Chemical Reactions Exam Review

1. Complete the following table:

Formula	IUPAC Name
$CaCl_2$	
	potassium carbonate
$Fe(NO_3)_3$	
	ammonium sulphate
I_2O_5	
	magnesium hydroxide

2. Gallium has two naturally occurring isotopes 69Ga (60.1% abundance) and 71Ga (39.9% abundance). Calculate the atomic weight of naturally occurring gallium.

3. What is the correct formula for the compound sodium sulfite?

A. Na_2SO_3
B. Na_2SO_4
C. Na_2S
D. $NaHSO_3$

4. Calculate the molar mass of the following substances.

a) $Mg(OH)_2$

b) F_2

c) NO_3^-

5. Balance the following reactions

a) $H_2SO_4(aq) + Fe(OH)_3(s) \longrightarrow Fe_2(SO_4)_3(aq) + H_2O(l)$

b) $KClO_3(s) \xrightarrow{\Delta} KCl(s) + O_2(g)$

c) $Cl_2(g) + KI(aq) \longrightarrow KCl(aq) + I_2(s)$

6. Write a balanced chemical equation, for each of the following reactions, including only those species that actually take part in the reactions. (i.e. omit all spectator species)

a) Solid magnesium carbonate ($MgCO_3$) reacts with nitric acid (HNO_3) to produce a colourless conducting solution, carbon dioxide and water.

b) Sodium metal burns in chlorine gas to produce solid sodium chloride.

c) Potassium chloride (KCl) solution is added to lead(II) nitrate ($Pb(NO_3)_2$) solution producing a white precipitate and a colourless conducting solution. What is the net ionic equation for this reaction?

d) Solid copper(II) nitrate is decomposed by heat to form solid copper(II) oxide, nitrogen dioxide gas and oxygen gas.

7. For the questions below, predict the reactants, include states, balance the reaction and state what type of reaction it is.

a) $(NH_4)_2CO_{3(aq)} + CuCl_{2(aq)} \rightarrow$

Type: _____

b) $F_{2(g)} + KCl_{(aq)} \rightarrow$

Type:_____

c) $H_{2(g)} + O_{2(g)} \rightarrow$

Type: _____

d) $CCl_{4(s)} \rightarrow$

Type: _____

d) $Mg(OH)_{2(aq)} + H_3PO_{4(aq)} \rightarrow$

Type: _____

8. Describe the concept of the mole and its importance to measurement in chemistry.

9. Convert each of the following into moles.

a) 12.04×10^{23} molecules of H_2

b) 33.50 g of solid NaCl

c) 67.2 L of CO_2 at STP

10. How many moles of H_2 are there in 44.8 L?

11. Calculate the percentage by mass of carbon in sugar, $C_{12}H_{22}O_{11}$

12. Calculate the empirical formula for a compound that has 43.7 g P (phosphorus) and 56.3 grams of oxygen.

13. Use the following equation to answer the questions below

$$4\ KO_2(s) + 2\ CO_2(g) \rightarrow 2\ K_2CO_3(s) + 3\ O_2(l)$$

a) How many **moles** of O_2 would be produced from 5 moles of exhaled CO_2?

b) How many **moles** of KO_2 would be required to produce 9 moles of O_2?

c) What mass of K_2CO_3 would be produced from 50.0 g of KO_2?

14. At a refinery, hydrogen gas (H_2) is used in the production of nickel. This gas is produced by the water-gas reaction using methane (CH_4):

$$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3\ H_2(g)$$

How many grams of hydrogen gas would be obtained if 10.6 kg of methane was reacted with excess water?

Chemical Reactions

Determine average atomic mass using isotopes and their relative abundance.
Include: atomic mass unit (amu, μ)

Calculate the mass of compounds in atomic mass units.

Write and classify balanced chemical equations from written descriptions of reactions.
Include: polyatomic ions

Predict the products of chemical reactions given the reactants and type of reaction.
Include: polyatomic ions

Describe the concept of the mole and its importance to measurement in chemistry.

Calculate the molar mass of various substances.

Calculate the volume of a given mass of a gaseous substance from its density at a given temperature and pressure.
Include: molar volume calculation

Solve problems requiring inter-conversions between moles, mass, volume, and number of particles.

Determine empirical and molecular formulas from percent composition or mass data.

Interpret a balanced equation in terms of moles and mass.

