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| Chemistry 11  Final Exam Review  Tuesday, June 13, 2017 |

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| **NOMENCLATURE**   * Write names or chemical formulae for   + Ionic compounds   + Covalent compounds   + Hydrates   + Acids and bases |

1. Write the correct formula for the following compounds:

a) ammonium chlorate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) copper (II) sulphite \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) zinc carbonate tetrahydrate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) nitric acid \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

e) phosphorus pentaiodide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

f) iron (III) thiocyanate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

g) sulphuric acid \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

h) chlorous acid \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write the correct names for the following compounds:

a) Mn(SO4)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) PbCrO4 **.** 6H2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) As2O3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) CH3COOH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

e) Ni2(C2O4)3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

f) NF3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

g) (NH4)2HPO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

h) Ba(OH)2 **.** 10H2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **CHEMICAL REACTIONS**   * Open and closed systems and the conservation laws * Writing and balancing chemical equations with proper phases * Types of reactants: synthesis, decomposition, single replacement, double replacement, combustion, neutralization * Predicting products of reactions * Energy changes in a reaction: endothermic vs. exothermic * Diatomic elements |

1. Balance the following equations.
2. NH3 + O2 🡪 NO + H2O
3. (NH4)2C2O4 + AlCl3 🡪 Al2(C2O4)3 + NH4Cl
4. C14H30 + O2 🡪 CO2 + H2O
5. Fe + HNO3 🡪 Fe(NO3)3 + H2
6. P4 + Cl2 🡪 PCl3
7. Na2Cr2O7 + HCl 🡪 NaCl + CrCl3 + H2O + Cl2
8. H3PO4 + Ca(OH)2 🡪 Ca3(PO­4)2 + H2O
9. Ba(ClO4)2 🡪 Ba + Cl2 + O2
10. C7H15OH + O2 🡪 CO2 + H2O
11. MgSO4 **.** 5H2O 🡪 MgSO4 + H2O
12. Write a balanced chemical equation for each of the following, and classify each as synthesis, decomposition, single replacement, double replacement, neutralization or combustion.

a) potassium sulphate is mixed with cobalt (III) nitrate

b) liquid propanol (C3H7OH) is burned in air

c) ammonium nitrate is decomposed into it’s elements

d) a piece of zinc is placed in a test-tube containing a solution of silver nitrate

e) bromine reacts with sodium iodide

f) bromine reacts with aluminum

g) rubidium reacts with chlorine gas

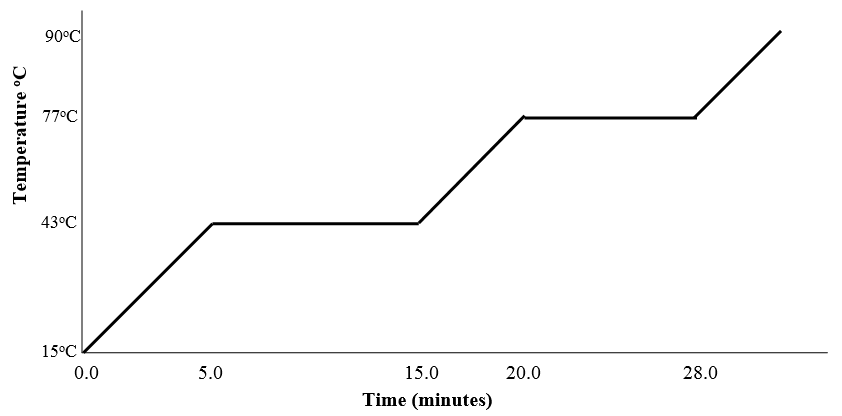
h) hydrochloric acid reacts with strontium hydroxide

1. State whether each of the following are ***exothermic*** or ***endothermic***.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ HCl + 432 kJ 🡪 H+ + Cl-
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_C12H22O11 + 12 O2 🡪 12CO2 + 11H2O ΔH = -5638 kJ
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ H2O(s) 🡪 H2O(l)
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ CD 🡪 C + D ΔH= 65.7 kJ
6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ E + F + 437 kJ 🡪 G + H
7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ I(g) → I(s)
8. Sketch a potential energy diagram for an exothermic reaction between Zn and HCl. Lable the axes, reactants, products, and change in enthalpy on the graph.
9. State whether the following are true for **exothermic** or **endothermic** reactions.

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| 1. \_\_\_\_\_\_\_\_\_\_\_\_Heat is released into the surroundings | 1. \_\_\_\_\_\_\_\_\_\_\_\_The reaction flask becomes cold |
| 1. Heat is absorbed into the system | 1. \_\_\_\_\_\_\_\_\_\_\_\_Heat is released by the system |
| 1. \_\_\_\_\_\_\_\_\_\_\_\_Heat is absorbed by the surroundings | 1. \_\_\_\_\_\_\_\_\_\_\_\_The reaction flask becomes hot |
| 1. \_\_\_\_\_\_\_\_\_\_\_\_A bright light emits from the reaction | 1. \_\_\_\_\_\_\_\_\_\_\_\_The reaction is violent and spontaneous |
| 1. \_\_\_\_\_\_\_\_\_\_\_\_Energy is flowing from the surroundings into the system |  |

