 0.940 L

34. What volume is occupied by 17.5 g of methane (CH₄) at 27°C and 2.13 atm?
- A) 18.2 L
 - B) 12.6 L
 - C) 1.13 L
 - D) 2.02×10^2 L
 - E) not enough data to calculate
35. The valve between a 5-L tank containing a gas at 9 atm and a 10-L tank containing a gas at 6 atm is opened. Calculate the final pressure in the tanks.
- A) 3 atm
 - B) 4 atm
 - C) 7 atm
 - D) 15 atm
 - E) none of these
36. Calculate the density of nitrogen at STP.
- A) 0.312 g/L
 - B) 0.625 g/L
 - C) 0.800 g/L
 - D) 1.25 g/L
 - E) 1.60 g/L
37. At 200 K, the molecules or atoms of an unknown gas, X, have an average velocity equal to that of Ar atoms at 400 K. What is X? (Assume ideal behavior.)
- A) He
 - B) CO
 - C) HF
 - D) HBr
 - E) F₂
38. What is the specific heat capacity of granite if it requires 296 J to raise the temperature of 15 grams of granite by 25°C?
- A) 1.3 J/g°C
 - B) 0.79 J/g°C
 - C) 0.47 J/g°C
 - D) 0.60 J/g°C
 - E) none of these

39. True or False? The specific heat capacities of metals are relatively low.
- A) True
 - B) False
40. What is the enthalpy change when 33.9 mL of 0.570 M sulfuric acid reacts with 22.8 mL of 0.335 M potassium hydroxide?
- $$\text{H}_2\text{SO}_4(aq) + 2\text{KOH}(aq) \rightarrow \text{K}_2\text{SO}_4(aq) + 2\text{H}_2\text{O}(l) \quad \Delta H^\circ = -111.6 \text{ kJ/mol}$$
- A) -0.426 kJ
 - B) -3.01 kJ
 - C) -2.16 kJ
 - D) -0.852 kJ
 - E) -112 kJ
41. Which of the following statements is correct?
- A) The internal energy of a system increases when more work is done by the system than heat was flowing into the system.
 - B) The internal energy of a system decreases when work is done on the system and heat is flowing into the system.
 - C) The system does work on the surroundings when an ideal gas expands against a constant external pressure.
 - D) All statements are true.
 - E) All statements are false.
42. In exothermic reaction, potential energy stored in chemical bonds is being converted to thermal energy via heat.
- A) True
 - B) False
43. The enthalpy of fusion of ice is 6.020 kJ/mol. The heat capacity of liquid water is 75.4 J/mol·°C. What is the smallest number of ice cubes at 0°C, each containing one mole of water, necessary to cool 500 g of liquid water initially at 20°C to 0°C?
- A) 1
 - B) 7
 - C) 14
 - D) 15
 - E) 126

44. A fuel-air mixture is placed in a cylinder fitted with a piston. The original volume is 0.225-L. When the mixture is ignited, gases are produced and 995 J of energy is released. To what volume will the gases expand against a constant pressure of 635 mmHg, if all the energy released is converted to work to push the piston?
- A) 11.5 L
 - B) 8.43 L
 - C) 12.0 L
 - D) 11.8 L
 - E) 1.79 L
45. A 48.5 g sample of a metal is heated to 98.6°C and then placed in a calorimeter containing 120.0 g of water ($c = 4.18 \text{ J/g}^\circ\text{C}$) at 21.3°C. The final temperature of the water is 24.5°C. Which metal was used?
- A) Aluminum ($c = 0.89 \text{ J/g}^\circ\text{C}$)
 - B) Iron ($c = 0.45 \text{ J/g}^\circ\text{C}$)
 - C) Copper ($c = 0.20 \text{ J/g}^\circ\text{C}$)
 - D) Lead ($c = 0.14 \text{ J/g}^\circ\text{C}$)
 - E) none of these
46. Which of the following atoms or ions has three unpaired electrons?
- A) N
 - B) O
 - C) Al
 - D) S^{2-}
 - E) Ti^{2+}
47. Which of the following frequencies corresponds to light with the longest wavelength?
- A) $3.00 \times 10^{13} \text{ s}^{-1}$
 - B) $4.12 \times 10^5 \text{ s}^{-1}$
 - C) $8.50 \times 10^{20} \text{ s}^{-1}$
 - D) $9.12 \times 10^{12} \text{ s}^{-1}$
 - E) $3.20 \times 10^9 \text{ s}^{-1}$

48. Consider the following representation of a $2p$ -orbital:



Which of the following statements best describes the movement of electrons in a p -orbital?