Solve stoichiometric problems involving moles, mass, given the reactants and products in a balanced chemical reaction.
Include: Heat of reaction problems

Perform a lab involving mass-mass or mass-volume relations, identifying the limiting reactant.
Include: theoretical yield and experimental yield

Gases and the Atmosphere Exam Review

1. If the weather forecast stated that the pressure is 104.2kPa

   a) What is the pressure in atmospheres?

   b) What would a barometer measure in mm of mercury?

2. A closed monometer is filled with mercury and connected to a container of oxygen. The difference is height of the mercury in the two arms is 124mm. What is the pressure, in kilopascals, of the oxygen.

3. An open monometer is fillet with mercury and connected to a container of nitrogen. The level of the mercury is 12mm higher on the tube connected to the open air. If the are pressure is 743mmHg what is the pressure of nitrogen in atm?

4. If the initial temperature and pressure of a gas are 25°C and 5atm. What is the temperature when the pressure changes to 8atm?

5. If the initial temperature and volume of a gas is 30°C and 2L. What is the volume when the pressure is -25°C?

6. A gas at 1.5L is compressed to 0.5L and is kept at a constant temperature. What would the final pressure be if the initial pressure was 2.5atm?

7. a) How does increasing the volume of a gas effect its pressure, assuming that temperature remains the same.

b) What happens to the particles for this phenomenon to occur?

8. A gas occupies 450mL at 1.4atm and 223K. At what pressure will the gas occupy 290ml at 300K?

9) A sample of hydrogen gas has volume of 305mL when the temperature is 25°C and the pressure is 41.5kPa. What volume will the gas occupy at STP? (STP Temperature = 273K Pressure= 101.3kPa)

Gases and the Atmosphere

Describe the various units used to measure pressure.
Include: atmospheres (atm), kilopascals (kPa), mm of mercury (mmHg)

Experiment to develop the relationship between pressure and volume of a gas using visual, numerical and graphical representations.

Experiment to develop the relationship between volume and temperature of a gas using visual, numerical and graphical representations.
Include: the determination of absolute zero, and the Kelvin temperature scale.

Experiment to develop the relationship between pressure and temperature of a gas using visual, numerical and graphical representations.

Solve quantitative problems involving the relationships among pressure, temperature and volume of a gas using dimensional analysis.
Include: symbolic relationships

Identify various industrial, environmental, and recreational applications of gases.
Examples: SCUBA, anaesthetics, air bags, acetylene welding, propane appliances, hyperbaric chambers…

Solutions Exam Review

1. Provide an example for each of the following solution types

   a) Solid in liquid-

   b) Gas in Liquid-

2. What are two physical characteristics of water that make it an important molecule in nature.

3. How does the structure of a salt crystal change when it is dissolved in water. (use a diagram)

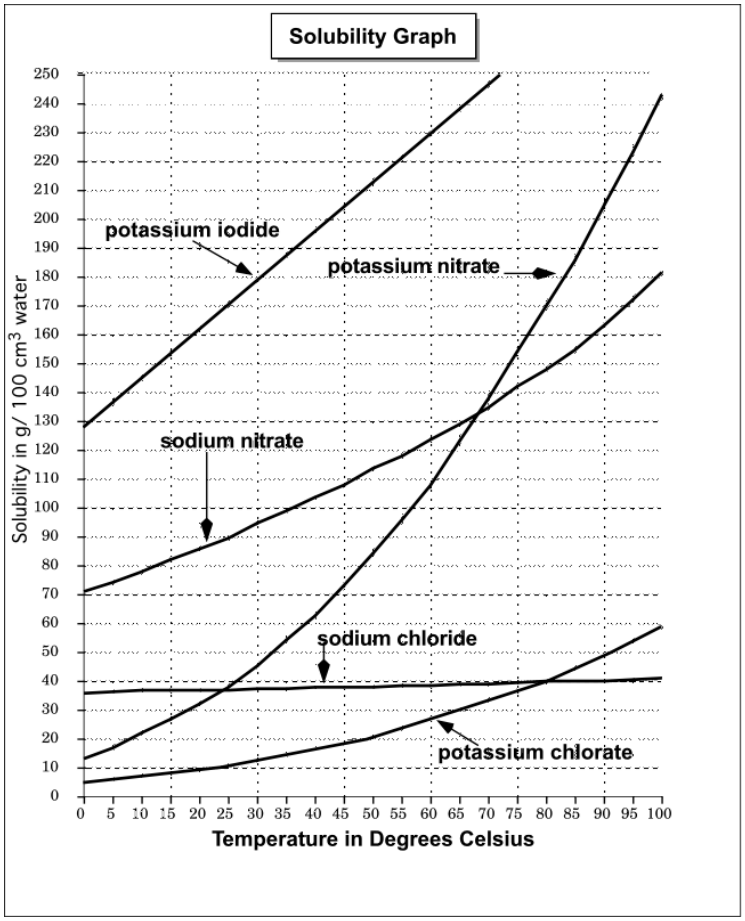
4. a) What will happen to the solubility of CO2 when you put an open carbonated drink in the fridge.

b) What will happen to the solubility of salt if you heat up the water it's in.

