TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

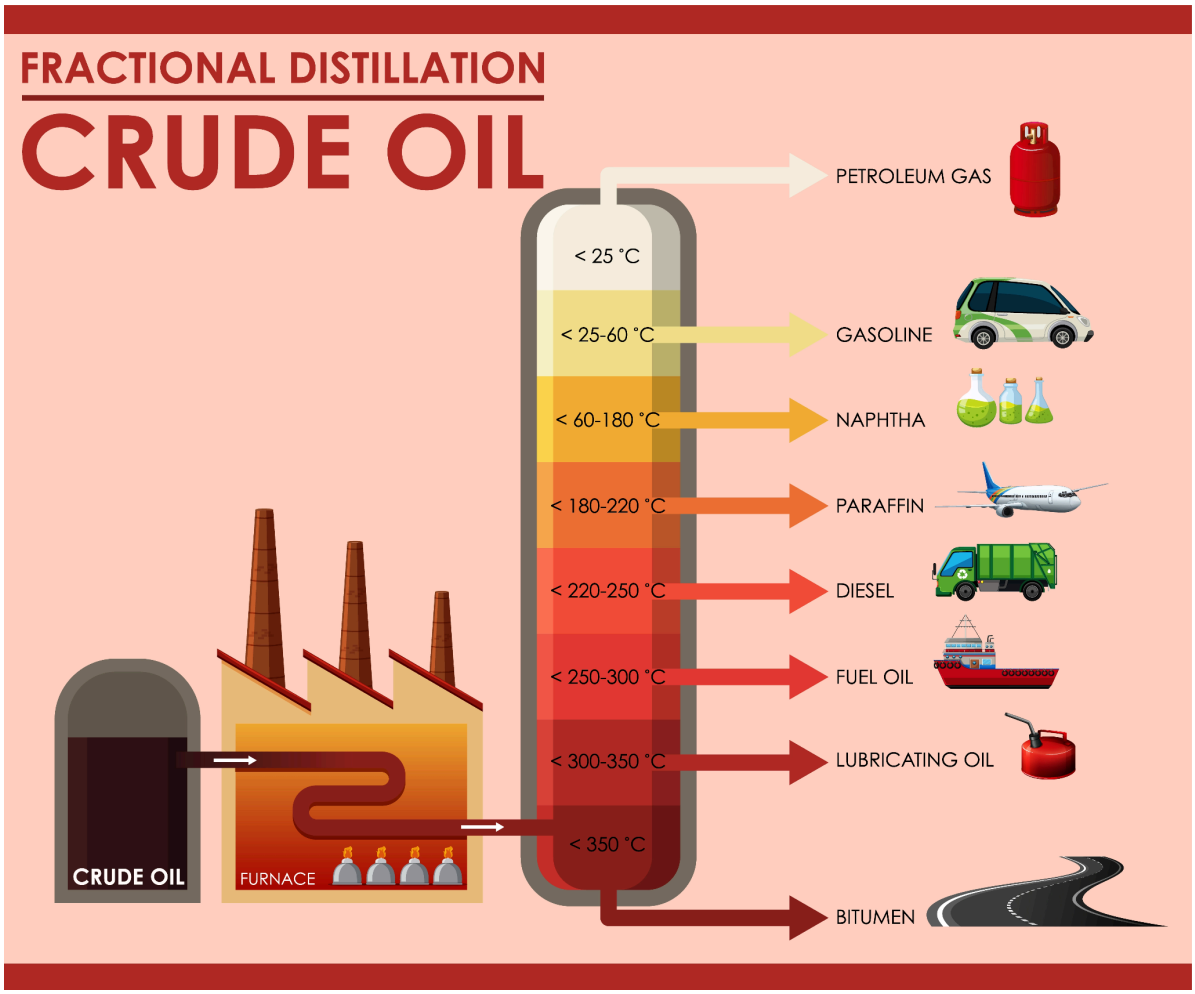
Pure Chemistry Intensive: Organic Chemistry

Fractional Distillation of Crude Oil / Petroleum

Process of Fractional Distillation of Crude Oil:

1. _____ the crude oil in the _____
2. Pass the vapour through the _____

(**Different boiling point allows crude oil to separate into different fractions.)



