VERSION 1

CHM151 Exam 1 100 Pts Spring 2005 Name: Key

MULTIPLE CHOICE

1. The law of constant composition applies to _____.
   a) solutions
   b) heterogeneous mixtures
   c) compounds
   d) homogeneous mixtures
   e) solids

2. Which of the following is not a physical property of water?
   a) It is a liquid at room temperature.
   b) It can be decomposed into oxygen and hydrogen gases.
   c) It boils at 100°C.
   d) It melts at 0°C.
   e) These are all physical properties of water.

3. What is the volume of a 12.2 g piece of metal with a density of 9.43 g/cm^3?
   a) 12.2 cm^3
   b) 1.29 cm^3
   c) 0.773 cm^3
   d) 115 cm^3
   e) none of these

$$\frac{12.2\ \text{g} \mid \text{cm}^3}{9.43\ \text{g}} = \text{cm}^3$$

4. Of the following, _____ is the greatest mass.
   a) 4.22×10^8 mg $\times 10^{-3} = 4.22 \times 10^5$
   b) 6.83×10^{-5} mg $\times 10^{-3} =$
   c) 9.73×10^9 pg $\times 10^{-12} =$
   d) 7.73×10^{-2} mg $\times \times 10^{-3} =$
   e) 4.23×10^8 pg $\times 10^{-12} =$

5. 1 picometer = _____ centimeters
   a) 1×10^{10}
   b) 1×10^{-10}
   c) 1×10^8
   d) 1×10^{-8}
   e) 1×10^{-12}

$$\frac{1 \times 10^{-12}\ \text{m} \mid \text{C}}{10^{-2}} = \text{cm}$$

6. How many significant figures should there be in the answer to the following?
   23.1 + 0.11 + 140.3 + 52.07 = _____
   a) 5
   b) 1
   c) 2
   d) 3
   e) 4

$$\begin{array}{r} 23.1 \\ 0.11 \\ 140.3 \\ +\ 52.07 \\ \hline 215.58 \end{array}$$

Answer to the 0.1 place

7. What is the correct answer (reported to the proper number of significant figures) to the following?
   (2115-2101) × (5.11 × 7.72) = _____
   a) 552
   b) 552.29
   c) 552.3
   d) 5.5×10^2
   e) 6×10^2

$$14 \times (5.11 \times 7.72) = 552.2888$$

2 s.f. 3 s.f. 3 s.f.

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8. Osmium has a density of 22.6 g/cm³. The mass of a block of osmium that measures 1.01 cm × 0.233 cm × 0.648 cm is _____ g.
   a) 6.75×10^{-3}
   b) 3.45
   c) 148
   d) 6.75×10^{3}
   e) 34.5

$V = l \cdot w \cdot h = 0.1525\ cm^3$

$0.1525\ cm^3 \left| \frac{22.6\ g}{cm^3} \right. = \_\_\_\_\ g$

9. A cube of an unknown metal measures 1.61 mm on one side. The mass of the cube is 36 mg. Which of the following is most likely the unknown metal?

metal	density g/cm³
rhodium	12.4
copper	8.96
niobium	8.57
vanadium	6.11
zirconium	6.51

$1.61 \times 10^{-3}\ m \left| \frac{c}{10^{-2}} \right. = 0.161\ cm$

$36 \times 10^{-3}\ g \left| \frac{}{(0.161\ cm)^3} \right. = 8.63\ \frac{g}{cm^3}$

   a) copper
   b) rhodium
   c) niobium
   d) vanadium
   e) zirconium

10. Which pair of substances could be used to illustrate the law of multiple proportions?
   a) SO_2, H_2SO_4
   b) SO, SO_2
   c) H_2O, O_2
   d) CH_4, $C_6H_{12}O_6$
   e) NaCl, KCl

11. Different isotopes of a particular element contain the same number of _____.
   a) protons
   b) neutrons
   c) protons and neutrons
   d) protons, neutrons, and electrons
   e) subatomic particles

12. Which one of the following is a nonmetal?
   a) W
   b) Sr
   c) Os
   d) Ir
   e) Br

13. Which pair of elements below should be the most similar in chemical properties?
   a) C and O
   b) B and As
   c) I and Br
   d) K and Kr
   e) Cs and He

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14. There are 38 electrons, 35 protons, and 42 neutrons in the ion $^{77}_{35}X^{3-}$?
   a) 38, 35, 42
   b) 77, 32, 77
   c) 32, 80, 35
   d) 77, 77, 35
   e) 35, 35, 42

15. Predict the empirical formula of the ionic compound that forms from aluminum and oxygen.
   a) AlO
   b) Al_3O_2
   c) Al_2O_3
   d) AlO_2
   e) Al_2O

$Al^{3+}_2 O^{2-}_3$

16. Consider the following reaction:

$$2\,Al(NO_3)_3 + 3\,Na_2S \rightarrow 1\,Al_2S_3 + 6\,NaNO_3$$

The coefficients that balance the reactions are _____.
   a) 2,3,1,6
   b) 2,1,3,2
   c) 1,1,1,1
   d) 4,6,3,2
   e) none of these

