

# CHEMISTRY 2

## Summer 2001 EXAM #2 KEY

### Chapters 5-9

Answer the following by writing the word, words, letter, letters or number in each blank that best completes each sentence. (1/2 point each blank)

1. A(n) \_\_\_\_\_ acid an acid that donates its  $H^+$  ions to water in a reaction that goes completely to products. Such a compound produces close to one  $H_3O^+$  ion in solution for each acid molecule dissolved in water. A substance that is incompletely ionized in water due to the reversibility of the reaction with water that forms hydronium ions,  $H_3O^+$  is a(n) \_\_\_\_\_ acid. They yield significantly less than one  $H_3O^+$  ion in solution for each molecule dissolved in water.
2. A(n) \_\_\_\_\_ solution is a solution with a significant concentration of hydroxide ions,  $OH^-$ .
3. \_\_\_\_\_ taste bitter.
4. Any chemical change in which at least one element gains electrons, either completely or partially, is called \_\_\_\_\_.
5. A(n) \_\_\_\_\_ agent is a substance that gains electrons, making it possible for another substance to lose electrons and be oxidized.
6. A(n) \_\_\_\_\_ is a system in which two half-reactions for a redox reaction are separated, allowing the electrons transferred in the reaction to be passed between them through a wire.
7. A(n) \_\_\_\_\_ is a device that has two or more voltaic cells connected together. The term is also used to describe any device that converts chemical energy into electrical energy using redox reactions.
8. The \_\_\_\_\_ electrode is the electrode at which oxidation occurs. It is the source of electrons and is the negative electrode.
9. A(n) \_\_\_\_\_ battery is a battery that is not rechargeable. A(n) \_\_\_\_\_ battery or storage battery is a rechargeable battery.

10. \_\_\_\_\_ is the process by which a redox reaction is pushed in the nonspontaneous direction or the process of applying an external voltage to a voltaic cell, causing electrons to move from what would normally be the cell's cathode toward its anode.
11. \_\_\_\_\_ energy is the capacity to do work due to the motion of an object. \_\_\_\_\_ energy is the retrievable, stored form of energy an object possesses by virtue of its position or state.
12. The accepted international unit for energy is the \_\_\_\_\_.
13. \_\_\_\_\_ is the thermal energy transferred from a region of higher temperature to a region of lower temperature due to collisions between particles.
14. Tiny packets or particles of radiant energy are called \_\_\_\_\_.
15. \_\_\_\_\_ is the distance in space over which a wave completes one cycle of its repeated form.
16. A(n) \_\_\_\_\_ change is a change that leads to *heat* energy being released from the system to the surroundings.
17. A(n) \_\_\_\_\_ is a substance that speeds a chemical reaction without being permanently altered itself.
18. Ultraviolet radiation in the range of about 40 to 290 nm wavelengths is called \_\_\_\_\_. Almost all of it is filtered out by our atmosphere. Because DNA and proteins absorb radiation in this range, it could cause crop damage and general ecological disaster if it were to reach the earth's surface in significant quantities.
19. Increased stability leads to \_\_\_\_\_ (increased or decreased) potential energy.
20. Of the two forms of radiant energy, ultraviolet and infrared, the \_\_\_\_\_ has the higher energy.
21. A mass calculated by multiplying the decimal fraction of each component in a sample by its mass and adding the results of each multiplication together is called a(n) \_\_\_\_\_ mass.
22. A(n) \_\_\_\_\_ is the amount of substance that contains the same number of particles as there are atoms in 12 g of carbon-12.

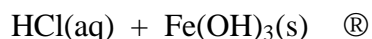
23. A(n) \_\_\_\_\_ is a group represented by a substance's chemical formula, that is, a group containing the kinds and relative numbers of atoms or ions listed in the chemical formula. It is a general term that can be used in reference to elements, molecular compounds, or ionic compounds.
24. Classify each of the following solutions as acidic, basic, or neutral. (1 point each)
- Saliva with a pH of 7.0 \_\_\_\_\_
  - Beer with a pH of 4.712 \_\_\_\_\_
  - A solution of a drain cleaner with a pH of 14.0 \_\_\_\_\_
25. Classify each of the substances as a weak acid, strong acid, weak base, or strong base in the Arrhenius acid-base sense. (1/2 point each)
- $\text{H}_2\text{SO}_4$  \_\_\_\_\_
  - ammonia \_\_\_\_\_
  - KOH \_\_\_\_\_
  - phosphorous acid \_\_\_\_\_
  - $\text{Na}_2\text{CO}_3$  \_\_\_\_\_
26. Classify each of the following names as representing either (1) a binary ionic compound, (2) an ionic compound with polyatomic ion(s), (3) a binary covalent compound, (4) a binary acid, or (5) an oxyacid. Write the chemical formula that corresponds to each name. (1/2 point each box)

