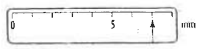
CHEM-IS-TRY 11
FINAL EXAM REVIEW

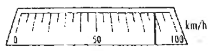
Name: _____
BK: ___ Date: _____

Certainty and Precision

municate values with acceptable precision, for the following scale readings. Report the precision ach value, e.g., 12.5 cm ±0.1 cm).

(a) 

(b) 

(c) 

(d) 

(e) 

2. For each of the measurements, give the certainty (report the number of significant digits).
   (a) 3.4 km
   (b) 51.85 g
   (c) 0.7 mL
   (d) 0.650 mol
   (e) 200.59 g/mol

3. Round each of the following calculated answers to three significant digits. Then change the prefix (if necessary) to report the answer according to the rule of a thousand.
   (a) 1266.65 g
   (b) 0.0175 L
   (c) 1879 mL
   (d) 0.0874 g
   (e) 34.08 g/mol

4. For each of the following, show all work and report the answer in accepted units and certainty.
   (a) 46 mol × 44.01 g/mol
   (b) $45.4\ g \times \frac{1\ kg}{1000\ g}$
   (c) 1.3 cm + 0.85 cm + 102 cm
   (d) 150.4 g + 32.06 g
   (e) (39.10 + 12.01 + 14.01) g/mol × 0.225 mol
   (f) 0.3785 m × 100 cm/m
   (g) $4.79\ g \times \frac{1\ mol}{159.61\ g}$
   (h) 107.83 g − 98.52 g
   (i) 29.6°C − 5.3°C

5. The following are some experimentally determined molar masses for some common gases. Determine the accuracy of these values, i.e., calculate the percent difference between the respective experimental and predicted values.
   (a) carbon dioxide, 45.2 g/mol and 44.01 g/mol
   (b) sulfur trioxide, 79.3 g/mol and 80.06 g/mol
   (c) dinitrogen pentoxide, 105.6 g/mol and 108.02 g/mol

Writing Chemical Equations

rite unbalanced chemical equations for the following chemical reactions.
ssume pure substances unless otherwise indicated. Include states of matter.)
ample: sodium metal + chlorine → sodium chloride
iswer: $Na_{(s)} + Cl_{2(g)} \rightarrow NaCl_{(s)}$

. water → hydrogen + oxygen

. nitrogen + hydrogen → ammonia

3. sulfuric acid + aqueous sodium hydroxide → water + aqueous sodium sulfate

4. aluminum + aqueous copper(II) nitrate → copper + aqueous aluminum nitrate

5. chlorine + aqueous potassium bromide → bromine + aqueous potassium chloride

. lead(II) $nitrate_{(aq)}$ + sodium $iodide_{(aq)}$ → lead(II) $iodide_{(s)}$ + sodium $nitrate_{(aq)}$

. aqueous sodium hydroxide + aqueous aluminum sulfate →
solid aluminum hydroxide + aqueous sodium sulfate

phosphorus + oxygen → solid tetraphosphorus decaoxide

. methanol + oxygen → carbon dioxide + water vapor

). nitrogen dioxide gas + water → nitric acid + nitrogen monoxide gas

Balancing Chemical Reaction Equations

Use the Dalton theory of the conservation of atoms to balance the following chemical equations.

1. $\_\_Ni_{(s)} + \_\_HCl_{(aq)} \rightarrow \_\_NiCl_{2(aq)} + \_\_H_{2(g)}$

2. $\_\_Ca(OH)_{2(s)} + \_\_HCl_{(aq)} \rightarrow \_\_CaCl_{2(aq)} + \_\_HOH_{(l)}$

3. $\_\_Cl_{2(g)} + \_\_NaBr_{(aq)} \rightarrow \_\_Br_{2(l)} + \_\_NaCl_{(aq)}$

$\_\_Cr_2O_{3(s)} \rightarrow \_\_Cr_{(s)} + \_\_O_{2(g)}$

5. $\_\_Fe_{(s)} + \_\_HCl_{(aq)} \rightarrow \_\_FeCl_{3(aq)} + \_\_H_{2(g)}$

6. $\_\_C_3H_{8(g)} + \_\_O_{2(g)} \rightarrow \_\_CO_{2(g)} + \_\_H_2O_{(g)}$

7. $\_\_P_{4(s)} + \_\_F_{2(g)} \rightarrow \_\_PF_{3(l)}$

8. $\_\_Ca(NO_3)_{2(aq)} + \_\_KOH_{(aq)} \rightarrow \_\_Ca(OH)_{2(s)} + \_\_KNO_{3(aq)}$

9. $\_\_KHCO_{3(s)} \rightarrow \_\_K_2CO_{3(s)} + \_\_H_2O_{(l)} + \_\_CO_{2(g)}$

10. $\_\_H_3PO_{4(aq)} + \_\_NaOH_{(aq)} \rightarrow \_\_Na_3PO_{4(aq)} + \_\_HOH_{(l)}$

1. $\_\_Ca(NO_3)_{2(aq)} + \_\_Na_3PO_{4(aq)} \rightarrow \_\_Ca_3(PO_4)_{2(s)} + \_\_NaNO_{3(aq)}$

12. $\_\_Cu_{(s)} + \_\_HNO_{3(aq)} \rightarrow \_\_Cu(NO_3)_{2(aq)} + \_\_NO_{2(g)} + \_\_H_2O_{(l)}$

Predicting Chemical Reactions

For each of the following questions, classify the reaction type (formation, simple decomposition, combustion, single replacement, double replacement, or other) and predict the balanced chemical equation. Provide a word equation as well.