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| **PHYSICAL PROPERTIES AND CHANGES**   * Classification of matter: homogeneous, heterogeneous, pure substance, mixtures (solution, suspension, mechanical mixture) * Separation and purification techniques   + Hand separation   + Filtration   + Distillation   + Evaporation   + Solvent extraction   + Recrystallization   + Gravity separation   + Chromatography * Heating curves |

1. Write P for physical property and C for chemical property for the properties of water below.
2. \_\_\_\_\_\_\_ Water has a density of 1.0 g/mL
3. \_\_\_\_\_\_\_ Water is colourless
4. \_\_\_\_\_\_\_ Water boils at 100°C
5. \_\_\_\_\_\_\_ Water generates H2 gas when in contact with an alkali metal
6. \_\_\_\_\_\_\_ Water freezes at 0°C
7. \_\_\_\_\_\_\_ Water is insoluble with oil
8. \_\_\_\_\_\_\_ Water with metal oxides will generate a base
9. Explain how distillation works to separate substances. What kind of mixtures can be distilled?
10. Explain how gravity separation works and what kind of mixtures it can be used for.
11. Explain how to separate and isolate a mixture of sand, sugar, water, and alcohol.
12. Given the following graph of Temperature vs. Time for warming substance “X” which starts out as a solid, describe what is happening at each time interval. Be sure to include the terms **intermolecular forces** and **kinetic energy**. Label the diagram with phase transitions and melting and boiling points.



* 1. During time 0.0 – 5.0 minutes

* 1. During time 5.0 – 15.0 minutes

* 1. During time 15.0 – 20.0 minutes

* 1. During time 20.0 – 28.0 minutes
  2. The melting point of substance “X” is \_\_\_\_\_\_\_\_\_\_\_\_\_and the boiling point is \_\_\_\_\_\_\_\_\_\_\_\_\_
  3. If a greater amount of substance “X” was used, the melting point would be
     1. a lower temperature
     2. a higher temperature
     3. the same temperature
  4. What phase is substance “X” at 90°C? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Explain how chromatography works for identification of components in a mixture.
2. What is the physical changed called when
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ solid to gas
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ liquid to solid
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ solid to liquid
6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gas to liquid
7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gas to solid
8. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ liquid to gas

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| **SIGNIFICANT FIGURES AND MEASUREMENTS**   * What are the SI units * Unit conversion * Metric prefixes * Accuracy vs. precision * Significant figures * How to read a scale |

1. What is the SI unit for time? \_\_\_\_\_\_\_\_\_\_ Mass in chemistry? \_\_\_\_\_\_\_\_\_\_ Volume? \_\_\_\_\_\_\_\_\_\_
2. How many significant figures are in the following numbers?

|  |  |  |  |
| --- | --- | --- | --- |
| 1. 4.500 |  | 1. 0.005 |  |
| 1. 300.0 |  | 1. 0.00300 |  |
| 1. 10 |  | 1. 10100 |  |

1. Convert the following to scientific notation while maintaining the number of significant numbers in the original value.

|  |  |  |  |
| --- | --- | --- | --- |
| 1. 0.00000977 |  | 1. 194000000 |  |
| 1. 988.540000 |  | 1. 0.000500 |  |

1. Round the following numbers to two significant figures.

|  |  |  |  |
| --- | --- | --- | --- |
| 1. 2 000 000 000 |  | 1. 3.8894 x 1028 |  |
| 1. 106 000 |  | 1. 0.000 000 7895 |  |

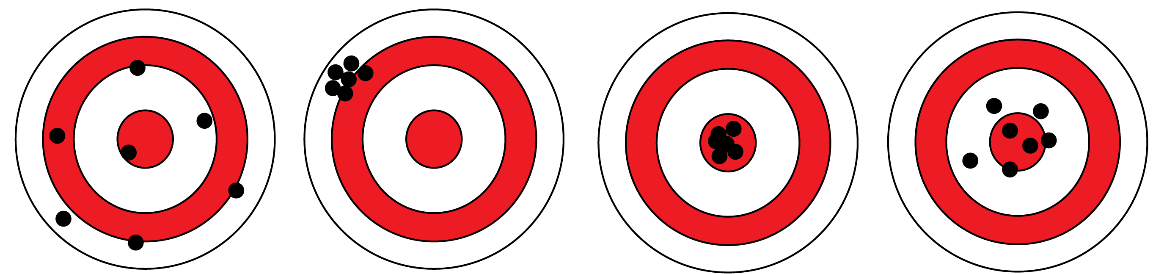
1. What kind of values do not carry significant figures?
2. Perform the following calculations with proper significant figures.

|  |  |
| --- | --- |
| 1. 2.1500 x 0.31 | 1. 83.00 ÷ 1.2300 x 102 |
| 1. 8.90 x 103 ÷ 4.400 x 10-6 | 1. 4.905 x 106 ÷ 4 x 10-2 |
| 1. 0.05 + 394.7322 | 1. 98.0076 - 2.195 |
| 1. (3.33 x 9.52) + 13.983 | 1. 0.00000200 x 245.912 |
| 1. 3.813 + 98.98 + 2.669 | 1. 5.802 ÷ 6.21 + 2.41 ÷ 9.2565 |

1. A student was measuring the density of water. She found that 100.0 mL of water had a mass of 94.04 g. Given that the density of water is 1.0000 g/mL, what is the relative error of her measurement?
2. How do you find the uncertainty of a reading from a scale?
3. Read the following scales. Include the uncertainty in the measurement, then give the range of values your measurement could be.

