

CHEMISTRY 123-01
Practice exam #1 – answer key
September 04, 2007

PART I: MULTIPLE CHOICE (Each multiple choice question is worth 2 pts)

1. The freezing point and boiling point of water are often used to calibrate thermometers. Give those temperatures in degrees Celsius.
 - a. 32 and 212
 - b. 0 and 100**
 - c. 273 and 373
 - d. 100 and 273
 - e. 0 and 373

2. Which of the following is not a physical property of water?
 - a. Water boils at 100 °C.
 - b. Water freezes at 32 °F.
 - c. Water can be broken down into hydrogen gas and oxygen gas.**
 - d. Water is a liquid at room temperature.
 - e. Water dissolves sugar.

3. Which of the following describes a chemical change?
 - a. Ethanol boils when heated.
 - b. Ethanol is a clear, colorless liquid.
 - c. Ethanol mixes with water.
 - d. Ethanol can be produced by the fermentation of grapes.**
 - e. Ethanol evaporates quickly at room temperature.

4. In a chemical reaction, 36 g of water is broken down to yield 32 g of oxygen gas and 4 g of hydrogen gas. This is an example of:
 - a. The Law of Conservation of Energy
 - b. The Law of Conservation of Mass**
 - c. Dalton's Atomic Theory
 - d. The Law of Constant Composition**
 - e. The Law of Multiple Proportions

5. Which of the following is not the symbol of an element?
 - a. CO**
 - b. Ag
 - c. Cu
 - d. C
 - e. Ni

6. Which of the following is a metal?
 - a. Hydrogen (H, atomic number 1)
 - b. Carbon (C, atomic number 6)
 - c. Boron (B, atomic number 5)
 - d. Iridium (Ir, atomic number 77)**
 - e. Radon (Rn, atomic number 86)

7. Which statement about electrons is false?
 - a. All atoms have electrons as part of their structure.
 - b. Electrons have much less mass than any atom.
 - c. Electrons are found in the nucleus of the atom.**
 - d. Electrons are negatively charged.
 - e. Electrons are attracted to positively charged electrodes.

8. Rutherford's gold foil experiment used alpha particles to reveal that:
 - a. Isotopes exist
 - b. Atoms have electrons
 - c. Atoms have neutrons
 - d. Atoms are radioactive

e. Atoms have a nucleus

9. Which metric prefix means 1×10^{-9} ?

a. kilo

b. nano

c. pico

d. micro

e. milli

10. Which of the following is incorrect?

a. ^{63}Cu has 29 protons, 29 electrons and 34 neutrons

b. ^{55}Mn has 25 protons, 25 electrons and 30 neutrons

c. ^{37}Cl has 20 protons, 20 electrons and 20 neutrons

d. ^{74}Se has 34 protons, 34 electrons and 40 neutrons

e. ^{40}Ar has 18 protons, 18 electrons and 22 neutrons

11. An element containing 32 protons, 32 electrons and 41 neutrons will have the symbol:

a. ^{73}Ta

b. ^{41}Ge

c. ^{41}Nb

d. ^{73}Nb

e. ^{73}Ge

12. Which of the following statements about two isotopes is false?

a. They will have the same atomic numbers.

b. They will have the same atomic weights.

c. They will have the same charge on the nucleus.

d. They will have different numbers of neutrons.

e. They will have essentially the same chemical reactivity.