Substance	Type of Compound	Formula
hydrochloric acid		
ammonium nitride		
sulfur hexafluoride		
nitric acid		
iron(III) hydrogen sulfate		
aluminum oxide		

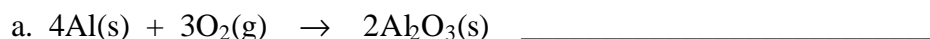
27. Classify each of the following formulas as representing either (1) a binary ionic compound, (2) an ionic compound with polyatomic ion(s), (3) a binary covalent compound, (4) a binary acid, or (5) an oxyacid. Write the name that corresponds to each formula. (½ point each box)

Substance	Classification	Name
$\text{Cu}_2\text{CO}_3$		
$\text{HC}_2\text{H}_3\text{O}_2$		
$\text{HF}(\text{aq})$		
$\text{F}_2\text{O}$		
$\text{CaF}_2$		

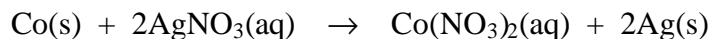
28. Write the complete equation for the neutralization reaction that takes place when the following water solutions are mixed. (2 points)



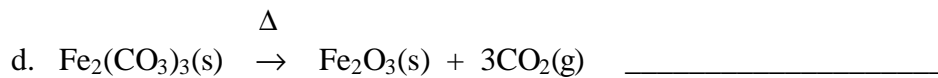
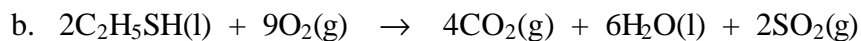
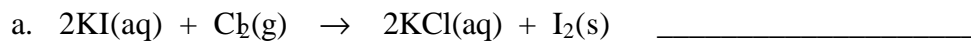
29. Are the electrons in the following redox reactions transferred completely from the atoms of one element to the atoms of another or are they only partially transferred? (1 point each)



30. For the equation below, write the oxidation number for each atom above its symbol in the equation. Identify what is oxidized, what is reduced, the oxidizing agent, and the reducing agent. (4 points)

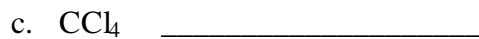
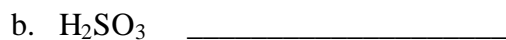
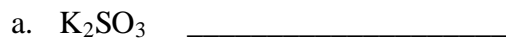


31. Classify each of these reactions with respect to the following categories: combination reaction, decomposition reaction, combustion reaction, and single displacement reaction. (1/2 point each)



32. Write a balanced equation for the complete combustion of  $\text{CH}_3\text{COSH}(\text{l})$ . (2 points)

33. For each of the following examples, decide whether it would be better to use the term *molecule* or *formula unit*. (1/2 point each)



34. For each of the following situations, you are asked which of two objects or substances has the higher energy. Explain your answer with reference to the capacity of each to do work and say whether the energy that distinguishes them is kinetic energy or potential energy. (1/2 point each)
- An ozone molecule,  $O_3$ , with a velocity of 393 m/s or the same molecule moving with a velocity of 410 m/s. (These are the average velocities of ozone molecules at 25 °C and 50 °C.)
  - An ozone molecule,  $O_3$ , moving at 300 m/s or an oxygen molecule,  $O_2$ , moving at the same velocity.
  - An HOCl molecule or an OH molecule and a chlorine atom formed from breaking the bond between the chlorine atom and the oxygen atom in the HOCl molecule. (The conversion of HOCl into Cl and OH takes place in the stratosphere.)
  - Water in the liquid form or water in the gaseous form. (Assume that the two systems are at the same temperature.)