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| 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcRScIXZqyI4iBBrbJ5HUaZATgUJbKrgA9TG96Qvyr4eicTHUuOV | 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   http://www2.southeastern.edu/Academics/Faculty/wparkinson/help/measurement/rulerb.gif |
| 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   http://chemwiki.ucdavis.edu/@api/deki/files/426/=20graphicaa.gif?revision=1 | 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   http://www.uky.edu/~holler/survey/images/24_74.jpg |

1. Darts are thrown onto a dart board. Assess whether each outcome for precision and accuracy.



1. In a lab, what does it mean if your results are precise, but inaccurate?

1. Convert the following with proper significant figures.

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| --- | --- | --- |
| 1. 9.0 ng to g | 1. 0.045 cm to km | |
| 1. 25.5 mL to L | 1. 0.33 kg to mg | |
| 1. 54 g/L to g/mL | 1. 2.5 cm3 to m3 | |
| **THE MOLE**   * Know and use Avogadro’s number * What is a mole * What is atomic mass, molar mass * Mole calculations with mass, density, percents, STP * How to find the empirical formula and molecular formula | | |

1. Make the following conversions, clearly showing your steps. Include proper units in all of your work and in your answer.
   1. 133.44 grams of PCl5 = ? moles
   2. 0.00256 moles of Li2Cr2O7 = ? grams
   3. 170.24 L of NO2 at STP = ? moles
   4. 570.625 g of PCl3 gas = ? L (STP)
   5. 1030.4 mL of C2H6 gas at STP = ? g
   6. 5.00 kg of nitrogen gas = ? L (STP)
   7. 0.5696 kg of CH4(g) = ? mL (STP)
   8. 9.8 g of NH3 = ? molecules
   9. How many atoms of Cl are there in 5.55 g of PCl5?
   10. How much does a billion molecules of sugar, C6H12O6, weigh?
2. The density of liquid ethanol C2H5OH is 0.790 g/mL. Calculate the number of molecules in a 35.0 mL sample of liquid ethanol.

1. A 100.0 mL sample of liquid mercury contains 6.78 moles. Calculate the density of liquid mercury from this data.
2. Calculate the density of PCl3(g) at STP.

1. The density of a gas at STP is 4.955 g/L.
2. Calculate the molar mass of this gas.
3. The gas is an oxide of selenium. Determine the molecular formula.

1. Find the percent composition in Sr3(PO4)2.

1. What mass of Ca(OH)2 can be made from 5.00 grams of Ca?
2. How many grams of cobalt (II) chloride hexahydrate can be made with 10.0 g of the anhydrous salt?
3. A compound was analyzed and the following results were obtained:

Molar mass: 270.4 g/mol

Mass of sample: 162.24 g

Mass of potassium: 46.92 g

Mass of sulphur: 38.52 g

Mass of oxygen: the remainder of the sample is oxygen

1. Determine the mass of oxygen in the sample.
2. Determine the empirical formula for this compound.
3. A compound has the empirical formula of CHO. Name 3 molecular formulas that have CHO as their empirical formula.
4. 3.36 g of C, 0.708 g of H and 2.24 g of O combine to form 0.0702 moles of compound. What are its empirical and molecular formulas?

1. What are the empirical formulas of the following compounds?
2. compound 1: 25.8% oxygen by mass, the rest is sodium.
3. compound 2: 28.2% potassium, 25.6% chlorine and 46.2% oxygen.
4. A compound is 42.9% C, 7.1% H and 50.0%N. It has a molar mass of 140 g/mole. What is its molecular formula?
5. 10.0 grams of a compound containing C, H and N is burned in oxygen. 16.28 grams of CO2 and 3.34 grams of water are produced. When a sample of the compound is compared to the same volume of Neon gas at the same temperature and pressure, it is found to be 6.75 times heavier. What is the molecular formula of the compound?
6. What is the empirical formula for a compound which contains only C, H, and O if the combustion of 0.255 g yields 0.561 g of CO2 and 0.306 g of H2O?

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| **STOICHIOMETRY**   * Calculate mass, moles, number of particles of one species given the data for another in a chemical equation * Find the excess and limiting reagents in a reaction * Find the percent yield of a reaction * Predict amount of reactant or product in a reaction knowing its percent yield * Explain factors that lead to a percent yield less than 100%, and greater than 100% |

1. Given the equation C12H22O11 + 12O2 🡪 12CO2 + 11H2O + 5638 kJ which occurs at STP
2. How many grams of C12H22O11 is required to produce 50.0 g of CO2?
3. How much heat is released during the formation of 880.0 g of CO2?
4. How much heat is released during the formation of 5.6 moles of H2O?
5. If 179.2 L of O2 are consumed, how much heat is released?
6. How many litres of CO2 will be produced if 30.0 g of O2 were used?
7. How many moles of CO2 are produced from the burning of 16 g of CH3OH according to the unbalanced reaction below?