Fractions of Crude Oil	Uses
P _ _ _ _ _ _ _ _ _ _ _	Fuel for
P _ _ _ _ _	Fuel for
N _ _ _ _ _ _	
K _ _ _ _ _ _ _ / P _ _ _ _ _ _ _	Fuel for
D _ _ _ _ _ _ _ _	Fuel for
L _ _ _ _ _ _ _ _ _ _ _ _	
B _ _ _ _ _ _	

TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

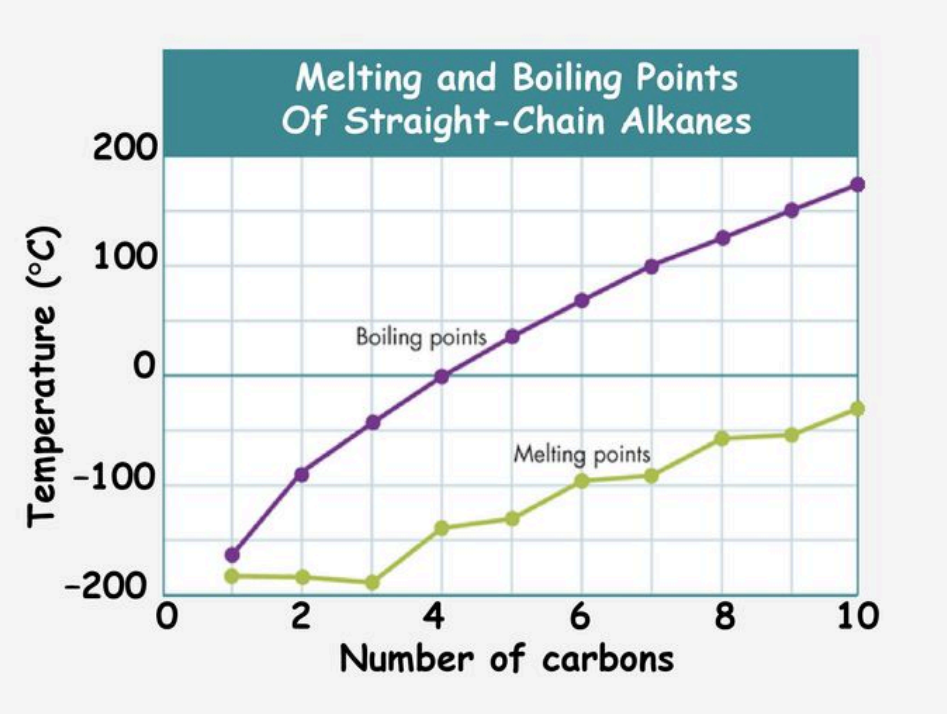
Understanding Organic Chemistry

Keywords	Definitions/ Remarks
Hydrocarbons	Molecules that are made up of _____ and _____ only.
Homologous Series	Family of organic compounds that have 1. the same _____ 2. the same _____ 3. Each consecutive members differ by _____

Physical Trends of Organic Compounds

As the number of carbon atoms increases,

Melting & boiling point _____	Intermolecular forces between molecules become stronger
Volatility _____	
Viscosity _____	
Flammability _____	Harder to achieve complete combustion
Density _____	More atoms are present per unit volume



TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Structures of Alkanes & Alkenes

	Alkanes	Alkenes
General Formula		
Functional Group		
1 Carbon (meth…)	Methane, CH_4	
2 Carbon (eth…)		
3 Carbon (prop…)		
4 Carbon (but…)		

Other Prefixes:

TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Keywords	**Definitions/ Remarks**
Unsaturated	
Isomers	Organic compounds with same _ _ _ _ _ _ _ _ _ formula but different _ _ _ _ _ _ _ _ _ _ formula

Isomers:

Isomers of butene		
Straight-chain:	Branched:	Cycloalkane:

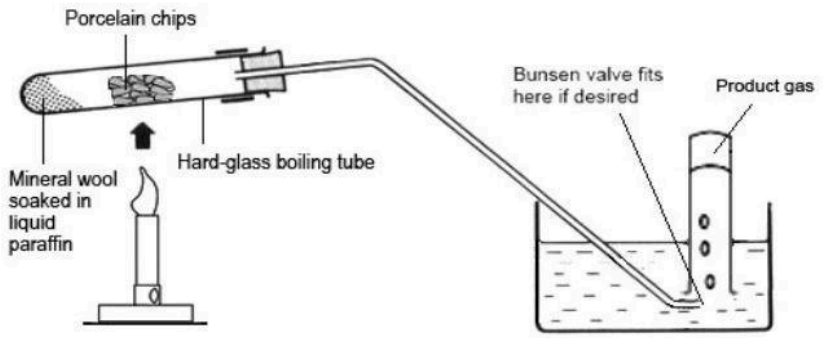
Isomers of pentene		
Straight-chain:	Branched:	Cycloalkane:

TUITION CLASS Pte Ltd (UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Reactions of Alkanes & Alkenes

Alkane Reaction	Equations & Remarks	Conditions
Combustion		
_ _ _ _ _ _ _ _ _ _ _ _ Reaction (Photochemical)	Structural Equation 1. Monochloromethane formed: $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ 2. _____ formed: $CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$ 3. _____ formed: $CH_2Cl_2 + Cl_2 \rightarrow CHCl_3 + HCl$ 4. _____ formed: $CH_3Cl + Cl_2 \rightarrow CCl_4 + HCl$ <u>Remarks:</u> 1. Forms CFCs (chlorofluorocarbons) that depletes ozone 2. Forms acid rain	
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	$C_{20}H_{42} \rightarrow$ ____ C_3H_6 + ____ C_2H_6  <u>Purpose:</u> 1. To crack large hydrocarbons (e.g. bitumen) into smaller more useful hydrocarbons (e.g. petrol) 2. To produce hydrogen	

TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

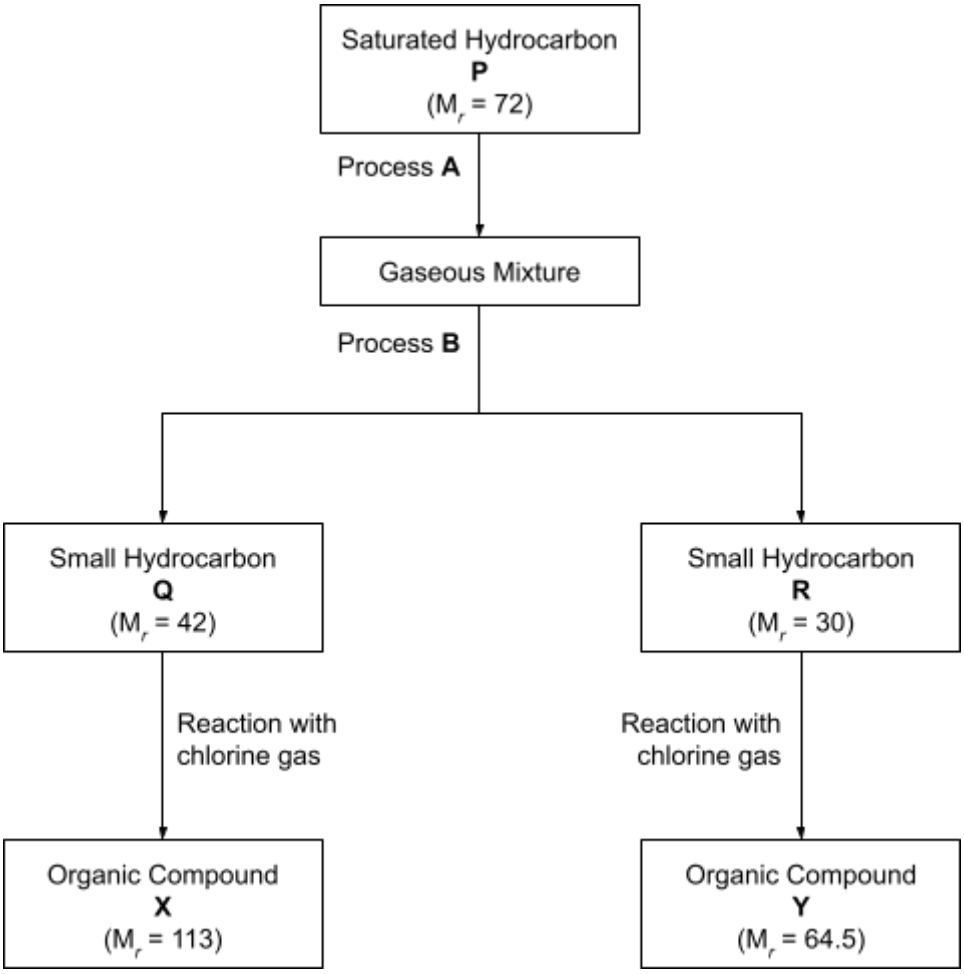
Addition Reactions: Reaction where small molecules react with _ _ _ _ _ _ _ _ _ _ _ organic molecules to form a _ _ _ _ _ _ product.

