Chemistry 1210 Test 1 Fall 1999, Jordan

Name Key

ID yes

By submitting this test, I certify that I have received no help on this quiz from any other person or used any unauthorized material.

Please show all work near the relevant question when applicable. Failure to show work will result in partial or total deduction of points. Remember, significant figures count.

Helpful formulas and conversion factors: mass/volume, moles/liters, °F = 1.8(°C) + 32, K = °C + 273, 1lb = 0.454 kg, 1oz = 28.4 g

(1) List 4 of the SI base units and give the property they measure and list two derived units and the property measure.

meter - length
kilogram - mass
second - time
Kelvin - temperature
mole - ~~amount~~ amount
candela - luminous intensity
ampere - current

density - $\frac{g}{mL}$
volume - m^3, L, mL
etc.

(2) Two samples of a compound containing only hydrogen and oxygen were analyzed. Sample A was found to contain 4.10 g of carbon and 10.9 g of oxygen. Sample B was found to contain 6.00 g of carbon and 16.0 g of oxygen. What law is demonstrated by these two compounds (show work)?

A $\frac{10.9\text{g O}}{4.10\text{g C}} = 2.66$

B $\frac{16.0\text{g O}}{6.00\text{g C}} = 2.66$

Same → Law of Constant Composition.

main point

(3) What did Dalton propose in his Atomic Theory? How does this lead to the Law of Conservation of Mass?

- Dalton proposed that matter was composed of atoms.
- Elements were composed of atoms of the same type.
- In a chemical reaction, atoms are just rearranged.

If all mass is composed of atoms, and atoms are just rearranged in a reaction, then the mass of the products and reagents in a reaction are identical.

(4) What part of Dalton's Atomic Theory did J.J. Thompson disprove and how did he do it?

Dalton thought atoms were indestructible and indivisible.
Thompson discovered the electron which was part of the atom.
This proved the atom was <u>not</u> indivisible.

(5) Classify the following as a compound, element or a mixture. If it is a mixture, classify it as heterogeneous or homogeneous (solution).

(a) sulfur element

(b) a plate of french fries with ketchup. heterogeneous mixture

(c) distilled water compound

(d) window cleaner mixture - solution

(6) Name the following compounds

(a) $Li_2(HSO_4)$ lithium hydrogen sulfate

(b) $Co(Cl)_2$ cobalt (II) chloride

(c) SCl_2 sulfur dichloride

(d) BaS barium sulfide

(7) Write the formulas of the following compounds from their names

(a) chromium (III) oxide Cr_2O_3

(b) phosphorus tribromide PBr_3

(c) magnesium nitrate $Mg(NO_3)_2$

(c) carbon disulfide CS_2

(8) An unknown compound found in mothballs was sent for analysis. The results found that the compound was 93.70% C by mass and 6.30% H by mass.

(a) What is the empirical formula for the compound

assume a 100.0g sample

then

C: $93.70\,g \times \frac{mol}{12.01\,g} = 7.80\,moles \div 6.24\,moles = 1.25$

H: $6.30\,g \times \frac{mol}{1.01\,g} = 6.24\,moles \div 6.24\,moles = 1$

$4(C_{1.25}H_1) = C_5H_4$

empirical formula C_5H_4

(b) A mass spectrum of the unknown compound consisted mainly of a peak with mass 128 and no peaks to higher mass. What is the formula for the unknown.

C_5H_4 FW = 64.09 $\quad \frac{128}{64.04} = 2$

$\therefore 2(C_5H_4) = C_{10}H_8$ = formula

(9) Frozen carbon dioxide (dry ice) has a temperature of -78 °C. Convert this temperature to

(a) K $\quad K = °C + 273 \quad K = -78 + 273 = 195\,K$

(b) °F $\quad °F = 1.8(°C) + 32 \quad °F = 1.8(-78) + 32 = -108\,°F$

(10) A can of coke contains 355 mL of fluid. If the density of the drink is 1.0 g/mL, express the contents of the can in

(a) g $\quad 355\,mL \times \frac{1.0\,g}{mL} = 355\,g = 360\,g$

(b) kg $\quad 360\,g \times \frac{1\,kg}{1000\,g} = 0.36\,kg$

(c) oz $360\,g \times \frac{1\,oz}{28.4\,g} \approx$ 13 oz

(11) Archimedes put a crown in water to determine it's density. If he put a crown into a large graduated flask and the water rose from 10.25 L to 11.60 L and the mass of the crown is 15,500 g (15.5 kg).

(a) What is the density of the crown.