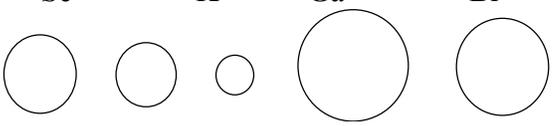
- A) The electrons move along the outer surface of the p -orbital, similar to a “figure 8” type of movement.
- B) The electrons move within the two lobes of the p -orbital, but never beyond the outside surface of the orbital.
- C) The electrons are concentrated at the center (node) of the two lobes.
- D) The electrons are only moving in one lobe at any given time.
- E) The electron movement cannot be exactly determined.

49. Which of the following statements are *false*?

- I. It takes less energy to add an electron to nitrogen than to carbon because nitrogen will be closer to achieving a noble gas configuration.
 - II. It takes more energy to add an electron to fluorine than to oxygen because the radius of fluorine is smaller and more repulsion would occur in the p -orbitals.
 - III. It takes more energy to add an electron to nitrogen than to carbon because of the extra repulsions that would occur in the $2p$ orbitals.
 - IV. Less energy is released in adding an electron to iodine than to chlorine because the radius of iodine is larger and the electron is added at a distance further from the nucleus.
- A) II, III
 - B) I, II, IV
 - C) III only
 - D) I, II
 - E) All of the above are false statements.

50. How many electrons can be described by the quantum numbers $n = 3, l = 3, m_l = -1$?

- A) 0
- B) 2
- C) 6
- D) 10
- E) 14

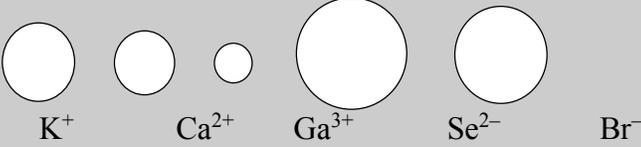
51. The geometry of BrF_6^+ is
- a) pyramidal
 - b) none of these
 - c) octahedral
 - d) trigonal planar
 - e) bent
52. Which of these is an isoelectronic series?
- $\text{Na}^+, \text{K}^+, \text{Rb}^+, \text{Cs}^+$
 - $\text{K}^+, \text{Ca}^{2+}, \text{Ar}, \text{S}^{2-}$
 - $\text{Na}^+, \text{Mg}^{2+}, \text{S}^{2-}, \text{Cl}^-$
 - $\text{Li}, \text{Be}, \text{B}, \text{C}$
 - none of these (A-D)
53. Which of the following arrangements is in order of increasing size?
- $\text{Ga}^{3+} < \text{Ca}^{2+} < \text{K}^+ < \text{Cl}^- < \text{S}^{2-}$
 - $\text{S}^{2-} < \text{Cl}^- < \text{K}^+ < \text{Ca}^{2+} < \text{Ga}^{3+}$
 - $\text{Ga}^{3+} < \text{S}^{2-} < \text{Ca}^{2+} < \text{Cl}^- < \text{K}^+$
 - $\text{Ga}^{3+} < \text{Ca}^{2+} < \text{S}^{2-} < \text{Cl}^- < \text{K}^+$
 - $\text{Ga}^{3+} < \text{Ca}^{2+} < \text{S}^{2-} < \text{K}^+ < \text{Cl}^-$
54. Match the ions below with the pictures that represent their relative sizes. Justify your answers.
- Ions: Se^{2-} K^+ Ga^{3+} Br^- Ca^{2+}
- 
55. In which pair do both compounds exhibit predominantly ionic bonding?
- PCl_3 and HF
 - Na_2SO_3 and NH_3
 - KI and O_3
 - NaF and H_2O
 - LiBr and MgS