CH3OH + O2 🡪 CO2 + H2O

1. Consider the following unbalanced reaction at STP:

Fe(s) + H2O(l) 🡪 Fe3O4(aq) + H2(g)

1. What is the number of moles of H2O needed by the reaction to form 3 moles of Fe3O4?
2. How many grams of Fe are needed to make 6.0 g of H2?
3. What mass of iron would be needed to fill a 1.5 litre balloon with hydrogen?
4. How many molecules of Fe3O4 will be produced from 5.00 g of Fe?
5. C2H2 burns completely in O2 to produce CO2 and H2O at STP.

1. If 7500 L of C2H2 are completely burned in excess oxygen, how many litres of CO2 at STP could be produced?
2. What volume of C2H2 at STP is needed to produce 56.0 g of water?
3. Consider the decomposition of water: H2O 🡪 H2 + O2. What is the number of moles of O2 produced by the decomposition of 90. g of H2­O?
4. How many grams of CO2 are produced by burning 0.400 moles of C4H10 in excess oxygen?
5. N2 and H2 react to form NH3.
6. How many litres of N2 are required to produce 60 litres of NH3?
7. How many litres of N2 are needed to react with 30 litres of H2?
8. Potassium sulfite reacts with phosphoric acid to give potassium phosphate and sulfurous acid.
9. 32.66 g of potassium sulfite and 14.74 g of phosphoric acid are reacted. Find the limiting reagent.
10. What is the mass of sulfurous acid and potassium phosphate that forms?
11. Consider the following unbalanced reaction.

Fe2(CO3)3­ + CaCl2 🡪 FeCl3 + CaCO3

1. 8.76 g of Fe2(CO3)3 and 9.546 g of CaCl2 were mixed. What is the limiting reagent?
2. What mass of FeCl3 forms?
3. How many moles of CaCO3 form?
4. How many grams of the excess reagent will be left over after the reaction is done?
5. 25.0 g of barium chloride and 25.0 g of potassium sulphate are reacted. What mass of barium sulfate forms?
6. An impure sample of zinc has a mass of 1.50 g. All of the zinc in the impure sample is converted into zinc oxide which was found to have a mass of 1.59 g. What is the percentage of zinc in the impure sample?
7. You wish to prepare as much magnesium acetate, Mg(CH3COO)2, as you can. You have 10.0 g of MgCrO4 and 15.0 g of MgSO4. Which reaction will yield more Mg(CH3COO)2?
8. Ammonia burns in oxygen according to the following reaction:

NH3 + O2 🡪 NO2 + H2O

50.0 g of ammonia is reacted with 100.0 g of oxygen. How much NO2 will be produced?

1. The cylinders of a car have a volume of 6.15 litres. Assuming that air fills this volume at STP and is 21% oxygen, what mass of octane (C8H18) would be needed to combine with the oxygen?
2. What is the percent yield if 67.6 g of product was obtained for a reaction that theoretically should have produced 80. g?
3. A reaction is done using 59.2 g of Cu2S and 47.8 L of O2 at STP to give Cu2O and SO2. If 26.1 g of Cu2O is produced, calculate the percent yield.
4. A scientist wishes to synthesize Fe2(SO4)3 using the following reaction:

3CuSO4 + 2Fe 🡪 Fe2(SO4)3 + 3Cu

How much CuSO4 should he use to make 125.0 g of Fe2(SO4)3 if the reaction has a 65.0% yield?

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| **GAS LAWS**   * Describe pressure, volume, and temperature and how they relate to one another * Convert between different units for pressure (atm, torr, kPa, bar, mmHg) and temperature (°C vs K) * Apply the Ideal Gas Law, Charles’s Law, Boyle’s Law, and the Combined Gas Law |

1. Fill in the blanks with the following words, which can be used more than once:

less more directly inversely increase(s) decrease(s) slow down speed up

As temperature increases, gaseous particles \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and exert \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force on their container. This causes a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in pressure. If the container is flexible, this causes a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in volume. As temperature decreases, gaseous particles \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and exert \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ force on their container. This causes a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in pressure. If the container is flexible, this causes a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in volume. Temperature is said to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ related to pressure and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ related to volume. Volume is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ related to pressure.

1. Convert the following pressures and temperatures.

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| 1. 56 kPa to atm | 1. 5 mmHg to atm |
| 1. 30°C to K | 1. 101 Torr to kPa |
| 1. 200. atm to kpa | 1. 19 K to °C |