5. Calculate the number of moles of Cl^- ions in 15.0 mL of 0.2 mol L^{-1} $AlCl_3$ solution in water.

6. An aqueous solution of calcium chloride contains 2.00 g of calcium chloride (molar mass 110.98 g mol^{-1}) in 100.0 mL. Calculate the concentration of **chloride ion** (Cl^-) in the solution.

7. What volume of 0.200 mol L^{-1} Na_2CO_3 solution can be prepared from 21.20 g of Na_2CO_3 (molar mass = 106.0 g mol^{-1}).



8. Please refer to the diagram of solubility curves for the following questions.

a) What is the solubility of potassium iodide at 30ºC?

b) What mass of NaCl is needed to prepare a saturated solution in 200g H2O at 80 ºC?

c) What is the lowest temperature at which 130g of sodium nitrate will completely dissolve in 100 g of H2O? (1)

d) What mass of potassium nitrate precipitates from solution if a saturated solution in 150g of water is cooled from 82ºC to 40 ºC? (3)

9. Describe two differences between a saturated and supersaturated solution.

10. Describe how to make a 100 mL solution of 0.2 M potassium nitrate. Full marks will not be awarded without a concluding statement.

11. What volume of water will you need of 12.4M stock solution HCl to prepare a 1.0 L solution with a concentration of 5.00 M.

Solutions

Describe and give examples of various types of solutions.
Include: all nine possible types

Describe the structure of water in terms of electro negativity and the polarity of its chemical bonds.

Explain the solution process of simple ionic and covalent compounds, using visual, particulate representations and chemical equations.
Include: crystal structure, hydration, dissociation

Explain heat of solution with reference to specific applications.
Examples: cold packs, hot packs

Perform a lab to illustrate the formation of solutions in terms of the polar and non-polar nature of substances.
Include: soluble, insoluble

Construct, from experimental data, a solubility curve of a pure substance in water.

Differentiate among saturated, unsaturated, and supersaturated solutions.

Use a graph of solubility data to solve problems

Explain how a change in temperature affects the solubility of gases

Differentiate among, and give examples of the use of various representations of concentration.
Include*: g/L , % W/W, % W/V, % V/V, ppm, ppb, mol/L (molarity)*

Solve problems involving calculation for concentration, moles, mass, and volume.

Prepare a solution given the amount of solute (in grams) and the volume of solution (in mL) and determine the concentration in moles/liter.

Solve problems involving the dilution of solutions
Include: dilution of stock solutions, mixing common solutions with different volumes and concentrations

Perform a dilution from a solution of known concentration.

Physical Properties of Matter Exam Review

1. Describe the two similarities and two differences between liquids and solids. Include the words density, compressibility, diffusion.

2. Describe how a molecule of perfume moves across a room. Use the terms: kinetic, random, intermolecular, elastic

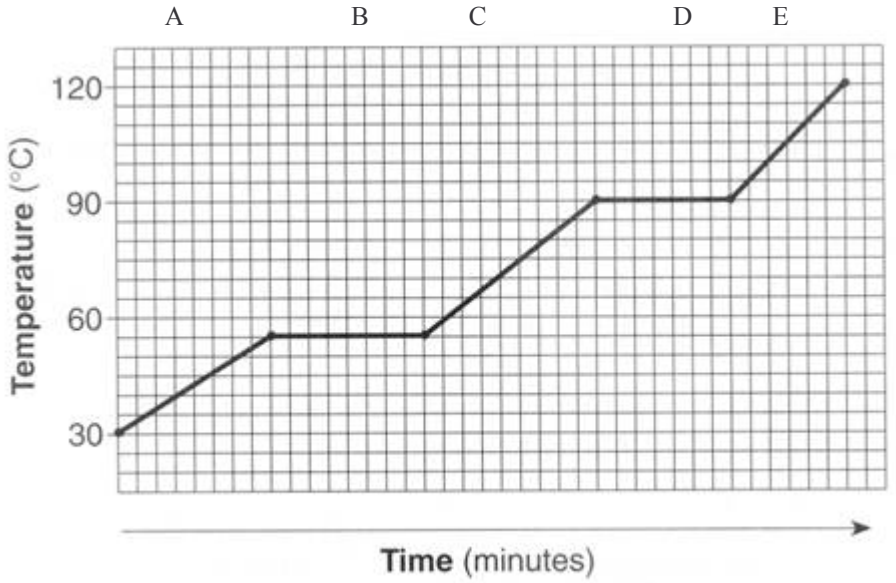
3. Explain the properties of liquids and solids using the Kinetic Molecular Theory.