$11.60\,L - 10.25\,L = 1.35\,L$ (volume of crown)

$1.35\,L \times \frac{1000\,mL}{1\,L} = 1.35 \times 10^3\,mL$

$D = \frac{mass}{volume} = \frac{15,500\,g}{1.35 \times 10^3\,mL} = 11.5\,\frac{g}{mL}$

(b) If the density of gold is 19.31 g/mL, is the crown pure gold?

no, it ~~would~~ has the wrong density

(12) List the number of protons, neutrons, and electrons for each of the following species

	protons	electrons	neutrons
(a) $^{57}_{26}Fe$	26	26	31
(b) $^{79}_{35}Br$	35	35	44
(c) $^{235}_{92}U$	92	92	143
(d) $^{23}_{11}Na^+$	11	10	12

(13) If the natural abundances of carbon were ^{12}C (67.00 %, mass = 12.00 amu) and ^{14}C (33.00%, mass = 14.00 amu), what would be the atomic mass for carbon listed on the periodic table (these are not the actual abundances).

weighted average $0.6700(12.00\text{ amu}) + 0.3300(14.00\text{ amu}) = 12.66\text{ amu}$

(14) What type of bonding is present in following species (ie ionic and covalent bonding)

(a) Li_2S ionic

(b) H_2O Covalent

(c) $LiClO_4$ ionic and covalent

(d) N_2O_4 covalent

(15) $C_3H_8 + {}^{5}O_2 \text{ ------> } {}^{3}CO_2 + {}^{4}H_2O$

(a) Balance the formula above and write it below.

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

(b) If 15.0 moles of C_3H_8 is burned, how much O_2 is required (in moles and grams)?

$15.0\text{ moles } C_3H_8 \times \frac{5\text{ moles } O_2}{1\text{ mole } C_3H_8} = 75.0\text{ moles } O_2$

$75.0\text{ moles} \times \frac{32.00\text{ g}}{\text{mole}} = 2.40 \times 10^3\text{ g}$

(16) If 15.0 moles of C_3H_8 is reacted with with 112 g of O_2 (the equation in problem 15), how much CO_2 will be produced? (in moles)

need 2.40×10^3 g O_2 to react with 15.0 moles C_3H_8 ∴

O_2 is the limiting reagent

$112\text{ g } O_2 \times \frac{\text{moles}}{32.00\text{ g}} = 3.50\text{ moles } O_2$

$3.50\text{ moles } O_2 \times \frac{3\text{ moles } CO_2}{5\text{ moles } O_2} = 2.10\text{ moles } CO_2.$

just moles

(17) If a 675 mL solution of HCl has a concentration of 0.235 M, how much HCl (in moles ~~and grams~~) is in the solution?

$675\text{mL} \times \frac{1\text{L}}{1000\text{mL}} = 0.675\text{L}$

$M = \frac{\text{moles}}{\text{L}}$

$\frac{0.235 \text{ moles}}{\text{L}} \times 0.675\text{L} = 0.159 \text{ moles HCl}$

(18) $2HCl + Ca(OH)_2 \text{ --------> } CaCl_2 + 2H_2O$

(a) If all of the solution of HCl from problem 17 (all 675 mL of it) was needed to neutralize a 1.00 L solution of $Ca(OH)_2$ (in a titration), how much $Ca(OH)_2$ was there in the unknown solution (in moles)?

0.159 moles HCl neutralized the $Ca(OH)_2$

$\therefore 0.159 \text{ moles HCl} \times \frac{1 \text{ mole } Ca(OH)_2}{2 \text{ moles HCl}} = 0.0793 \text{ moles } Ca(OH)_2$

(b) What was the concentration of the original 1.00 L solution of $Ca(OH)_2$? in M

$M = \frac{\text{moles}}{\text{L}} = \frac{0.0793 \text{ moles}}{1.00\text{L}} = 0.0793\text{M}$

(19) $Ag_2(SO)_4 + 2NaCl \text{ ------> } 2AgCl + Na_2(SO_4)$

If 1.00 mole of $Ag_2(SO_4)$ and 2.00 moles of NaCl are mixed,

(a) what is the theoretical yield of AgCl (in moles)

2.00 moles

(b) if 1.80 moles of AgCl are recovered, what is the yield in %?

$\frac{1.80 \text{ moles}}{2.00 \text{ moles}} = 0.900 \times 100\% = 90.0\%$

cutout

(20) In football, the field is 1.00×10^2 yards (3 feet to a yard) from goaline to goaline. Teams must move the ball 10 yards (2 sig figs) to get a 1st down.

(a) convert the distance from goaline to goaline (1.00×10^2 yards) to meters.

1.00×10^2 yards

(b) convert the distance needed for a 1st down (10 yards (2 sig figs)) to km.

Bonus Question:

What was Lavoisier's definition of an acid? Arrhenius' definition of an acid and a base? The Brønstead-Lowry definition of acid and base?

Lavoisier - acids contain O atoms

Arrhenius - acids produce H^+ ions in water

bases - produce $\bar{O}H$ ions in water

Bronsted-Lowry - acid - H^+ donor

base - H^+ acceptor