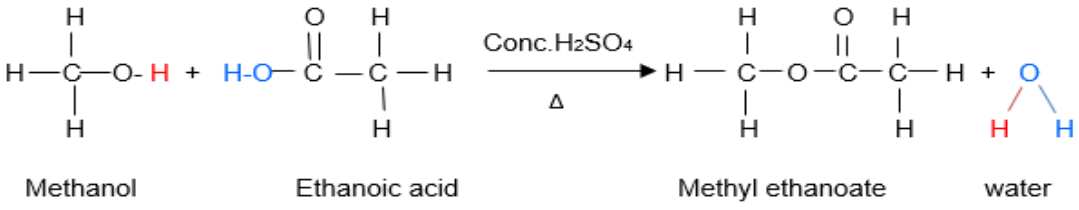
2020

ORGANIC REACTIONS

School EC

TERM 2

5/15/2020

NAME:
SCHOOL:
TEACHER:
ORGANIC REACTIONS: WORKSHEET 3
Organic Chemistry: Reactions and reaction conditions
Key Concepts / Information
Esterification, Combustion/oxidation reactions, Substitution reactions, Addition reactions , saturated compounds, unsaturated compounds
Background information
ESTERIFICATION REACTIONS
ESTERIFICATION: Reaction where **an alcohol** and a **carboxylic acid** are heated in the presence of concentrated sulphuric acid(H_2SO_4)
Alcohol + Carboxylic Acid ⟶ **Ester + water**
Example 
Reaction conditions: **Concentrated H_2SO_4** and **Heat** **NOTE!** Name of ESTER = **First part come from alcohol** + **Second part come from carboxylic acid**

ABOVE example: ALCOHOL + CARBOXYLIC ACID → ESTER

Methanol Ethanoic acid Methyl ethanoate

The part of C - chain attached to the O represent alcohol.

The part of C-chain attached to C = O part, represent the carboxylic acid side

Why do we use a water bath instead of direct heat? Because **ALCOHOL** is **HIGHLY FLAMMABLE**

COMBUSTION/OXIDATION REACTIONS

COMBUSTION /Oxidation reactions of Hydrocarbons (alkanes, alkenes, alkynes)

$$\text{Hydrocarbon} + O_2 \longrightarrow CO_2 + H_2O$$

example

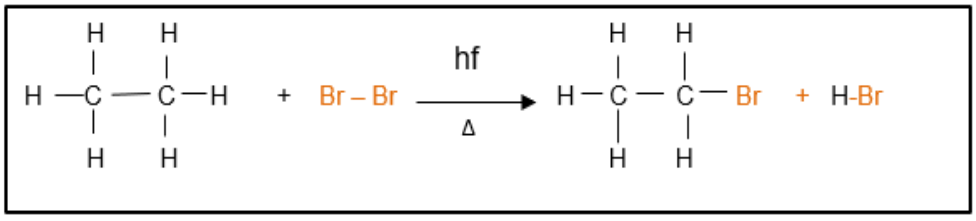
$$2\,C_3H_6 + 9\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$$

SUBSTITUTION REACTIONS

1. **Halogenation -replace a H with a halogen atom.**

Alkane + halogen $\xrightarrow{hf\ ,\ \Delta}$ **haloalkane + HX**

Example

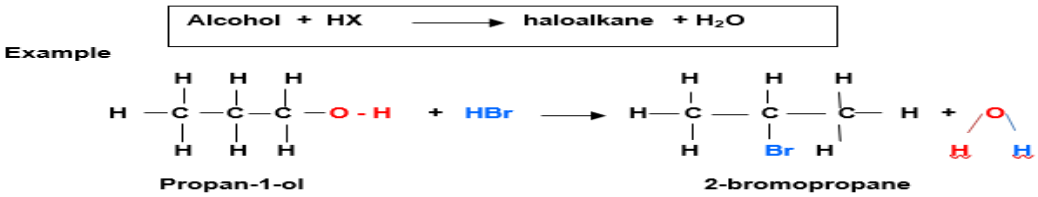


Reaction condition : Uv – light / sunlight / heat / hf / Δ

2. Hydrohalogenation – **replace -OH** with a **halogen atom.**

Reaction conditions: High temperatures

Example



ADDITION REACTIONS

ADDITION REACTIONS (UNSATURATED → SATURATED)

