This is a Class 1 exam

Lebanon Evangelical School for Boys and Girls

Loueizeh - Baabda

Stage Exam 06

13JUN2024 and 14JUN2024

Do NOT write in this box. Your MARK will be placed here.

Subject :	Chemistry
Class :	11S
Teacher :	Mrs. Mirella Freige
Duration :	1 hour

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Exercise 1

Identify the letter of the choice that best completes or answers the statement (1 point each)

1. The general formula of alkene is
   a) $C_n H_{2n+2}$
   b) $C_n H_{2n-2}$
   c) $C_n H_{2n}$
   d) None of the above

2. Which types of bond do alkenes have?
   a) Only single covalent bond
   b) Only double covalent bond
   c) Only triple covalent bond
   d) Single and double covalent bonds

3. Alkenes usually show
   a) Substitution reaction
   b) Addition reaction
   c) Superposition
   d) Elimination

4. How do you test for an alkene?
   a) They turn bromine water colorless
   b) They turn limewater cloudy
   c) They turn universal indicator purple
   d) All the above

5. The addition of chlorine molecule Cl_2 to propene gives
   a) 1,1-dichloropropane
   b) 1,2-dichloropropane
   c) 1,3-dichloropropane
   d) 2,3-dichloropropane

6. The addition of hydrogen chloride to 1- butene gives the major product
   a) 2-chlorobutane
   b) 1-chlorobutane
   c) 3-chlorobutane

7. The majority product from the addition of HCl on 2-methyl-2-pentene is:
   a) 1-chloro-2-methylpentane
   b) 2-chloro-2-methylpentane
   c) 3-chloro-2-methylpentane

Exercise 2 (6 points) **Law of definite proportions**

The quantitative analysis of a hydrocarbon shows that the percentage by mass of carbon is 83.3%.

1. Determine the percentage by mass of hydrogen.
2. Knowing that its molar mass is 72 g/mol, show that its molecular formula is C_5H_{12}.
3. Write the condensed structural formula of one of its isomers (A), whose main carbon chain has three carbon atoms. Name (A).
4. Write the condensed structural formula of one of its isomers (B), whose main carbon chain has five carbon atoms. Name (B).
5. Specify the type of isomerism that links (A) and (B).
6. The isomer (B) is chlorinated to produce a mono-chlorinated derivative.

Give the molecular formula of this chlorinated derivative, and write the condensed structural formula of two of its positional isomers.

Exercise 3 (3 points) **Sucrose**

Sucrose is naturally found in many plants, particularly in sugarcane and sugar beets. It is widely used as a sweetener in food and beverages, as well as in baking and cooking.

The combustion of 1 g of sucrose produces 1.544 g of carbon dioxide CO_2 and 0.579 g of water vapor H_2O.

1. Calculate the mass of carbon, hydrogen and oxygen present in this compound.
2. Deduce the percent mass composition of the compound.
3. Determine the molecular formula of sucrose knowing that its molar mass is equal to 342 g/mol.

Exercise 4 **Chemical Reactions**

1- Thermal cracking (2 points)

The octane brought to 500°C and in the presence of a suitable catalyst breaks to give among others, propene and an alkane (A).

Determine the molecular formula of (A), then write the equation for the breakdown reaction of octane using condensed structural formulas.

2- Addition reactions (5 points)

Complete the following equations using condensed structural formulas

2.1. Propene + ... → 1,2-dichloropropane

2.2. Propene + H_2O → .....(major product)

2.3. 2-butene + Cl_2 → .....

2.4. .....+ .....→ 2-methyl-2-propanol

2.5. 2-pentene + ... → pentane

3- Hydrogenation of alkenes (5 points)

Catalytic hydrogenation of an alkene (A) gives a compound (B) whose mass percentage in hydrogen is 17.2%.

3.1. Write the equation for the hydrogenation reaction using general formulas.

3.2. Show that the alkene has the molecular formula C_4H_8.

3.3. Write the three possible condensed structural formulas of (A), and give their names.

3.4. Write the two possible condensed structural formulas of (B), and give their names.

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Exercise 1 (1 point each)

1. c
2. d
3. b
4. a
5. b
6. a
7. b

Exercise 2

1. % by mass of H = 100 − %C = 100 − 83.3 = 16.7 %. (½)

2. M(Compound) = 72 g/mol. $C_x H_y$

According to the Law of definite proportions:

$$\frac{12x}{\%C} = \frac{y}{\%H} = \frac{M}{100} = \frac{72}{100} \quad (1/2)$$

$$\Rightarrow x = \frac{\%C \times 72}{12 \times 100} = \frac{83.3 \times 72}{1200} = 4.99 \simeq 5. \quad (1/2)$$

and $y = \frac{\%H \times 72}{100} = \frac{16.7 \times 72}{100} = 12.$ (½)

The molecular formula is C_5H_{12}.