1. $Al_{(s)} + O_{2(g)} \rightarrow$

2. $Ag_2O_{(s)} \rightarrow$

3. $Br_{2(l)} + KI_{(aq)} \rightarrow$

4. A strip of zinc metal is placed into a copper(II) nitrate solution.

5. $BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow$

6. Sulfuric acid is neutralized by aqueous sodium hydroxide.

7. $\rightarrow CuS_{(s)} + NaCH_3COO_{(aq)}$

8. $CuS_{(s)} + O_{2(g)} \rightarrow$

9. Propane burns in air.

10. $Na_2CO_{3(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + CO_{2(g)} + H_2O_{(l)}$

Molecular Nomenclature

1. List the molecular prefixes from one to ten.

2. For which type of molecular substances are these prefixes used?

3. Why is memorization required for the nomenclature of many molecular substances in this unit?

	Molecular Formula (with SATP state)	English IUPAC Name
4.		oxygen
5.	$P_2O_{5(s)}$	
6.		hydrogen chloride
7.	$NH_{3(g)}$	
8.		dinitrogen tetrahydride (liquid)
9.	$ICl_{3(s)}$	
10.		methane
11.	$N_{2(g)}$	
12.	$CH_3OH_{(l)}$	
13.		sucrose
14.	$S_4N_{2(s)}$	
15.		ethanol
16.	$CO_{(g)}$	
17.	$H_2O_{2(l)}$	
18.	$H_2S_{(g)}$	
19.		octasulfur
20.		propane

Ionic Nomenclature

Write the international chemical formula or the English IUPAC name for each of the compounds given. (This exercise involves all classes of ionic compounds.)

	International Chemical Formula	IUPAC Name
1.	$SrCl_{2(s)}$	
2.	$RbBr_{(s)}$	
3.	$Na_2O_{(s)}$	
4.		aluminum sulfide
5.		zinc chloride
6.		magnesium iodide
7.	$CoCl_{2(s)}$	
8.	$TiO_{2(s)}$	
9.	$Cu_2O_{(s)}$	
10.		tin(II) sulfide
11.		chromium(III) oxide
12.		iron(II) sulfide
13.	$KC_2H_3COO_{(s)}$	
14.	$Na_2S_2O_{3(s)}$	
15.	$NH_4HCO_{3(s)}$	
16.		ammonium sulfide
17.		barium sulfite
18.		magnesium hydroxide
19.	$FeSO_4 \cdot 7H_2O_{(s)}$	
20.	$LiCl \cdot 4H_2O_{(s)}$	
21.		sodium sulfate decahydrate
22.	$Au(NO_3)_{3(s)}$	
23.		bismuth(III) sulfate
24.		lead(II) acetate-3-water
25.	$KMnO_{4(s)}$	

Gravimetric Stoichiometry

Complete the following stoichiometric problems. Communicate your problem-solving approach using internationally accepted symbols for elements, quantities, numbers, and units.

1. Calculate the mass of iron(III) oxide (rust) produced by the reaction of 500 g of iron with oxygen from the air.

2. What mass of precipitate should form if 2.00 g of silver nitrate in solution is reacted with excess sodium sulfide solution?

3. Determine the mass of water vapor formed when 1.00 g of butane, $C_4H_{10(g)}$, is burned in a lighter.

4. Silver metal can be recovered from waste silver nitrate solutions by reaction with copper metal. What mass of silver can be obtained using 50 g of copper?

Applications of Stoichiometry

1. In a chemical analysis to test the purity of a bottle of sodium bromide, a solution containing 1.17 g of sodium bromide was reacted with an excess of dimercury(I) acetate solution. The dry precipitate had a mass of 2.73 g. Calculate the percent yield for the precipitate and comment on the purity of sodium bromide.

2. A solution containing 2.56 g of aluminum nitrate is mixed with a solution containing 1.02 g of ammonium sulfide. Determine the unreacted mass of the excess reagent and the mass of precipitate formed.

Atomic Orbitals and Models

1. Name the four types of orbitals in the sublevels, the number of orbitals in each sublevel, and the maximum number of electrons in that sublevel.