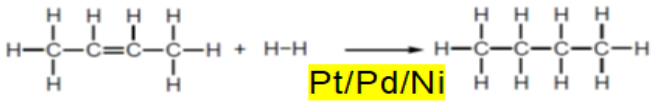
Addition reactions are reactions where atoms are added to an organic molecule.

The double bonds break open and the new atoms are added to the carbon atoms on either side of the double bond.

hydrogen (H_2), a **halogen** (Group 7 – e.g. Cl_2), a **Hydrogen halide** or **water H_2O** are added to **unsaturated hydrocarbons (alkenes).**

1. **Hydrogenation –** Addition of **hydrogen (H_2)**

Alkene + H_2 $\xrightarrow{Pt\ \Delta}$ **Alkane**



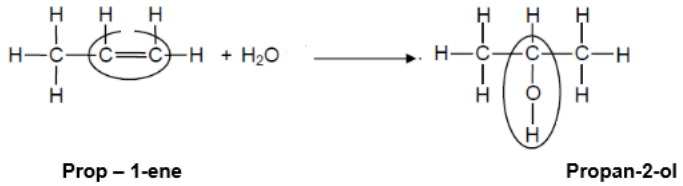
But-2-ene **Butane**

Reaction conditions: Needs **heat** and a **catalyst**(Platinum (Pt) / Nickel (Ni) / Paladium(Pd)

2. **Hydration** –Addition of water (H_2O)

Alkene + H_2O $\xrightarrow{\text{conc } H_2SO_4}$ **Alcohol**

Example



Reaction conditions needed for hydration.

- (**Excess) water** / H_2O in conc H_2SO_4 **OR** **Diluted** Sulphuric acid / H_2SO_4

What is the purpose of the acid(sulphuric acid/ phosphoric acid) in hydration?

- Acts as a catalyst.

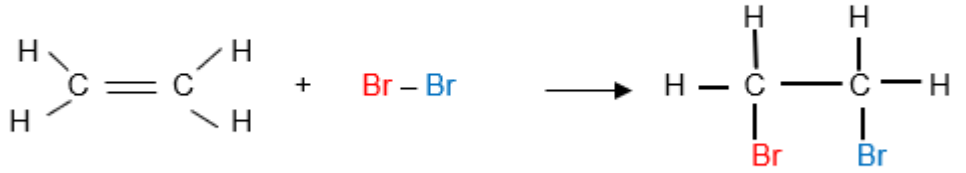
The **DOUBLE BOND** between C atoms split to form **A SINGLE BOND**. Each of these TWO C-atoms gain a BOND.

The H^+ will bond to the C atom with the **MOST H's** and the OH will bond with C with the LEAST H's.

3. Halogenation – Addition of two of the same halogen atoms eg. Cl_2 or Br_2

Example

Alkene + X_2 ⟶ Haloalkane



Ethene **1,2-dibromoethane**

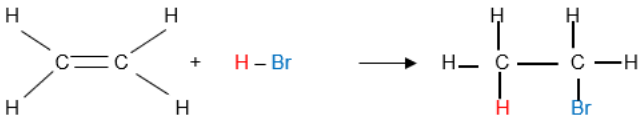
Reaction conditions: **NO water** and **NO catalyst** present

Halogenation – Addition of **two of the same halogen atoms** eg. Cl_2 or Br_2

4. **Hydrohalogenation –** Addition of a **halogen atom attached to a hydrogen atom**

Alkene + HX ⟶ Haloalkane

Example



Ethene **1-Bromoethane**

Reaction conditions: **NO water and NO catalyst** present.