3. $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$ (A) : dimethylpropane. (½) (½)

4. $CH_3-CH_2-CH_2-CH_2-CH_3$ (B) : pentane. (½) (½)

5. (A) and (B) are chain isomers. (1/2)

6. Molecular formula of the monochlorinated derivative:
$C_5H_{11}Cl$ (1/2)

$CH_3-CHCl-CH_2-CH_2-CH_3$ (1/2) ; $CH_2Cl-CH_2-CH_2-CH_2-CH_3$ (1/2)

Exercise 3 Sucrose. $C_xH_yO_z$

$m_{sucrose} = 1\,g$.

$m_{CO_2} = 1,544\,g$.

$m_{H_2O} = 0.579\,g$.

1. $m_C = \frac{3}{11} \times m_{CO_2} = \frac{3}{11} \times 1.544 = 0.4210\,g$. (1/4)

$m_H = \frac{1}{9} \times m_{H_2O} = \frac{1}{9} \times 0.579 = 0.0643\,g$. (1/4)

$m_O = m_{sucrose} - (m_C + m_H)$
$= 1 - (0.4210 + 0.0643)$
$m_O = 0.5147\,g$. (1/4)

2. $\%C = \frac{m_C}{m_{sucrose}} \times 100 = \frac{0.4210}{1} \times 100 = 42.10\%$. (1/4)

$\%H = \frac{m_H}{m_{sucrose}} \times 100 = \frac{0.0643}{1} \times 100 = 6.43\%$ (1/4)

$\%O = 100 - (42.10 + 6.43) = 51.47\%$. (1/4)

3. $M(Sucrose) = 342\,g/mol$.

Law of definite proportions:

$$\frac{12x}{\%C} = \frac{y}{\%H} = \frac{16z}{\%O} = \frac{M}{100}$$

$x = \frac{42.10 \times 342}{1200} = 11.99 \simeq 12.$ (1/2)

$y = \frac{6.43 \times 342}{1200} = 21.99 \simeq 22$ (1/2)

$z = \frac{51.47 \times 342}{1600} = 11.$ (1/2)

The molecular formula of sucrose is: $C_{12}H_{22}O_{11}$.

Exercise 4 Chemical Reactions

1- Thermal cracking

Octane $\longrightarrow$ propene + Alkane (A)

$C_8H_{18} \longrightarrow C_3H_6 + C_xH_y$

Law of conservation of mass; $8 = 3 + x \Rightarrow x = 5$.

(Number of atoms of each element is conserved) $18 = 6 + y \Rightarrow y = 12$. (1)

$CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3 \longrightarrow CH_2=CH-CH_3 + CH_3-CH_2-CH_2-CH_2-CH_3$

Propene pentane. (1)

2- Addition Reactions:

2.1. $CH_2=CH-CH_3 + Cl_2 \longrightarrow CH_2Cl-CHCl-CH_3$ (1)

2.2. $CH_2=CH-CH_3 + H_2O \longrightarrow CH_3-CHOH-CH_3$ (Major product) (1)

2.3. $CH_3-CH=CH-CH_3 + Cl_2 \longrightarrow CH_3-CHCl-CHCl-CH_3$ (1)

2.4. $CH_2=\underset{\underset{CH_3}{|}}{C}-CH_3 + H_2O \longrightarrow CH_3-\underset{\underset{CH_3}{|}}{COH}-CH_3$ (1)

2.5. $CH_3-CH=CH-CH_2-CH_3 + H_2 \longrightarrow CH_3-CH_2-CH_2-CH_2-CH_3$ (1)

3- Hydrogenation of Alkenes:

Alkene (A) + H_2 ⟶ Alkane (B)

C_nH_{2n} (A) + H_2 ⟶ C_nH_{2n+2} (B)

3.1. $C_nH_{2n} + H_2 \longrightarrow C_nH_{2n+2}$. (1)

3.2. C_nH_{2n+2} (B) % by mass of H = 17.2%.

$$\Rightarrow \frac{M(H)}{M(\text{Alkene})} \times 100 = 17.2\% \quad (1/2)$$

$$\Rightarrow \frac{2n+2}{12n+2n+2} \times 100 = 17.2$$

$$\Rightarrow \frac{(2n+2)}{14n+2} \times 100 = 17.2$$

$$\Rightarrow 200n + 200 = 17.2(14n+2)$$

$$\Rightarrow 40.8\,n = 165.6$$

$$\boxed{n = 4} \quad (1)$$

3.3. (A): C_4H_8 $CH_2=CH-CH_2-CH_3$ 1-butene (1/2)

$CH_3-CH=CH-CH_3$ 2-butene (1/2)

$CH_3-\underset{\underset{CH_3}{|}}{C}=CH_2$ methylpropene (1/2)

3.4 (B) C_4H_{10} $CH_3-CH_2-CH_2-CH_3$: butane (1/2) ; $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_3$: methylpropane. (1/2)