**For the following calculations, be sure to show your work and report your answer with the correct significant figures, units, and scientific notation. (4 points each unless otherwise stated)**

35. The diameter of typical bacteria cells is 0.00032 centimeter. What is this diameter in micrometers?

36. The earth weighs about  $1 \times 10^{21}$  tons. Convert this to gigagrams.  
(There are 2000 lb/ton.)

37. A ball of clay has a mass of 2.65 lb and a volume of 0.5025 qt. What is its density in g/mL?

38. The density of water at 0 °C is 0.99987 g/mL. What is the mass in kilograms of 185.0 mL of water?

39. While you are doing heavy work, your heart pumps up to 25.0 L of blood per minute. Your brain gets about 3-4% by volume of your blood under these conditions. What volume of blood in liters is pumped through your brain in 125 minutes of work that causes your heart to pump 22.0 L per minute, 3.43% of which goes to your brain?
40. A saturated salt solution boils at 226 °F. What is this temperature in °C? in K?
41. An antacid contains 200 mg of aluminum hydroxide per capsule. How many moles of  $\text{Al}(\text{OH})_3$  does each capsule contain?
42. There are several natural sources of the element titanium. One is the ore called rutile, which contains oxides of iron and titanium,  $\text{FeO}$  and  $\text{TiO}_2$ . Titanium metal can be made by first converting the  $\text{TiO}_2$  in rutile to  $\text{TiCl}_4$  by heating the ore to high temperature in the presence of carbon and chlorine. The titanium in  $\text{TiCl}_4$  is then reduced from its +4 oxidation state to its zero oxidation state by reaction with a good reducing agent such as magnesium or sodium. What is the mass of titanium in kilograms in 0.401 Mg of  $\text{TiCl}_4$ ?

43. A peanut butter sandwich provides about  $1.4 \times 10^3$  kJ of energy. A typical adult uses about 95 kcal/hr of energy while sitting. If all of the energy in one peanut butter sandwich were to be burned off by sitting, how many hours would it be before this energy was used? (A kcal is a dietary calorie. There are 4.184 J/cal.)

**Answer 6 of the following 10 questions. If you write answers to more than 6 questions, be sure to indicate which you want graded. If you do not, I will grade the first 6 questions with answers. (3 points each)**

44. Describe how the weak monoprotic acid hydrofluoric acid, HF (used in aluminum processing) acts when it is added to water. Include mention of the nature of the particles in solution before and after the reaction with water. If there is a reversible reaction with water, describe the forward and the reverse reactions.

45. Explain why weak acids produce fewer  $\text{H}_3\text{O}^+$  ions in water than strong acids, even when the same number of acid molecules are added to equal volumes of water.

46. Describe three different ways to increase the thermal energy of your skin.

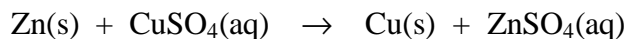
47. Consider the reaction of the strong acid hydrochloric acid,  $\text{HCl}(\text{aq})$ , with the strong base sodium hydroxide,  $\text{NaOH}(\text{aq})$ , to form water and sodium chloride,  $\text{NaCl}(\text{aq})$ .

a. Describe the solution at the instant that the  $\text{HCl}(\text{aq})$  and the  $\text{NaOH}(\text{aq})$  are combined. What chemical species are in the solution?

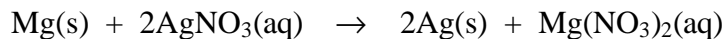
b. Describe the reaction that takes place in this solution.

c. Describe the solution after the reaction has taken place. What chemical species are in the solution?

48. We know that the following reaction can be used to generate an electric current in a voltaic cell.



Sketch similar voltaic cells made from the reaction presented below, showing the key components of the two half-cells and indicating the cathode electrode and the anode electrode, the negative and positive electrodes, the direction of movement of the electrons in the wire between the electrodes, and the direction of movement of the ions in the system. Show a salt bridge in the sketch, and show the movement of ions out of the salt bridge.



49. With reference to both their particle and the wave nature, describe the similarities and differences between red light and blue light.

50. Even on a hot day, you get cold when you step out of a swimming pool. Suggest a reason why your skin cools as water evaporates from it. Is evaporation an exothermic or endothermic process?

51. Explain why all chemical reactions either absorb or evolve energy.

52. Explain why the radiant energy found in the troposphere is unable to liberate chlorine atoms from CFC molecules but the radiant energy in the stratosphere is able to do this.

53. Explain why the chlorine atoms liberated from CFCs are thought to be a serious threat to the ozone layer.