4. Define the following terms and describe how they are measured:

   a) vapor pressure-

   b) normal boiling point

5. Answer the following questions using the graph below.



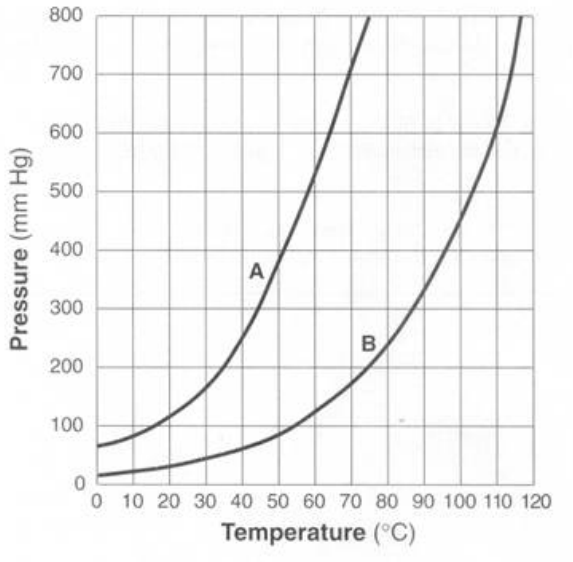
a) At which stages in the graph is there no change in Kinetic energy? _____

b) What is happening in section B? _____

c) What state would the substance be in section C? _____

d) If this data was collected at standard pressure, what would the vapor pressure of this substance be at 90°C? _____

6. Explain the process of condensation. Include the terms: intermolecular forces, random motion, dynamic equilibrium.



7. a) What is the vapor pressure of liquid B at 110°C? _____

b) What is the boiling point of liquid A at standard pressure (104.5kPa)? _____

c) What is the boiling point of liquid B if it was put in a container with a pressure of 400mmHg? _____

d) In a lab situation why would a scientist choose to measure pressure in mmHg instead of kPa or atm?

Physical Properties of Matter

Describe the properties of gases, liquids, solids, and plasma.
Include: density, compressibility, diffusion

Use the Kinetic Molecular Theory to explain properties of gases.
Include: random motion, intermolecular forces, elastic collisions, average kinetic energy, and temperature.

Explain the properties of liquids and solids using the Kinetic Molecular Theory.

Explain the process of melting, solidification, and deposition in terms of the Kinetic Molecular Theory.
Include: freezing point

Use the Kinetic Molecular Theory to explain the process of evaporation and condensation.
Include: intermolecular forces, random motion, volatility, dynamic equilibrium.

Operationally define vapour pressure in terms of observable and measurable properties.

Operationally define normal boiling point temperature in terms of vapour pressure.

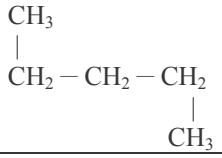
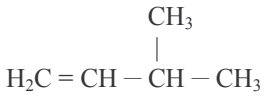
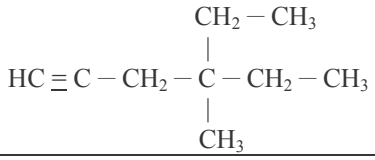
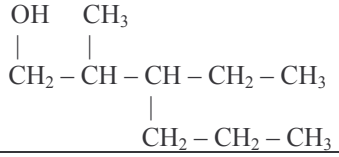
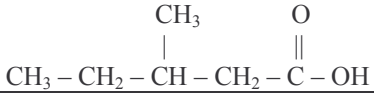
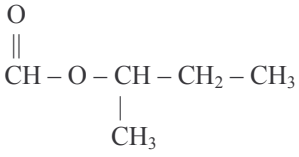
Interpolate and extrapolate the vapour pressure and boiling temperature of various substances from pressure verses temperature graphs.