1. What does STP stand for and what conditions does it represent?
2. Find the pressure inside a 5.0 L glass bulb filled with 5.0 mol of He at 25°C.
3. What is the volume 3.5 moles of gas at -55°C and 350. mmHg?
4. 0.025 moles of a gas at 101 atm occupies 6.3 mL of space. Find the temperature of this gas in °C.
5. 25 g of iodine is sublimated at 32°C into a 500.0 mL flask. Find the pressure inside the flask.
6. What mass of C2H6 at 45 kPa and 25°C contains the same number of molecules as 15 g of CH4 at 125 kPa and 0.0°C?
7. A gas at 45°C and 98 mmHg occupies 5.6 L of space. What would its volume be at STP?
8. A certain gas at 500. mL exerts 250 kPa in a canister with a piston. The piston is lowered to squeeze the gas to 120 kPa. What is the volume of the canister?
9. 3.0 mol of gas in a syringe set to 25 mL at 10°C exerts 98 atm. If the syringe is pulled to 55 mL, what will the new pressure be?
10. A gas is collected at 35°C and occupies 2.5 L. The storage tank available for this gas is only 500.0 mL. What temperature should this gas be stored at in order to use the 500.0 mL tank?
11. What is the new temperature of a gas that is compressed from 35 L at 25°C to 12 L?
12. A gas at 0°C is heated to 100°. How much will the volume increase as a result of this heating?
13. 500.0 liters of a gas are prepared at 700.0 mm Hg and 200.0 °C. The gas is placed into a tank under high pressure. When the tank cools to 20.0 °C, the pressure of the gas is 30.0 atm. What is the volume of the gas?
14. At conditions of 785.0 Torr of pressure and 15.0 °C temperature, a gas occupies a volume of 45.5 mL. What will be the volume of the same gas at 745.0 Torr and 30.0 °C?
15. A gas balloon has a volume of 106.0 liters when the temperature is 45.0 °C and the pressure is 740.0 mm of mercury. What will its volume be at 20.0 °C and 780 .0 mm of mercury pressure?
16. 73.0 mL of nitrogen at STP is heated to 80.0 °C and the volume increase to 4.53 L. What is the new pressure?
17. The pressure of a gas is reduced from 1200.0 mm Hg to 850.0 mm Hg as the volume of its container is increased by moving a piston from 85.0 mL to 350.0 mL. What would the final temperature be if the original temperature was 90.0 °C?
18. A 500. mL tank contains 2.0 g of He, Ne, and Ar gas at 30.°C. What is the partial pressure of each gas in the tank?
19. A canister contains 25 g of CO2, CH4, and O2. The total pressure is 650 kPa. What is the partial pressure of each gas?
20. A flask contains a mixture of 2.0 g of CH4 and 3.0 g N2. If the pressure in the flask is 60.0 atm, what is the partial pressure of each gas?
21. A chamber contains 0.25 mol O2, 0.35 mol of N2, and 0.45 mol of CO2. When all the N2 is removed, the pressure of the system drops by 35 kPa. What is the partial pressure of each gas and the total pressure?
22. Hydrogen sulfide reacts with sulfur dioxide to produce water and solid sulfur. How many litres of hydrogen sulfide is needed in order to produce 100.0 g of solid sulfur in a reaction at 25°C and 97 atm?
23. Some zinc was dropped in hydrochloric acid to produce hydrogen gas. The gas produced inflated a balloon to 6.0 L at 22°C and 98.1 atm. How much zinc was used?

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| **ATOMIC THEORY**   * Describe atoms using nuclear notation * Describe what an isotope is * Draw and interpret Bohr diagrams, and explain its flaws * Describe the major contributions of Democritus, Dalton, Thomson, Rutherford, Bohr, and Shrodinger * Describe the atomic orbitals * Write the electron configuration for neutral and charged atoms with and without an energy level diagram. Know the exceptions. * Count the number of valence electrons * Describe the periodic families * Describe the periodic trends: atomic radii, electronegativity, ionization energy, reactivity * Describe the 3 types of bonds: ionic, covalent, polar covalent * Assess polarity of a bond and assign partial charges * Draw Lewis structures for neutral and charged molecules, including those with resonance * Describe how bond length and electronegativity affect bond strength in ionic and covalent compounds |

1. Consider the following ideas:
2. Compounds are made up of molecules which are combinations of atoms
3. All atoms of an element are the same
4. Atoms of different elements are different
5. Atoms are indivisible particles

Who came up with these ideas? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ measured the charge/mass ratio of an electron and came up with the so-called “plum pudding” model of the atom.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ devised the Gold Foil Experiment, which showed that all atoms had a small dense \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Bohr came up with an atomic model to explain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

He said that the atom has certain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ levels which are allowed. If an electron absorbs a certain amount of energy, it will jump to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ level. It will release this energy (in the form of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) when it jumps back to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ level. Bohr’s model was revolutionary at his time, but has since then been proven to be flawed in two major ways: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Fill in the following table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nuclear Symbol | Protons | Neutrons | Electrons | Mass Number | Charge |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  | 105 |  |  | 262 | 2+ |
|  | 51 | 72 | 48 |  |  |
|  |  | 42 | 36 |  | 3- |
|  |  | 79 | 54 | 133 |  |
|  | 94 | 150 |  |  | 3+ |

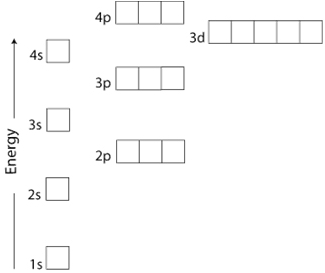
1. Element “X” is composed of the following naturally occurring isotopes:

|  |  |
| --- | --- |
| Isotope | % Abundance |
| X-79 | 50.69 |
| X-81 | 49.31 |

