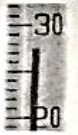
Unit 0 Practice Test
AP Chem

Name KEY
Date _____ Block ____

Multiple Choice Practice Questions: **NO CALCULATOR** (set up the problems, do your best to estimate)



1. How many significant figures are present in the temperature read from the thermometer?
   a) 1 c) 3
   b) 2 d) 4

2. The dimensions of a rectangular solid are 8.00 cm long, 4.00 cm wide, and 2.00 cm high. If the density of the solid is 10.0 g/cm3, what is its mass?
   a) 10/64 g d) 320 g
   b) 10.0 g e) 640 g
   c) 64.0 g

3. The number of significant digits in 0.30500 is
   a) 1 d) 4
   b) 2 e) 5
   c) 3

4. A student does a calculation using her calculator and the number 280.27163 is shown on the display. If there are actually three significant figures, how should she show the final answer?
   a) 280 d) 2.80×10^{-2}
   b) 280.3 e) 2.80×10^{2}
   c) 280.27

5. A box measures 3.50 cm x 2.915 cm. The product of these numbers = 10.2025cm². What is the proper way to report the area of the box?
   a) 10.20 cm² c) 10 cm²
   b) 10.2 cm² d) 10. cm²

6. The result of 2.350 x (4.0 + 6.311) is,
   a) 24 c) 24.21
   b) 24.2 d) 24.205

7. Classify each observation as a physical or a chemical property and tally them.
   Observation 1: Bubbles form on a piece of metal when it is dropped into acid.
   Observation 2: The color of a crystalline substance is yellow.
   Observation 3: A shiny metal melts at 650°C.
   Observation 4: The density of a solution is 1.84 g/cm³
   a) 2 chemical properties and 2 physical properties
   b) 3 chemical properties and 1 physical properties.
   c) 1 chemical properties and 3 physical properties
   d) 4 chemical properties
   e) 4 physical properties

8. Which of the properties listed are classified as intensive properties?

I. volume
II. density
III. melting point

   a) I. only
   b) II. only
   c) III. only
   d) I. & II.
   e) II. & III.

9. Chromatography is a good way to separate the
   a) elements in a compound
   b) the components in a mixture
   c) the atoms in an element
   d) the phases of a pure substance

10. When a pure solid substance was heated, a student obtained another solid and a gas, each of which was a pure substance. From this information which of the following statements is ALWAYS a correct conclusion?
    a) The original solid is not an element.
    b) Both products are elements.
    c) The original solid is a compound and the gas is an element.
    d) The original solid is an element and the gas is a compound.
    e) Both products are compounds

11. A solution of sugar water may be defined as a
    a) heterogeneous mixture
    b) homogeneous mixture
    c) heterogeneous compound
    d) homogeneous compound
    e) homogeneous element

12. Which of the terms shown above can be used correctly to describe the substance shown in the diagram?

    a) I. only
    b) II. only
    c) III. Only
    d) I. & II.
    e) II. & III.

    I. pure substance
    II. compound
    III. mixture

13. You measure the density of a slab of lead as 11.10 g/mL. The accepted value is 11.34 g/mL. The percent error for your measurement is
    a) 2.1 %
    b) 2.4 %
    c) 3.7 %
    d) 5.1 %

14. Which of the following processes requires a chemical change?
    a) Separating a saltwater solution into water and salt
    b) Separating liquid water into hydrogen gas and oxygen gas
    c) Separating an air sample into nitrogen, oxygen, and other gases
    d) Separating green ink into blue and yellow pigments
    e) Separating a mixture of sand and iron filings

15. Based on the data shown in the table below, which of the thermometers is best described as precise, but not accurate?

