SCH 4U
J. Kropac

SCH 4U: Exam Review

Unit 1: Structure and Property of Atoms

Concepts

- What are the four quantum numbers needed to describe the location of an electron
- What l value is associate with each orbital shape?
- What are the allowed values for each?
- Electron Configurations
- Describe the atomic trend for: atomic radius, ionic radius, electronegativity, electron affinity, ionization energy.
- Name each of the secondary structures of VSEPR notation
- Briefly outline intramolecular vs intermolecular forces. How do you know when you have a covalent bond, a polar covalent bond, and an ionic bond?
- List the five types of crystalline solids and the properties associated with each

Skills

- Fill out electron diagram, full electron configurations and condensed electron configurations of any given atom
- Draw Lewis diagrams for a given molecule (included co-ordinate covalent bonds, polyatomic atoms, expanded valency and incomplete valency)
- Describe VSPER notation and draw molecules with correct molecular shape

Practice Questions

Sketch the molecular structure of each of the following and give their name and VSEPR notation.

SF_5^{-1} BeF_2 BCl_3 PBr_5 NI_3

State the electron configuration of the following atoms:

Pd

Se

Sr

Which of the following quantum numbers feature pairs that are not allowed. Justify.

n=3	l=3	ml= -3	m_s= -0.5
n=5	l=2	ml= -3	m_s=0.5
n=1	l=0	ml= 0	m_s=1

Draw a Lewis structure for the following atoms:

NH_4^{1+} NO_3^-

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Unit 2: Organic Chemistry

Concepts

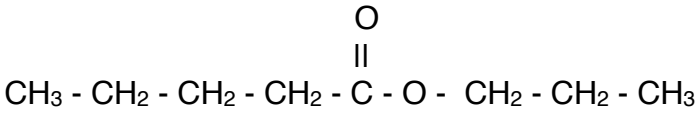
- Define saturated hydrocarbon, unsaturated hydrocarbon, and aromatic hydrocarbon.
- Be able to name and draw
  - Straight chain alkanes, branched alkanes, cycloalkanes, alkenes, alkynes, and aromatics
- Know the general formulas for alkanes, alkenes, and alkynes
- Know the structure of benzene
- Be able to predict which will have a higher boiling point
- Be able to name and draw
  - Alcohols, Haloalkanes, Ketones, Aldehydes, Carboxylic Acids, Esters, Ethers, Amines, and Amides
- Know the functional groups for: Alcohols, Haloalkanes, Ketones, Aldehydes, Carboxylic Acids, Esters, Ethers, Amines, and Amides
- Organic Reactions
  - Be able to identify and predict the products of addition, elimination, esterification, and substitution reactions
  - Know the terms halogenation and hydrogenation

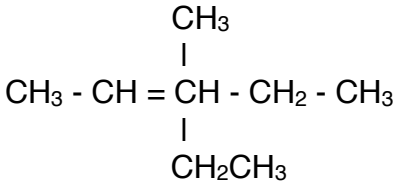
Skills

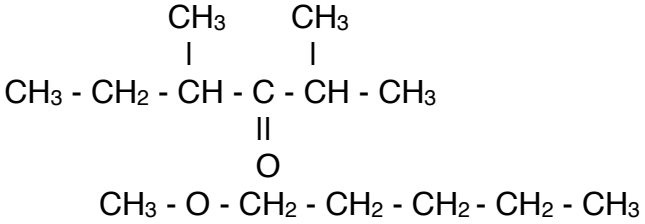
- Draw and name various hydrocarbons and hydrocarbon derivatives.
- Identify the types of and products of organic reactions.

Practice Questions

Name each of the following organic compounds:







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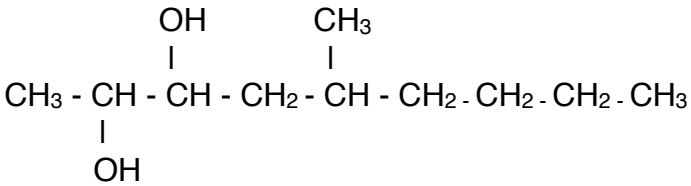
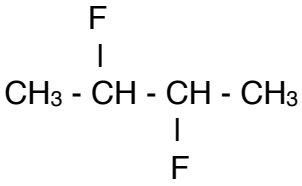




Draw the condensed structure for the following organic compounds:

2,2,3,4-tetramethylhept-3-ene

1,2,3-trimethylbenzene

2-methyl-3-phenylpentane

N-propylpentanamide

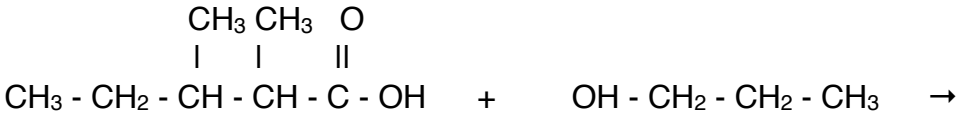
1,2-diethylbenzene

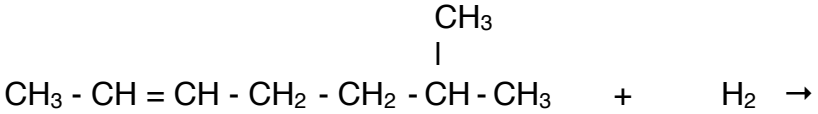
2,3-diethylpentanoic acid

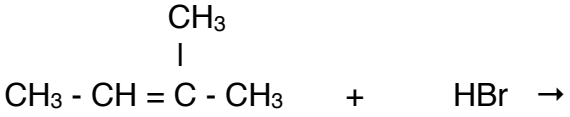
propyl 4,5-dimethylhexanoate

nonan-2-amine

For each of the following identify both the type of reaction and products







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Unit 3: Energy Changes and Rates of Reaction