2. State Hund's rule.

3. Write the full electron configurations for each of the following.
   (a) aluminum atom
   (b) cobalt atom
   (c) phosphide ion

4. What is the "kernel method" for writing electron configurations?

5. Write the chemical symbols for the atoms corresponding to the following descriptions.
   (a) $[Ar]\,4s^2$
   (b) $[Kr]\,5s^2\,4d^{10}\,5p^1$
   (c) $[Xe]\,6s^2\,4f^{14}\,5d^5$

6. List the chemical symbols and names for six ions isoelectronic with an argon atom.

7. What is the similarity among the atoms of Group 16 in terms of
   (a) electron configurations

   (b) Lewis models

Molar Mass and Conversions

1. Determine the molar mass of each of the following substances.

   (a) $MgI_{2(s)}$ (b) $Al(OH)_{3(s)}$

   (c) $(NH_2)_2CO_{(s)}$ (d) $CoCl_2 \cdot 6H_2O_{(s)}$

2. Convert each of the following masses into an amount in moles of the given substance.

   (a) 8.40 g of $NaOH_{(s)}$

   (b) 4.2 kg of $H_2O_{(l)}$

3. Convert each of the following amounts into a mass in grams of the given substance.

   (a) 0.456 mol of $Al_2(SO_4)_{3(s)}$

   (b) 0.518 mmol of $CuSO_4 \cdot 5H_2O_{(s)}$

4. Complete the following table.

Substance	Molar Mass (g/mol)	Mass (g)	Amount (mol)
$CaCl_{2(s)}$		18.6	
$Al_2O_{3(s)}$			0.267
$Mg(OH)_{2(s)}$		35.00	
$Na_2CO_3 \cdot 10H_2O_{(s)}$			0.150

Concentration of a Solution

Use concentration as a conversion factor to calculate the quantity requested in each question below. Communicate your problem-solving approach, including units and correct certainty.

1. Cow's milk contains 4.5 g of lactose per 100 mL of milk. What mass of lactose is present in 250 mL [one glass] of milk?

2. A 10% W/V salt solution is used for making pickles. What mass of salt is present in 750 mL of this solution?

3. A 250 mL measuring cup of cleaning solution contains 1.2 mol of dissolved ammonia. What is the molar concentration of this solution?

4. Fish require a concentration of about 4.5 ppm (4.5 mg/L) of dissolved oxygen in water. What volume of water would contain 100 mg of oxygen?

5. What volume of concentrated, 14.6 mol/L phosphoric acid would contain 2.00 mol of solute?

6. Hard water contains at least 120 ppm of dissolved minerals. If 2.0 L of hard water in a kettle is boiled to dryness, what mass of minerals would be obtained?

7. What amount of table salt is needed to prepare 12.0 L of a 5.20 mol/L solution?

8. A laboratory solution of zinc nitrate is labelled 24.0 mmol/L. What volume of this solution would contain 0.600 mol of solute?

Solution Preparation

Communicate your problem-solving approach when answering the questions below.

1. Calculate the molar concentration of a solution made by dissolving 20.0 g of sodium hydroxide to make 300 mL of solution.

2. Pure sodium thiosulfate-5-water, $Na_2S_2O_3 \cdot 5H_2O_{(s)}$, is used to make 250 mL of 20.0 mmol/L solution. Find the mass of solute required.

3. What mass of copper(II) nitrate will be required to prepare 10.0 L of 0.100 mol/L solution?

4. What volume of 75 mmol/L solution can be prepared from 10 g of sodium carbonate?

5. Determine the volume of concentrated hydrochloric acid required to prepare 10.0 L of a 0.200 mol/L solution. → 11.6 M HCl

6. What volume of concentrated ammonia is required to prepare 2.0 L of a 1.0 mol/L solution? → 14.6 M NH_3

Alkanes

For each of the following IUPAC names, draw a structural diagram.

1. 2-methylpentane
2. 3-ethylhexane
3. 2,3-dimethylbutane
4. octane
5. cyclobutane
6. 2,3-dimethylhexane
7. trimethylbutane
8. 3-ethyl-3-methylhexane
9. methylcyclopentane
10. 2,2,3-trimethylpentane

For each of the following questions, draw a structural diagram equation and classify the reaction type.

11. heptane burns in a fuel mixture

12. cyclooctane + hydrogen → propane + pentane

13. butane + propane → 2,3-dimethylpentane + hydrogen

Hydrocarbon Derivatives

In the following questions, the IUPAC names of a variety of hydrocarbon derivatives are provided. Draw a structural diagram for each name and identify the organic family to which the compound belongs.

1. 2-bromopentane
2. 1,4-dichlorobenzene
3. butanoic acid
4. ethyl methanoate
5. 1-butanol
6. propanal
7. 1,1-dichloro-2,2-difluoroethane
8. trimethylamine
9. 2-methyl-2-propanol
10. propanamide

Communicate acceptable English IUPAC names for the following structural models.

11. $CH_3-CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$
12. $Cl-CH_2-CH_2-CH_2-Cl$
13. $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-OH$
14. $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-O-CH_3$