Thermometer	Observed Boiling Point of Water (°C)	Average BP (°C)
A	94.5, 99.3, 97.2, 108.9	100.0
B	92.2, 92.1, 92.2, 92.1	92.2
C	100.1, 105.5, 95.9, 106.1	101.9
D	99.9, 100.0, 100.1, 100.0	100.0

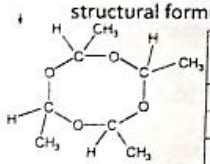
16. Which of the following calculations represents the number of cups that are equivalent to a volume of 2 liters? (Note: 1 cup = 8 oz. and 1 oz. = 29.5 mL)
    a) (2 x 1000) ÷ (29.5 x 8)
    b) (2 x 1000 x 29.5) ÷ (8)
    c) (2 x 1000 x 8) ÷ (29.5)
    d) (2 x 29.5) ÷ (1000 x 8)

17. The molar mass of $(NH_4)_2S$ is closest to:
a) 50 g/mol
b) 82 g/mol
c) 68 g/mol
d) 100 g/mol

18. Calculate the number of atoms in 4.0×10^{-5} g of aluminum.
a) 8.9×10^{17}
b) 4.6×10^{19}
c) 6.5×10^{20}
d) 3.8×10^{23}

19. What is the percent nitrogen (by mass) in ammonium carbonate, $(NH_4)_2CO_3$?
a) 14.53%
b) 27.83%
c) 29.16%
d) 33.34%

20. Which of the following represents the correct molecular formula and empirical formula for metaldehyde, whose structural formula is shown?



	Molecular Formula	Empirical Formula
A	$C_4H_{16}O_4$	CH_4O
B	$C_8H_{12}O_4$	C_2H_3O
C	$C_8H_{16}O_8$	CH_2O
D	$C_8H_{16}O_4$	C_2H_4O

21. An organic compound which has the empirical formula CHO has a molar mass of 232. Its molecular formula is:
a) CHO
b) $C_2H_2O_2$
c) $C_4H_4O_4$
d) $C_8H_8O_8$

22. Balance the following equation:
$4\ NH_3 + 7\ O_2 \rightarrow 4\ NO_2 + 6\ H_2O$
The balanced equation shows that 1.00 mole of NH_3 requires ___ mole(s) of O_2.
a) 0.57
b) 1.25
c) 1.33
d) 1.75

23. Write a balanced equation for the combustion of propane, C_3H_8.
$1\ C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
When properly balanced, the equation indicates that ___ moles of O_2 are required for each mole of C_3H_8.
a) 3
b) 3.5
c) 5
d) 8

24. A sample of solid potassium chlorate ($KClO_3$, FW = 122.6) was placed in a test tube and heated strongly in the presence of a catalyst until it completely decomposed. The products of the decomposition reaction are potassium chloride and oxygen gas (which escaped from the test tube). If the mass of $KClO_3$ used in the experiment was 12.26 g, how many grams of oxygen gas were produced in this experiment?
a) 2.4 g
b) 3.2 g
c) 4.8 g
d) 6.4 g
e) 7.2 g

$PCl_5 + 4\ H_2O \rightarrow 5\ HCl + H_3PO_4$

25. In the reaction represented above, how many molecules of PCl_5 are required to react completely with 18 grams of water?
a) 1.5×10^{23}
b) 3.0×10^{23}
c) 6.0×10^{23}
d) 1.2×10^{24}
e) 2.4×10^{24}

$2\ NH_4NO_3(s) \rightarrow 2\ N_2(g) + O_2(g) + 4\ H_2O(g)$

26. In the reaction represented above, what is the total number of moles of gases produced when 3.00 moles of ammonium nitrate decomposes completely?
a) 3.50
b) 7.00
c) 10.5
d) 14.0
e) 21.0

27. What is the limiting reactant and the theoretical yield of ammonia when 3.0 g of H_2 reacts with 7.0 g of N_2 ?

	Limiting Reactant	Theoretical Yield of NH_3
(A)	hydrogen	8.5 g
(B)	hydrogen	17 g
(C)	nitrogen	8.5 g
(D)	nitrogen	17 g

28. Complete combustion of a sample of a hydrocarbon in excess oxygen produces 44 g CO_2 and 18 g H_2O. Which of the following could be the molecular formula of the hydrocarbon?
a) CH_4
b) C_2H_2
c) C_3H_8
d) C_4H_{10}
e) C_5H_{10}

29. The empirical formula of a compound is XF_4. This compound contains 1.6 grams of X atoms for every 3.8 grams of fluorine atoms. The atomic mass of element X is most likely to be
a) 16 amu
b) 32 amu
c) 48 amu
d) 64 amu
e) 128 amu