17. What is the coefficient of H_2S when the following equation is balanced?

$$3\,H_2S + 2\,Fe(OH)_3 \rightarrow Fe_2S_3 + 6\,H_2O$$

   a) 2
   b) 3
   c) 4
   d) 5
   e) 1

18. Given the information below, calculate the weighted average atomic mass (amu) of the element X.

Isotope	Abundance (%)	Mass (amu)			
^{221}X	74.22	220.9	× 0.7422	=	163.95
^{220}X	12.78	220.0	× 0.1278	=	28.12
^{218}X	13.00	218.1	× 0.1300	=	28.353
					220.423

   a) 219.7
   b) 220.4
   c) 22042
   d) 218.5
   e) 221.0

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19. The formula weight (amu) of aluminum sulfate is _____.

a) 342.14
b) 123.04
c) 59.04
d) 150.14
e) 273.06

$Al_2(SO_4)_3$

12 × 16.00 =
3 × 32.07 =
2 × 26.98 =
} 342.17

20. Calculate the percentage by mass of chlorine in $PtCl_2(NH_3)_2$.

a) 23.63
b) 11.82
c) 25.05
d) 12.53
e) 18.09

6 × 1.01 =
2 × 14.01 =
2 × 35.45 = 70.9
1 × 195.1 =
300.08

$\frac{70.9}{300.08} \times 100 = \%$

21. How many grams of oxygen are in 65 g of $C_2H_2O_2$?

a) 18
b) 29
c) 9.0
d) 36
e) 130

molar mass = 58.036

$\%\,O = \frac{32.0}{58.036} \times 100 = 55.1$

$65 \times 0.551 = 35.8\ g\ O$

22. What is the empirical formula of a compound that contains 49.4% K, 20.3% S, and 30.3% O by mass?

a) KSO_2
b) KSO_3
c) K_2SO_4
d) K_2SO_3
e) KSO_4

Assume 100 g

K: $\frac{49.4\ g}{39.10\ g/mol} = 1.26 \div 0.633 = 2$

S: $\frac{20.3\ g}{32.07\ g/mol} = 0.633 \div 0.633 = 1$

O: $\frac{30.3\ g}{16.0\ g/mol} = 1.894 \div 0.633 = 3$

K_2SO_3

23. A sample of nitrogen (9.27 g) reacts completely with magnesium, according to the equation:

$$3\ Mg + N_2 \rightarrow Mg_3N_2$$
(? g Mg, 9.27 g N_2)

The mass of Mg consumed is _____ g.

a) 8.04
b) 24.1
c) 16.1
d) 0.92
e) 13.9

$\frac{9.27\ g\ N_2}{28.02\ g\ N_2} \left| \frac{1\ mol\ N_2}{1\ mol\ N_2} \right| \frac{3\ mol\ Mg}{1\ mol\ N_2} \left| \frac{24.31\ g\ Mg}{mol\ Mg} \right| = 24.12\ g\ Mg$

24. The combustion of C_3H_8 produces CO_2 and H_2O:

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$
(2.5 mol O_2, ? mol H_2O)

The reaction of 2.5 mol of O_2 will produce _____ mol of H_2O.

a) 4.0
b) 3.0
c) 2.5
d) 2.0
e) 1.0

$\frac{2.5\ mol\ O_2}{5\ mol\ O_2} \left| \frac{4\ mol\ H_2O}{} \right. = 2\ mol\ H_2O$

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25. If the reaction of 3.82 g of magnesium nitride with 7.73 g of water produced 3.60 g of magnesium oxide, what is the percent yield of this reaction? Balance the reaction.

$Mg_3N_2 + 3H_2O \rightarrow 2NH_3 + 3MgO$

3.82 g 7.73 ↳ actual yield = 3.60 g

a) 94.5
b) 78.8
c) 46.6
d) 49.4
e) 99.9

Based on Mg_3N_2:

$$\frac{3.82\ g\ Mg_3N_2}{1} \left| \frac{1\ mol\ Mg_3N_2}{100.95\ g\ Mg_3N_2} \right| \frac{3\ mol\ MgO}{1\ mol\ Mg_3N_2} \left| \frac{40.31\ g\ MgO}{1\ mol\ MgO} \right. = 4.576\ g\ MgO$$

Theoretical yield

Based on H_2O:

$$\frac{7.73\ g\ H_2O}{1} \left| \frac{1\ mol\ H_2O}{18.02\ g\ H_2O} \right| \frac{3\ mol\ MgO}{3\ mol\ H_2O} \left| \frac{40.31\ g\ MgO}{1\ mol\ MgO} \right. = 17.29\ g\ MgO$$

$$\% \text{ yield} = \frac{3.60\ g}{4.576\ g} \times 100 = 78.7\ \%$$