13. Which element can be classified as a noble gas?

a. O

b. Na

c. Kr

d. Ti

e. P

14. Which element can be classified as an alkaline earth metal?

a. Ag

b. Au

c. Na

d. Al

e. Mg

15. The chemical compound $\text{C}_6\text{H}_4(\text{COOH})_2$ can also be represented as:

a. $\text{C}_7\text{H}_6\text{O}_2$

b. $\text{C}_7\text{H}_5\text{O}_2$

c. $\text{C}_7\text{H}_5\text{O}_4$

d. $\text{C}_8\text{H}_6\text{O}_2$

e. $\text{C}_8\text{H}_6\text{O}_4$

16. Which compound is not organic?

a. $\text{C}_2\text{H}_6\text{O}$

b. $\text{C}_6\text{H}_{12}\text{O}_6$

c. C_4H_{10}

d. NH_4NO_3

e. $\text{C}_6\text{H}_5\text{OH}$

17. Which formula-name combination is incorrect?

a. SeCl_4 selenium trifluoride

b. N_2O_3 dinitrogen trioxide

c. P_4O_{10} tetraphosphorus decaoxide

d. AsF_5 arsenic pentafluoride

e. SF_6 sulfur hexafluoride

18. Find the correct combination of protons and electrons below for the magnesium ion.

a. 12 protons and 10 electrons

b. 12 protons and 12 electrons

c. 12 protons and 14 electrons

d. 24 protons and 24 electrons

e. 24 protons and 22 electrons

19. Which of the following is not an ionic compound?

a. MgCl_2

b. H_2S

c. NaF

d. AlCl_3

e. CaO

20. Give the formula for the ionic compound that forms between magnesium and nitrogen.

a. MgN

b. Mg_2N

c. Mg_3N

d. MgN_2

e. Mg_3N_2

21. Which ion is incorrectly named?

a. K^+ potassium ion

b. Cr^{4+} chromium(IV) ion

c. Ba^{2+} barium ion

d. Al^{3+} aluminum(III) ion

e. Ni^{2+} nickel(II) ion

22. Which compound is incorrectly named?

a. MgO magnesium(II) oxide

b. Fe_2O_3 iron(III) oxide

c. CsCl cesium chloride

d. K_2S potassium sulfide

e. Na_3N sodium nitride

PART II: NOMENCLATURE OF MOLECULAR AND IONIC COMPOUNDS.

23. (7 pts) Name the following compounds:

a. Cu_2SO_4 ;

Copper(I) Sulfate

b. PN ;

Phosphorous Nitride

c. NBr_3 ;

Nitrogen Tribromide

d. H_3PO_3 ;

Phosphorous Acid

e. $\text{Ni}(\text{CN})_2$

Nickel(II) Cyanide

f. KH_2PO_4 ;

Potassium Dihydrogen Phosphate

g. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$;

Iron(II) Sulfate Heptahydrate

24. (8 pts) Write the correct molecular formula for each of the following compounds:

h. Strontium perbromate (Strontium = Sr);

$\text{Sr}(\text{BrO}_4)_2$

i. Copper(II) Sulfite;

CuSO_3

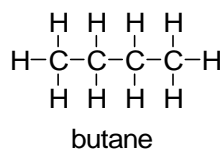
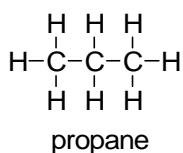
j. Barium Permanganate;

$\text{Ba}(\text{MnO}_4)_2$

k. Phosphoric acid

H_3PO_4

25. (4 pts) Provide structural formulas for propane and butane.



PART III: CALCULATION PROBLEMS (Show your work in its entirety. Do not provide just a single number! Pay attention to significant figures!).

26. (4 pts) In a laboratory sample of boron the isotopic ratio of the two boron isotopes ^{10}B (10.013 amu) and ^{11}B (11.009 amu) has been altered from the ratio found in nature, and the sample contains 48.73% ^{10}B . Determine the average atomic weight of the sample of boron.

Solution:

According to definition: **Average atomic weight** = $(\text{Fractional abundance})_1 \times (\text{isotopic mass})_1 + (\text{Fractional abundance})_2 \times (\text{isotopic mass})_2$

Percentage of ^{10}B = 48.73%

Therefore **Fractional abundance**₁ = 0.4873 and **Fractional abundance**₂ = 0.5127

Average atomic weight = $0.4873 \times 10.013 + 0.5127 \times 11.009 = 10.524$ amu

Answer: The average atomic weight of the sample of boron is 10.524 amu

27. (4 pts) How many atoms are in a 25.0 g sample of beryllium?

Solution:

We need to know that 1 mol of beryllium contains 6.022×10^{23} atoms of beryllium (i.e. an Avogadro number atoms of Be). Then we have to determine how many moles is 25.0 g of beryllium. We use two conversion factors to solve this problem.

First conversion factor: Molar mass of beryllium is 9.0122 g/mol or 1mol/9.0122 g

Second conversion factor: 6.022×10^{23} atoms/1 mol or 1mol/ 6.022×10^{23} atoms

of atoms of beryllium = $25.0 \text{ g} \times (1\text{mol}/9.0122 \text{ g}) \times (6.022 \times 10^{23} \text{ atoms}/1 \text{ mol}) = 1.67 \times 10^{24}$ atoms of beryllium.

Answer: 25.0 g of beryllium contain 1.67×10^{24} atoms

28. (4 pts) An average cup of coffee contains about 125 mg of caffeine (Molecular formula: $\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$).

- How many moles of caffeine are in a cup?
- How many molecules of caffeine are in a cup?

Solution: To solve this problem we need three conversion factors:

First conversion factor: Molar mass of caffeine is 194.19 g/mol or 1mol/194.19 g

Second conversion factor: 6.022×10^{23} molecules/1 mol or 1mol/ 6.022×10^{23} molecules

Third conversion factor: 1000 mg/1g or 1g/1000 mg

We have to convert: mg \longrightarrow g \longrightarrow mol \longrightarrow molecules

$125 \text{ mg} \times (1\text{g}/1000 \text{ mg}) \times (1 \text{ mol}/194.19 \text{ g}) = 6.43 \times 10^{-4}$ mol of caffeine

$6.43 \times 10^{-4} \text{ mol} \times (6.022 \times 10^{23} \text{ molecules}/1 \text{ mol}) = 3.88 \times 10^{20}$ molecules of caffeine