PLASTICS AND POLYMERS

Concepts

Macromolecule: a **molecule** that consists of a **large number of atoms**

Polymer: a **large molecule** composed of **smaller monomer units covalently bonded** to each other in a **repeating pattern**

Monomer: **small organic molecules** that can be **covalently bonded** to each other in a **repeating pattern**

Polymerisation: a **chemical reaction** in which **monomer molecules join** to form a **polymer**

Plastics: **synthetic materials** derived from **organic compounds**

Industrial uses of Polyethene

Polyethene is used to manufacture

Plastic bags

Plastic Squeeze bottles

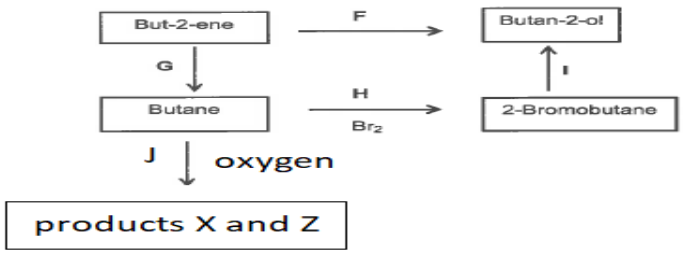
Cling wrap

Bullet Proof vests

Worked Example 1

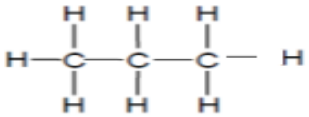
Fossil fuel is a general term for burried combustile geologic deposits of organic materials. These deposits are formed from decayed plants and animals that have been converted to crude oil, coal,natural gas, or heavy oils by exposure to heat and pressure in earths ‘s crust over hundreds of millions of years. Alkanes are the most important fossil fuels. Some countries like Canada produce 18.3 billion cubic feet of natural gas per day. Propane is produced as a by-product of two other processes, natural gas processing and petroleum refining. Propane is a cleaner-burning alternative fuel. Butane is another gaseous fuel derived from petroleum. The reactions that are undergone by propane are summarised in the flow diagram below.

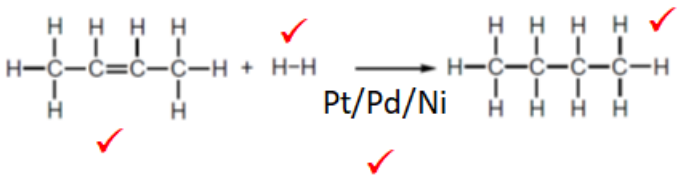
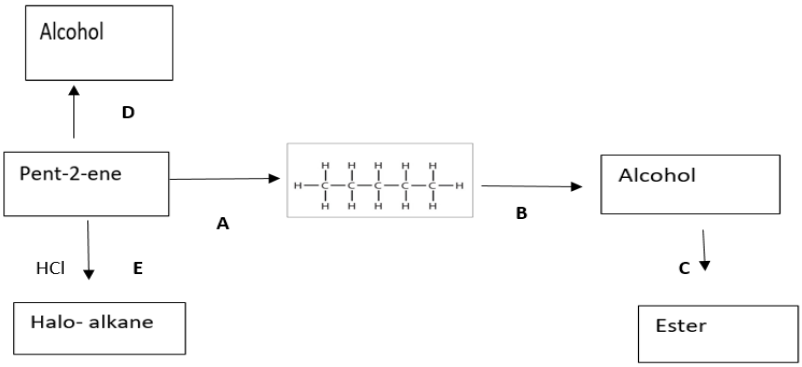
Refer to both the passage and flow diagram to answer questions that follow.