Organic Chemistry Exam Review

1. What is the purpose of a fractionating column and how does it work?

2. What is the difference between an organic compound and a molecular compound?

3. Name the following compounds and identify each as an alkane, alkene, alkyne, alcohol, a carboxylic acid, or an ester.

	Structural Formula	IUPAC Name	Type of Compound
a.			
b.			
c.			
d.			
e.			
f.			

4. Draw the structural formulas for each of the following compounds.

a. 3 – methyl – 1 – pentyne	
b. Ethyl butanoate	
c. 2, 3 – ethanediol	
d. 2, 2, 4 – trimethyl – 3 – ethyl pentane	
e. 2 – methyl – 1 – propene	
f. 3 – methyl butanoic acid	

5. Identify the type of organic molecule from its chemical formula. Select from alkanes, alkenes, alkynes, alcohols, carboxylic acids, and esters.

Chemical Formula	Type of Compound	Chemical Formula	Type of Compound
a. CH_4		b. CH_3COOH	
c. C_4H_8		d. $C_3H_7COOCH_3$	
e. C_2H_5OH		f. C_6H_{12}	

6. Sketch and name 4 isomers of C_4H_9OH.

7. How does CH_3OH differ from NaOH?

8. What is a characteristic property of:
   a. an alcohol

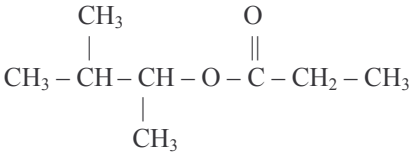
   b. a carboxylic acid

   c. an ester

9. Draw the structural formulas for all reactants and products for the hydrolysis of propyne with 2 moles of hydrogen gas in the presence of a platinum catalyst.

10. Sketch the structural formulas of all chemical species AND name the ester product in the esterification reaction of 2 – methyl – 2 – propanol and ethanoic acid.

11. The ester represented by the following formula may be synthesized from



12. Nonene is cracked catalytically. One of the products is pentane.
    a. Draw the structural formula and name the second product.

    b. What other reactant must be present to obtain a balanced chemical equation?

13. Write the balanced chemical equations for all reactants and products involved in the combustion of heptanol.

Organic Chemistry Specific Learning Outcomes

Compare and contrast inorganic and organic chemistry.
Include: the contributions of Friedrich Wöhler to the overturn of vitalism

Identify the origins and major sources of hydrocarbons and other organic compounds
Include: natural and synthetic sources

Describe the structural characteristics of carbon.
Include: bonding characteristics of the carbon atom in hydrocarbons (single, double, triple bonds)

Compare and contrast the molecular structures of alkanes, alkenes, and alkynes.
Include: trends in melting points and boiling points of alkanes only

Differentiate between saturated and unsaturated hydrocarbons

Name, draw and construct molecular models of the first ten alkanes.
Include: IUPAC nomenclature, structural formula, molecular formula, general formula $C_nH_{(2n+2)}$

Name, draw and construct molecular models of branched alkanes
Include: parent chain; methyl and ethyl substituent groups; IUPAC nomenclature

Name, draw and construct molecular models of isomers for alkanes up to six carbon atoms.

Outline the transformation of alkanes to alkenes and vice versa.
Include: dehydrogenation/hydrogenation; molecular models

Name, draw and construct molecular models of alkenes and branched alkenes
Include: methyl and ethyl substituent groups; IUPAC nomenclature, structural formula, molecular formula, general formula C_nH_{2n}

Outline the transformation of alkenes to alkynes and vice versa.
Include: dehydrogenation/hydrogenation; molecular models

Name, draw and construct molecular models of alkynes and branched alkynes
Include: methyl and ethyl substituent groups; IUPAC nomenclature; molecular models, structural formula, molecular formula, general formula C_nH_{2n-2}

Write formulas for and name common alcohols.
Include: maximum of six carbon parent chain; IUPAC nomenclature

Describe uses of methyl, ethyl and isopropyl alcohols.

Write formulas for and name organic acids.
Include: maximum of six carbon parent chain; IUPAC nomenclature

Describe uses of common organic acids.
Examples: acetic, ascorbic, citric, formic, acetylsalicylic (ASA), lactic, …

Perform a lab involving the formation of esters, and examine the process of esterification.

Write formulas for and name esters.
Include: up to 6-C alcohols and 6-C esters; IUPAC nomenclature

Describe uses of common esters.
Examples: pheromones, artificial flavourings, …