1. Calculate the average atomic mass of element “X” to 3 decimal places.
2. What is Element X? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Regions in space occupied by electrons are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Sketch the four types.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

1. Fill the energy level diagram for phosphorous.



1. How many shells have electrons? \_\_\_\_\_\_\_
2. How many sub-shells have electrons? \_\_\_\_\_\_\_
3. How many orbitals have a single electron? \_\_\_\_\_\_\_
4. How many orbitals have paired electrons? \_\_\_\_\_\_\_
5. Write the electron configuration for the following atoms in full and core notation.

|  |  |
| --- | --- |
| 1. P |  |
| 1. Mo |  |
| 1. Se |  |
| 1. Rb |  |
| 1. Cl- |  |
| 1. Al3+ |  |
| 1. K+ |  |
| 1. S2- |  |

1. How many valence electrons are in Mg? \_\_\_\_\_\_ F? \_\_\_\_\_\_\_ S? \_\_\_\_\_\_\_\_ Ti? \_\_\_\_\_\_\_\_ Zn? \_\_\_\_\_\_\_\_
2. Circle the metalloid: Be Rb Os Ge Pb Al
3. Circle the most reactive element in the following: Na Mg Si Al Ar
4. Circle the most reactive element in the following: Na K Rb Cs Li
5. Circle the most reactive element in the following: Cl Br I At Ne
6. Circle the element with the largest atomic radius of these: Na Mg Si Al Ar
7. Circle the element with the largest atomic radius of these: N P As Sb Bi
8. Circle the element with the largest ionization energy of these: K Ca Ga As Kr
9. Circle the element with the largest ionization energy of these: C Si Ge Sn Pb
10. Circle the element with the smallest atomic radius: Mg Mg2+ Be Be2+

1. Circle the element with the highest electronegativity of these: Mg Si S Cl
2. Circle the element with the highest electronegativity of these: F Cl Br I
3. Circle the most metallic element of these: Be Mg Ca Sr Ba
4. Circle the element with the largest atomic radius: F Cl Br- Se
5. Circle the most metallic element of these: Ga Ge Se Br Kr
6. Circle the compound you’d expect to have the highest melting point: NaCl NaF
7. Circle the compound you’d expect to have the highest melting point: MgO MgS MgCl2
8. In an ionic bond, electrons are
   1. shared equally by two atoms
   2. shared unequally by two atoms
   3. transferred from a metal to a non-metal
   4. transferred from a non-metal to a metal
   5. closer to one end of a molecule, forming a temporary dipole
9. In a covalent bond, electrons are
10. shared equally by two atoms
11. shared unequally by two atoms
12. transferred from a metal to a non-metal
13. transferred from a non-metal to a metal
14. closer to one end of a molecule, forming a temporary dipole
15. In a polar covalent bond, electrons are
16. shared equally by two atoms
17. shared unequally by two atoms
18. transferred from a metal to a non-metal
19. transferred from a non-metal to a metal
20. closer to one end of a molecule, forming a temporary dipole
21. Match each descriptor with its chemical family.

|  |  |
| --- | --- |
| 1. Alkali metal | \_\_\_\_\_\_\_\_ These elements have a valence of 8 or 0 |
| 1. Alkaline earth metal | \_\_\_\_\_\_\_\_ These elements form +2 ions |
| 1. Transition metals | \_\_\_\_\_\_\_\_ These elements have both metal and non-metal properties |
| 1. Metalloids | \_\_\_\_\_\_\_\_ These elements are soft, silver, and shiny |
| 1. Halogens | \_\_\_\_\_\_\_\_ These elements are coloured and multivalent |
| 1. Noble gases | \_\_\_\_\_\_\_\_ These elements are diatomic and poisonous |

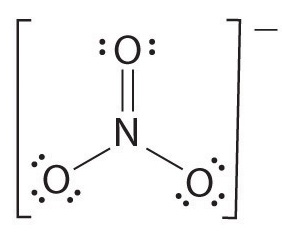
1. If a bond were to be made between the following pairs of elements, the result would be covalent (C), polar covalent (PC), or ionic (I)?

|  |  |  |
| --- | --- | --- |
| 1. \_\_\_\_\_\_\_\_ O and O | 1. \_\_\_\_\_\_\_\_ S and O | 1. \_\_\_\_\_\_\_\_ F and N |
| 1. \_\_\_\_\_\_\_\_ Mg and Cl | 1. \_\_\_\_\_\_\_\_ B and Si | 1. \_\_\_\_\_\_\_\_ P and S |

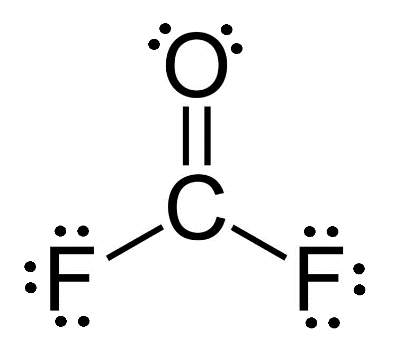
1. Draw Lewis structures for the following:

|  |  |  |
| --- | --- | --- |
| 1. MgCl2 | 1. PBr3 | 1. SeF2 |
| 1. CH3CH2I | 1. SF2 | 1. NSH |
| 1. SiS2 | 1. CHF3 | 1. PCl5 |
| 1. COF2 | 1. SH6 | 1. N2 |