56. Which of the following molecules has no dipole moment?
- CO₂
 - NH₃
 - H₂O
 - all
 - none
57. According to the VSEPR model, the arrangement of electron pairs around NH₃ and CH₄ is
- different, because in each case there are a different number of atoms around the central atom
 - different, because in each case there are a different number of electron pairs around the central atom
 - the same, because both nitrogen and carbon are both in the second period
 - the same, because in each case there are the same number of electron pairs around the central atom
 - different or the same, depending on the conditions leading to maximum repulsion
58. Choose the compound with the most ionic bond.
- LiCl
 - KF
 - NaCl
 - LiF
 - KCl
59. Choose the electron dot formula that most accurately describes the bonding in CS₂. (Hint: Consider formal charges.)
- $\text{:}\ddot{\text{S}}=\text{C}=\ddot{\text{S}}\text{:}$
 - $\text{:}\ddot{\text{C}}=\text{S}=\ddot{\text{S}}\text{:}$
 - $\text{:}\ddot{\text{S}}-\text{C}-\ddot{\text{S}}\text{:}$
 - $\text{:}\ddot{\text{S}}-\ddot{\text{C}}=\ddot{\text{S}}\text{:}$
 - $\text{:}\ddot{\text{S}}-\text{C}\equiv\ddot{\text{S}}\text{:}$

Answer Key

1.	B
	Chapter/Section: 1.6
2.	D
3.	E
4.	B
5.	B
6.	D
7.	D
8.	E
9.	a) iron (II) sulfate b) sodium acetate c) potassium nitrite d) calcium hydroxide e) nickel (II) carbonate
10.	A
11.	H ₂ S
12.	calcium sulfate
13.	dinitrogen trioxide
14.	B
	Chapter/Section: 3.9
15.	molar mass
	Chapter/Section: 3.7
16.	C
	Chapter/Section: 3.11
17.	C
	Chapter/Section: 3.7
18.	B
	Chapter/Section: 3.4
19.	A
	Chapter/Section: 3.6
20.	C
	Chapter/Section: 3.6
21.	E
	Chapter/Section: 4.2
22.	D
	Chapter/Section: 4.8
23.	B
	Chapter/Section: 4.9
24.	$\text{H}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{HCl}$
	Chapter/Section: 4.6
25.	$\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
	Chapter/Section: 4.9
26.	C

	Chapter/Section: 4.2
27.	E
	Chapter/Section: 4.6
28.	A
	Chapter/Section: 4.5
29.	B
	Chapter/Section: 5.2
30.	B
	Chapter/Section: 5.2
31.	C
	Chapter/Section: 5.4
32.	B
	Chapter/Section: 5.2
33.	B
	Chapter/Section: 5.4
34.	B
	Chapter/Section: 5.3
35.	C
	Chapter/Section: 5.5
36.	D
	Chapter/Section: 5.4
37.	C
	Chapter/Section: 5.6
38.	B
	Chapter/Section: 6.2
39.	A
	Chapter/Section: 6.2
40.	A
	Chapter/Section: 6.2
41.	C
	Chapter/Section: 6.1
42.	A
	Chapter/Section: 6.1
43.	B
	Chapter/Section: 6.2
44.	C
	Chapter/Section: 6.1
45.	B
	Chapter/Section: 6.2
46.	A
	Chapter/Section: 7.11
47.	B
	Chapter/Section: 7.1
48.	E
	Chapter/Section: 7.7
49.	D

	Chapter/Section: 7.12
50.	A
	Chapter/Section: 7.8
51.	C
	Chapter/Section: 8.13
52.	B
	Chapter/Section: 8.4
53.	A
	Chapter/Section: 8.4
54.	 <p> K^+ Ca^{2+} Ga^{3+} Se^{2-} Br^- </p> <p> Se^{2-} and Br^- each have the electron configuration of Kr. K^+, Ca^{2+}, and Ga^{3+} each have the electron configuration of Ar. The Se^{2-} and Br^- contain electrons in a higher energy level, therefore making their radii larger than the other three ions. Since Br^- has more protons, this will draw the electrons in slightly more than Se^{2-} (due to a slightly higher effective nuclear charge). For the other three ions, Ga^{3+} will be the smallest because it has the highest number of protons. K^+ has the least number of protons and is thus the biggest ion of the three. See Sec. 8.4 in Zumdahl, <i>Chemistry</i>. </p>
	Chapter/Section: 8.4
55.	E
	Chapter/Section: 8.1
56.	A
	Chapter/Section: 8.3
57.	D
	Chapter/Section: 8.13
58.	B
	Chapter/Section: 8.2
59.	A
	Chapter/Section: 8.12