1.1		In which phase does butane occur at room temperature?	(1)
1.2		Draw the structural formula of propane	(2)
1.3		Give one important use of alkanes	(1)
1.4		Write down the type of reactions represented by	

	1.4.1	F	(1)
	1.4.2	G	(1)
	1.4.3	H	(1)
	1.4.4	I	(1)
	1.4.5	J	(1)
1.5		During reaction I, the haloalkane reacts in the presence a base to form alcohol.	
		Write down:	
	1.5.1	the **Name** of the suitable base used in the reaction.	(1)
	1.5.2	the reaction conditions required in required in the reaction.	(2)
	1.6	With the use of molecular formulae write down a balance chemical reaction for reaction **J**	(3)
2.1		Use structural formulae to write down the balanced chemical reaction for reaction **G**	
		Solutions to worked example 1	
1.1		Gas ✓	(1)

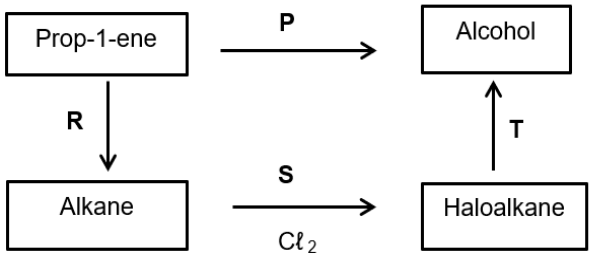
1.2		 ✓✓	(2)
1.3		Used as fossil fuels✓	(1)
	1.4.1	Addition -Hydration✓	(1)
	1.4.2	Addition- hydrogenation✓	(1)
	1.4.3	Substitution - halogenation✓	(1)
	1.4.4	Substitution - Hydrolysis✓	(1)
	1.4.5	Combustion/ oxidation✓	(1)
	1.5.1	Sodium hydroxide/Potassium hydroxide ✓ (Penalize if chemical formula is written).	(1)
	1.5.2	A dilute strong base✓ and **mild** heat ✓ (Penalize if only heat is written.)	(2)
	1.6	$2C_4H_{10} + 13O_2$ ✓ ⟶ $8CO_2$ ✓+ $10H_2O$ ✓	(3)
2.1			(4)

			
			[19]
ACTIVITIES			
ACTIVITY 1			
Consider the flow diagram below and answer questions that follow			
			
1.1		What type of reaction is represented by each of the following	
	1.1.1	A	(1)
	1.1.2	B	(1)
	1.1.3	C	(1)
	1.1.4	D	(1)

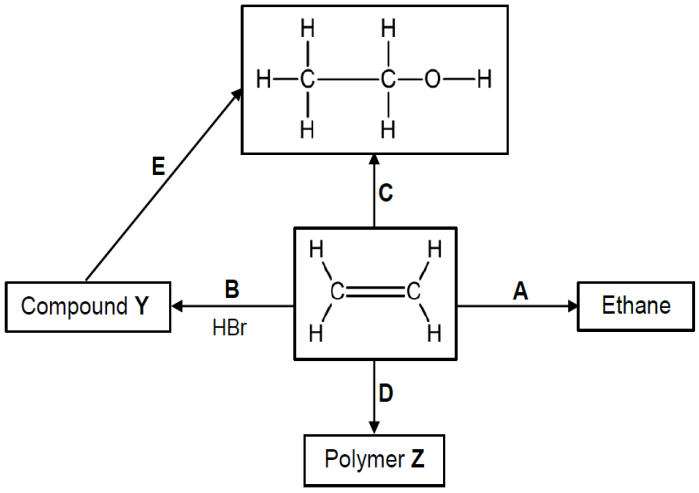
1.2		Both reaction B and D produce alcohol as the product through different reaction types..	
	1.2.1	Explain the difference in these reactions. Refer to **SATURATED/UNSATURATED** status of hydrocarbons, **REACTION TYPE(S)** in each reaction and **REACTION CONDITIONS** required	(3)
1.3		Give the IUPAC name of the alcohol (s) formed in reaction	
	1.3.1	D	(1)
	1.3.2	B	(1)
1.4		Draw the structural formula of halo-alkane formed in reaction E	(2)
	1.4.1	Is the haloalkane formed a major of a minor product?	(1)