1. One structure for NO3- is shown. Draw the other resonance structures.



1. On the following molecule, draw the symbol for bond dipole for all bonds and assign partial charges.



|  |
| --- |
| **VSEPR THEORY AND SOLUTION CHEMISTRY**   * Explain VSEPR theory * Predict the 3D shapes and bond angles of molecules * Describe the intermolecular forces (dipole-dipole, London, H-bonds) and how they differ from intramolecular forces (ionic, polar covalent, covalent) * Explain how substances dissolve and predict solubility in different solvents * Write dissociation reactions * Calculate molar concentrations using mass and volume * Calculate ion concentrations after dilutions, mixing solutions, precipitation * Predict the solubility of compounds using the Solubility Chart * Write formula, complete ionic, and net ionic equations * Predict the conductivity of various solutions |
|  |

1. What is meant by molar concentration or molarity?
2. 123.11 g of zinc nitrate are dissolved in enough water to form 650.0 mL of solution. Calculate the molarity of the solution.

1. Calculate the mass of potassium sulphite needed to make 800.0 mL of a 0.200 M solution.
2. What volume of 2.50 M Li2CO3 would need to be evaporated in order to obtain 47.232 g of solid Li2CO3?
3. You add 50.0 mL of a 2.0 M Na2CO3 solution to a reaction. How many grams did you add?
4. Draw and name VSEPR structures for the following and determine whether they are polar.

|  |  |  |
| --- | --- | --- |
| 1. MgCl2 | 1. PBr3 | 1. SeF2 |
| 1. CH3CH2I (Challenge) | 1. SF2 | 1. NSH |
| 1. SiS2 | 1. CHF3 | 1. PCl5 |
| 1. COF2 | 1. SH6 | 1. N2 |

1. A molecule is said to be polar if \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What are the three intramolecular forces? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. What are the three intermolecular forces? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Which is stronger, intramolecular forces or intermolecular forces?
5. For ionic compounds, which force is involved in melting, intramolecular or intermolecular?
6. For covalent compounds, which force is involved in boiling, intramolecular or intermolecular?
7. Of the intermolecular forces, which is the strongest? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. Analyze the following molecules for the presence of intermolecular bonds.

|  |  |  |  |
| --- | --- | --- | --- |
|  | H-bonds | Dipole-dipole | London Forces |
| 1. CH2F2 |  |  |  |
| 1. CH3CH2CH3 |  |  |  |
| 1. CH3CH2OH |  |  |  |
| 1. SF6 |  |  |  |
| 1. PH4F |  |  |  |

1. Which of the compound(s) from the previous question would you expect to have the lowest boiling point? Explain.
2. Circle the most conductive: Fe(s) NaCl(s) CH3OH(aq)
3. Circle the most conductive: 1.0 M NaCl 1.2 M LiF 0.5 M MgCl2
4. Circle the most conductive: KF(s) KF(aq) CH4(l)
5. Given the following reaction

MgCO3 (s) + 2HCl (aq) 🡪 CO2 (g) + H2O (l)  + MgCl2(aq)

What mass of MgCO3 will react completely with 15.0 mL of 1.5 M HCl?

1. Calculate the volume of 2.0 M HCl which would be needed to react completely with 37.935 grams of magnesium carbonate.
2. In a titration, 18.20 mL of 0.300 M Ba(OH)2 is required to react completely with a 25.0 mL sample of a solution of HNO3. Find the [HNO3].
3. In a titration, 11.06 mL of 0.200 M HNO3 is required to react completely with a sample of 0.250M Ba(OH)2 . Find the volume of the Ba(OH)2 sample.
4. 150.0 mL of water are added to 400.0 mL of 0.45 M HNO3. Calculate the final [HNO3].
5. What volume of water needs to be added to 150.0 mL of 4.00 M H2SO4 in order to bring the concentration down to 2.50 M?