Concepts

- Exothermic vs Endothermic reactions. Where does the energy travel to and from? What Q values are associated with each?
- What is the difference between a thermochemical equation and a potential energy diagram? Be able to draw both.
- What is meant by the term molar enthalpy?
- Describe collision theory. Know the difference between an effective vs ineffective collision.
- What is meant by the term rate determining step? How would you determine what the rate determining step is?
- Know the Symbol and Units for: Specific Heat Capacity, Heat, Molar Enthalpy, Enthalpy of a system (reaction)

Skills

- Determine the heat added to or released from a system (Q) using mass, specific heat capacity, and temperature change.
- Use calorimetry to calculate the molar enthalpy of a substance.
- Use a variety of equations and Hess's law to determine the enthalpy of a reaction.
- Use enthalpy of formation data to determine the enthalpy of a reaction.
- Sketch thermochemical equations and draw potential energy diagrams.

Practice Questions:

When a 100 g sample of ethanol at 25.0ºC absorbs 6.10 kJ of energy, it's temperature increases to 50.0ºC. What is the specific heat capacity of ethanol?

Use Hess's Law to determine $\triangle H$ for the following reaction:

$$4CO_{(g)} + 8H_{2(g)} \rightarrow 3CH_{4(g)} + CO_{2(g)} + 2H_2O_{(l)}$$

You have been provided with the following equations:

$C_{(s)} + 2H_{2(g)} \rightarrow CH_{4(g)}$	$\triangle H$=-74.8 kJ
$CO_{(g)} + 1/2O_{2(g)} \rightarrow CO_{2(g)}$	$\triangle H$= -283.1 kJ
$H_{2(g)} + 1/2\ O_{2(g)} \rightarrow H_2O_{(g)}$	$\triangle H$ = -241.8 kJ
$C_{(s)} + 1/2\ O_{2(g)} \rightarrow CO_{(g)}$	$\triangle H$ = -110.5 kJ
$H_2O_{(l)} + \ \rightarrow H_2O_{(g)}$	$\triangle H$= + 44.0 kJ

Use the standard enthalpy of formation data to determine the standard enthalpy for the reaction below. Note the enthalpy of formation of $ClF_{3(g)}$ is -157.87 kJ/mol.

$$2ClF_{3(g)} + 2NH_{3(g)}) \rightarrow N_{2(g)} + 6HF_{(g)} + Cl_{2(g)}$$

In a calorimeter, 3.86 g of sodium bromide is dissolved into 2800 mL of water. The initial temperature of the water was 22º C and the final temperature was 42.8º C . Based on this information, what would you expect the $\triangle H_{sol}$ of sodium bromide to be? Provide your answer in kJ/mol.

There is 500 kJ of energy given off when 50 g of carbon monoxide gas, $CO_{(g)}$, is formed. Determine the enthalpy of formation, $\triangle H_{f,}$ of carbon monoxide. Give your answer in kJ/mol. (5 marks)

Unit 4: Chemical Systems at Equilibrium

Concepts

- What happens to a systems in equilibriums when: The concentration of reactants is increased, the concentration of products is increased, the concentration of reactant is decreased, temperature is increased, temperature is decreased, a catalyst is added, pressure is increased, volume is increased.
- What is reaction quotient? How can it help you determine the direction of the reaction?
- What does K_a stand for and how does it relate to the strength of an acid. Kb?
- What is titration? What are the products of titration always going to be?
- Describe how to identify the equivalence point.

Skills

- Be able to write a K_{eq} expressions
- Calculate K_{eq} using a variety of methods (initial concentration, partial pressures, ICE table)
- Calculate pH using pOH or concentration of hydrogen
- Calculate K_a and K_b using pH and initial concentration

Sample Calculations:

Based on the following reaction:

$$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$$

What would happen if: temperature increased, oxygen increased, pressure increased, a catalyst was introduced.

Write the solubility product formation expression for the following:

$Ca(NO_3)_2$ $AlCl_3$ Ag_3PO_4

In a 10 L flask, 0.8 mols of $N_{2(g)}$, 3.1 moles of $3H_2$ is present, and 9.2 moles of $NH_{3(g)}$ was recorded. Calculate K_{eq} for this reaction.

$$N_{2\,(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)}$$

In a 8 L flask, 2 mols of $Br_{2(g)}$ and 2 moles of $Cl_{2(g)}$ was recorded. If $K_{eq}=1.1 \times 10^{-2}$, what is the concentration of $2BrCl_{(g)}$ at equilibrium?

$$Br_{2(g)} + Cl_{2(g)} \rightleftharpoons 2BrCl_{(g)}$$

Propanoic acid is a weak acid. Calculate the pH of a 1.38 M solution of propanic acid, which has a Ka value of 1.3 x 10-3. The ionization of propanic acid is below.

$$CH_3CH_2COOH \rightleftharpoons CH_3CH_2COO^- + H_3O^+$$

Unit 5: Electrochemistry

Concepts

- Define oxidizing and reducing agent
- Describe a galvanic cell. In what directions do electrons flow?

Skills

- Be able to identify oxidizing and reducing agents.
- Be able to balance redox reactions.