1.5		Use structural formula to write down a balanced equation between methanoic acid and alcohol formed in reaction **B.** **NOTE: Both alcohol and carboxylic acid must be correctly oriented .**	(4)
	1.5.1	What type of alcohol is formed in reaction **D** **Write only primary/secondary/tertiary**	(1)
1.6		Write down the formula for the inorganic product formed in reaction C	(2)
1.7		What is type of reaction is reaction **C**?	(1)
2.1		Write down the reaction conditions for the following Reactions	
	2.1.1	**B**	(1)
	2.1.2	**C**	(1)
	2.1.3	**D**	(1)

	2.1.4	**E**	(1)
2.2		Write down one use of alcohols	(1)
			[25]
ACTIVITY 2			
		Fossil fuels are formed by the natural process of decomposition of organisms under heat and pressure. They contain a high percentage of carbon and include fuels such as coal, petrol and natural gases. Alkanes are the most important fossil fuel. The combustion of alkanes (also known as oxidation) is highly exothermic.	
2.1		Why alkanes are referred to as organic compounds?	(1)
2.2.		Write down the reaction condition for the complete combustion/oxidation of alkanes.	(1)
2.3		Write a balanced equation using molecular formulae to show the complete combustion reaction of propane	(3)

2.4		Prop-1-ene can be converted to other compounds by means of different organic reactions represented by **P**, **R**, **S** and **T**, as shown below.	
			
	2.4.1	Why propene is referred to as a hydrocarbon?	(1)
	2.4.2	Is propene as **saturated** or an **unsaturated** hydrocarbon?	(1)
	2.4.3	Explain your answer in 2.4.2	(1)
	2.5	Write down the TYPE of the reaction represented by:	
	2.5.1	**P**	(1)
	2.5.2	**S**	(1)
	2.5.3	**R**	(1)

2.6		Using structural formulae, write down a balanced equation for reaction **P.**	(3)
2.7		What are the reaction conditions for reaction **S**?	(1)
2.8		Write down the IUPAC name for	(1)
	2.8.1	the haloalkane formed in reaction **S**	(1)
	2.8.2	the alcohol formed in reaction T	(1)
2.9		Draw the structural formula for the alcohol mentioned **in 2.8.2** above.	(2)
			[20]

ACTIVITY 3			
The diagram below shows how ETHENE can be converted into other organic compounds. The letters **A, B, C, D** and **E** represent different organic reactions			
			
3.1		Reaction E and C produce an alcohol, classify the alcohol as **Primary/secondary/tertiary**.	(1)
3.2		Write down the **type** of reactions represented by	
	3.2.1	**C**	(1)
	3.2.2	**E**	(1)
3.3		Write down the type of addition reaction represented by:	
	3.3.1	**A**	(1)
	3.3.2	**B**	(1)

3.4		Consider reaction **A**. Write down the NAME or FORMULA of the:	
	3.4.1	Inorganic reactant needed	(1)
	3.4.2	Catalyst needed	(1)
3.5		Write down:	
	3.5.1	the **structural FORMULA** of the **functional group** of compound **Y**.	(2)
	3.2	The IUPAC name of compound **Y**.	(2)
	3.3	Two reaction conditions for reaction E	(2)
3.6		Use structural formulae to write down the balanced equation for reaction **C**.	(3)
3.7		Reaction **D** represents a Polymerisation reaction	
	3.7.1	Define Polymerisation	(2)

	3.7.1	Distinguish between a polymer and a monomer	(4)
3.8		Write down	
	3.8.1	the IUPAC name of the MONOMER used in reaction **D**.	(1)
	3.8.2	the IUPAC name of polymer **Z**	(1)
3.9		Define plastics	(2)
3.10		Give two industrial uses of Polyethene	(2)
			[29]

TOTAL [74] **YOUR TOTAL**