1. Give directions on how to make 5.00 L of 0.020 M Ca(ClO)2 using solid Ca(ClO)2 and water.
2. 200.0 mL of 2.0 M Na2SO4 is mixed with 300.0 mL of 1.5 M NaNO3. Find the final concentration of all ions.
3. 25.5 mL of 3.0 M Na3PO4 is mixed with 40.0 mL of 2.0 M Ca(NO3)2.
4. Will there be a precipitate? If yes, what will it be? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Write the formula equation.
6. Write the complete ionic equation.
7. Write the net ionic equation.
8. Find the final concentration of each ion.
9. Describe how to make 200. mL of a 0.65 M solution of LiI
10. How many grams of CaCl2 are contained in 1.25 L of a 0.25 M solution of CaCl2?
11. What is the molarity of a solution made from dissolving 15.6 g of CaI2 into 1900 mL of water?
12. 14.5 g of calcium chloride and 13.76 g of aluminum chloride are dissolved in order to make a solution that is 2.5 L. What is the chloride ion concentration in the final solution?
13. 2.5 L of a 0.96 M solution of Li2CO3 are added to 3.0 L of water. What are the final concentrations of the Li+ and CO32- ions after mixing?
14. What volume of 1.37 M sucrose can be made from 300 mL solution that is 2.7 M sucrose?
15. What are the concentrations of each of the ions of AlCl3 as 1.40 L of a 0.45 M solution is concentrated to 0.23 L?
16. What are the final concentrations of all ions when 2.5 L of 1.56 M AgNO3 is mixed with 1.9 L of 1.36 M KCl?
17. 200.0 mL of 1.60 M aluminum bromide is mixed with 3.0 L of 1.40 M barium bromide. What is the final bromide ion concentration?
18. FeCl3(aq) is mixed with Sr(OH)2. Write out the molecular, complete ionic and net ionic equations for the reaction.
19. 0.967 L of 0.90 M FeCl2 is mixed with 1.10 L of 1.10 M Na2S. What are the concentrations of all of the ions after mixing, and what mass of precipitate forms?
20. Circle the best solvent for LiF: CH3OH CH3OCH3 HCl
21. Circle the best solvent for NSH CH3CH2CH3 HF CH3CH2F
22. Circle the best solvent for CH3CH2CH3: H2O cyclohexane HNO3
23. Circle the best solvent for Mg(OH)2: methanol propanol butanol

|  |
| --- |
| **ORGANIC CHEMISTRY**   * Interpret/draw condensed structures and line diagrams from molecular formulae and organic names for   + Alkanes, alkenes (including cis and trans), alkynes   + Branched and cyclic structures   + Alkyl halides   + Alcohols   + Ketones   + Aldehydes   + Carboxylic acids   + Esters   + Ethers   + Amines   + Amides * Identify various functional groups * Predict the products or reactants for an esterification reaction |

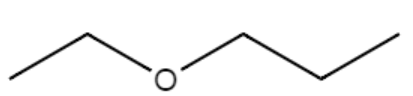
1. Name and draw the following molecules.

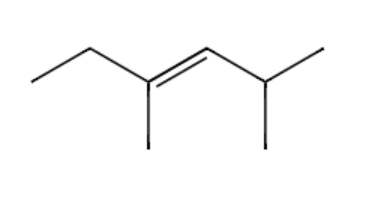
|  |  |
| --- | --- |
|  | 1. 2-butyne |
| 1. 3,3-diethylheptanoic acid |  |
|  |  |
| 1. methyl pentanoate |  |
|  |  |
|  |  |
| 1. aminobenzene | 1. 2,3,3-trichloropentanal |
|  | 1. 3-methyl-4-phenyl-1-pentyne |
|  | 1. trans,cis-8-methyl-3,5-nonadiene |
|  |  |

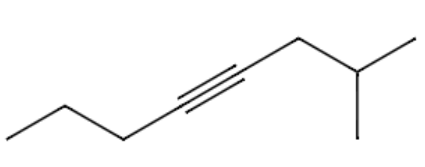
1. Match the following descriptors with the correct functional group or organic structure.

|  |  |
| --- | --- |
| 1. Saturated hydrocarbon | \_\_\_\_\_\_\_\_ A halogen branch |
| 1. Aromatic compound | \_\_\_\_\_\_\_\_ Would turn litmus paper red |
| 1. Alkyl group | \_\_\_\_\_\_\_\_ Have cis and trans isomers |
| 1. Alkenes | \_\_\_\_\_\_\_\_ Alkanes are also known as this |
| 1. Alkynes | \_\_\_\_\_\_\_\_ Are an anesthetics |
| 1. Alcohols | \_\_\_\_\_\_\_\_ Any branch that contains carbons and hydrogens |
| 1. Ketones | \_\_\_\_\_\_\_\_ Have a linear 180°C section |
| 1. Aldehydes | \_\_\_\_\_\_\_\_ Names end in “-one” |
| 1. Esters | \_\_\_\_\_\_\_\_ Can be made from carboxylic acids with alcohol |
| 1. Ethers | \_\_\_\_\_\_\_\_ Have an amino group next to a carbonyl |
| 1. Amines | \_\_\_\_\_\_\_\_ Smells fishy |
| 1. Amides | \_\_\_\_\_\_\_\_ A C = O group |
| 1. Carboxylic acids | \_\_\_\_\_\_\_\_ Compounds that are poisonous and have a strong odor |
| 1. Carbonyl group | \_\_\_\_\_\_\_\_ Benzene is an example |
| 1. Alkyl halide | \_\_\_\_\_\_\_\_ A carbonyl group at the first carbon |
|  |  |

1. Convert these line diagrams to condensed structures.







1. What are isomers?
2. Why are cyclic alkanes not an isomer of their non-cyclic alkane counterparts? For example, why is cyclobutane not an isomer of C4H10?
3. Predict the product or reactant structures for each esterification.

|  |
| --- |
| 1. methanol + ethanoic acid 🡪 ? |
| 1. 2-butanol + 2-methylpropanoic acid 🡪 ? |
| 1. Cyclohexanol + 2,3-dimethylbutanoic acid 🡪 ? |
|  |
|  |
|  |