Free Response Practice Questions: **CALCULATOR ALLOWED**

1. Use conversion factors to do the following problems. You must show your work clearly and neatly so that both numbers and units are represented in the steps involved to calculate your answer. Round off your final answer so that it contains the correct number of significant figures.

a) A cube of solid gold has a length of 4.25 inches on each side. The density of gold is 19.3 g/mL. What is the weight of this cube in units of pounds?
(1 kg = 2.2 lb.; 1 cm^3 = 1 mL; 1 inch = 2.54 cm)

$$(4.25\ in)^3 \times \left(\frac{2.54\ cm}{1\ in}\right)^3 \times \frac{1\ mL}{1\ cm^3} \times \frac{19.3\ g}{1\ mL} \times \frac{1\ kg}{1000\ g} \times \frac{2.2\ lbs}{1\ kg}$$

= 53.4 lbs

b) Children's Tylenol contains 160 milligrams of acetaminophen ($C_8H_9NO_2$) for every 1 teaspoon. How many moles of acetaminophen are present in a bottle that contains 120 mL of medicine? (1 teaspoon = 4.93 mL)

$$120\ mL\ Ty \times \frac{1\ tsp}{4.93\ mL} \times \frac{160\ mg\ C_8H_9NO_2}{1\ tsp} \times \frac{1\ g}{1000\ mg} \times \frac{1\ mol}{151\ g}$$

0.026 moles

2. A chemist needs to determine the empirical formula of an unknown compound. This compound contains the elements C, H, N, and O. A sample of the unknown compound with a mass of 3.8625 g was burned in excess oxygen. The reaction produced 1.7557 g of $H_2O(g)$. Combustion analysis showed that the sample contained 0.5462 g of N.

a) Determine the mass, in grams, of H in the 3.8625 g sample of the compound.

$$1.7557\ g\ H_2O \times \frac{1\ mol\ H_2O}{18\ g\ H_2O} \times \frac{2\ mol\ H}{1\ mol\ H_2O} \times \frac{1.01\ g}{1\ mol\ H} =$$

0.19703 g H

b) When the compound is analyzed for C content only, the mass percent of C is found to be 48.48 percent. Determine the mass, in grams, of C in the original 3.8625 g sample of the compound.

$$48.48\%\ C = \frac{x}{3.8625} \times 100$$

x = 1.873 g C

c) Determine the mass, in grams, of O in the original 3.8625 g sample of the compound.

3.8625 − 1.873 g − .19703 g − .5462 g

= 1.246 g O

d) Determine the empirical formula of the compound.

C: $1.873\ g\ C \times \frac{1\ mol}{12\ g} = 0.156\ mol\ C \rightarrow 4$

H: $.19703\ g \times \frac{1\ mol}{1.01\ g} = .1951\ mol\ H \rightarrow 5$

N: $.5462\ g \times \frac{1\ mol}{14\ g} = 0.039\ mol\ N \rightarrow 1$

O: $1.246\ g \times \frac{1\ mol}{16\ g} = 0.07788\ mol\ O \rightarrow 2$

$C_4H_5NO_2$

e) In another experiment, it was determined that a 8.65-g sample of this compound contained 1.75×10^{22} molecules. Calculate the molar mass of this compound.

$$1.75 \times 10^{22}\ molecules \times \frac{1\ mole}{6.02 \times 10^{23}\ molec} = 0.02907\ moles$$

$8.65\ g / .02907\ mol = 298\ g/mol$

f) Determine the molecular formula of this compound. Justify your answer.

MF		298
EF	$C_4H_5NO_2$	99

$= 3$

$C_{12}H_{15}N_3O_6$

$2\ C_5H_{12}O + 15\ O_2 \rightarrow 10\ CO_2 + 12\ H_2O$

3. Liquid pentanol undergoes complete combustion in the presence of oxygen gas according to the equation above. In a certain experiment, 7.3 mL of pentanol (density = 0.814 g mL-1) is added to 16.0 L of oxygen gas at 150°C. (density of O_2 @ 150°C = 0.922 g L-1).

a) Calculate the following quantities.

i. moles of pentanol

$7.3\text{mL}\ C_5H_{12}O \frac{.814\text{g}}{1\text{mL}} \frac{1\text{mol}\ C_5H_{12}O}{88\text{g}} = 0.068\ \text{mol}\ C_5H_{12}O$

ii. moles of oxygen gas

$16\text{L}\ O_2 \times \frac{0.922\text{g}}{1\text{L}} \times \frac{1\text{mol}\ O_2}{32\text{g}} = 0.46\ \text{mol}\ O_2$

b) Identify the limiting reactant in this experiment. Justify your answer.

O_2. ex: using molar ratios,

$\frac{.068\text{mol}}{2} = .034\ \text{mol}\ C_5H_{12}O$ is available used in the reaction, but only $\frac{.46\text{mol}}{15} = .0306\ \text{mol}\ O_2$ is available to be completely reacted, so this will produce fewer moles of product

c) Calculate the theoretical yield, in units of grams, of carbon dioxide that could be produced from this experiment.

$.46\text{mol}\ O_2 \frac{10\text{mol}\ CO_2}{15\text{mol}\ O_2} \times \frac{44\text{g}}{1\text{mol}\ CO_2} = 13\text{g}\ CO_2$

d) If the mass of carbon dioxide that was obtained from this experiment is 11.0 g, calculate the percent yield from the experiment.

$\frac{11\text{g}}{13\text{g}} \times 100 = 85\%$

4. In a laboratory experiment, a student obtained a sample of barium hydroxide hydrate. The number of water molecules in the hydrate formula was unknown. The formula for this compound can be written as $Ba(OH)_2 \cdot xH_2O$, where x indicates the number of moles of water per mole of $Ba(OH)_2$.

A sample of this hydrate was heated strongly in a crucible, in order to drive off the water of hydration. The anhydrous $Ba(OH)_2$ salt was then treated with excess sodium sulfate solution. This resulted in the formation of a white precipitate, barium sulfate. The precipitate was filtered from the solution, dried and weighed. The data table below indicates measurements recorded in this experiment.

Mass of clean, dry crucible	61.857 g
Mass of crucible + $Ba(OH)_2 \cdot xH_2O$ (before heating)	66.081 g
Mass of white precipitate, $BaSO_4$	3.126 g

a) Calculate the mass of the hydrate sample $Ba(OH)_2 \cdot xH_2O$ (before heating).

$66.081\text{g} - 61.857\text{g} = 4.224\text{g}$

b) Write a balanced chemical equation for the double replacement reaction between barium hydroxide and sodium sulfate.

$1\ Ba(OH)_2 + 1\ Na_2SO_4 \rightarrow 1\ BaSO_4 + 2\ NaOH$

c) The mass of the white precipitate was 3.126 g. Calculate the number of moles of this precipitate.

$3.126\text{g}\ BaSO_4 \frac{1\text{mol}}{233.39\text{g}} = 0.01339\ \text{mol}\ BaSO_4$

d) Calculate the mass of the anhydrous salt, $Ba(OH)_2$.

$.01339\ \text{mol}\ BaSO_4 \frac{1\ \text{mol}\ Ba(OH)_2}{1\ \text{mol}\ BaSO_4} \frac{171.33\text{g}}{1\ \text{mol}\ Ba(OH)_2} = 2.294\text{g}\ Ba(OH)_2$

e) Calculate the mass of water that was lost in the heating process.

$4.224\text{g} - 2.294\text{g} = 1.930\text{g}\ H_2O$

f) Calculate the value of x for the sample of $Ba(OH)_2 \cdot xH_2O$.

$Ba(OH)_2: 2.294\text{g} \frac{1\text{mol}}{171.33\text{g}} = .01339\ \text{mol}\ Ba(OH)_2$

$H_2O: 1.930\text{g} \frac{1\text{mol}}{18.02\text{g}} = 0.107\ \text{mol}\ H_2O$

$\frac{0.107\text{mol}\ H_2O}{0.01339\ \text{mol}\ Ba(OH)_2} = \frac{8\ \text{mol}\ H_2O}{1\ \text{mol}\ Ba(OH)_2} \rightarrow Ba(OH)_2 \cdot 8H_2O$