Alkene Reactions	Equations & Remarks	Conditions
_ _ _ _ _ _ _ _ _ _ _ _ (Halogenation)	$C_3H_6 + Br_2 \rightarrow$ _____ Structural Equation: Test for unsaturated substance (alkenes): - Add 2 to 3 drops of aqueous bromine - If _____ solution decolourises, substance is unsaturated. - If solution remains _____, substance is saturated.	
_ _ _ _ _ _ _ _ _ _ _ _ _	$C_2H_4 + H_2 \rightarrow$ _____ Structural Equation: Remarks: To form margarine (saturated) from vegetable oil (unsaturated)	
_ _ _ _ _ _ _ _ _	$C_3H_6 + H_2O \rightarrow$ _____ Structural Equation: Remarks: Formation of alcohol	

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Quick Exercise:



(a) State the conditions for process **A** to occur.

.....

(b) Name the process **B**.

.....

(c) Suggest which hydrocarbon, **Q** or **R**, undergoes hydration reaction to form alcohol.

.....

(d) Suggest two differences in the chlorine reaction with **Q** and **R**.

.....

.....

TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Structures of Alcohol & Carboxylic

	Alcohol	Carboxylic Acid
General Formula		
Functional Group		
1 Carbon (meth…)	Methanol, CH_3OH	
2 Carbon (eth…)		
3 Carbon (prop…)		
4 Carbon (but…)		

TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Alcohol & Carboxylic Acid Reaction

Reaction	Equations & Remarks	Conditions
_ _ _ _ _ _ _ _ _	$C_3H_7OH + 2[O] \rightarrow C_2H_5COOH + H_2O$ Structural Equation: *Recap redox reaction	
_ _ _ _ _ _ _ _ _ _ _ _ _ of glucose	_____ → _____ + _____ glucose → ethanol + carbon dioxide Set-up:	
Neutralisation of carboxylic acid	$NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$ sodium hydroxide + ethanoic acid → sodium ethanoate + water	

TUITION CLASS
Pte Ltd
(UEN: 202223967E)

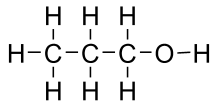
Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _	$CH_3OH + C_2H_5COOH \rightarrow$ _____ + H_2O Methanol + propanoic acid → _____ Structural formula of ester: Uses of esters:	

Quick Exercise:

1. Complete the table by writing the name, chemical formula and draw the structures of the organic substances.

Alcohol	Carboxylic Acid	Ester formed
Name: Formula: Structure: 	Name: Formula: HCOOH Structure:	Name: Propyl Methanoate Formula: Structure:
Name: Methanol Formula: Structure:	Name: Ethanoic acid Formula: Structure:	Name: Formula: Structure:
Name: Ethanol Formula: Structure:	Name: Ethanoic Acid Formula: Structure:	Name: Formula: Structure:

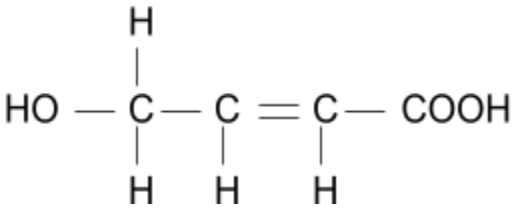
TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

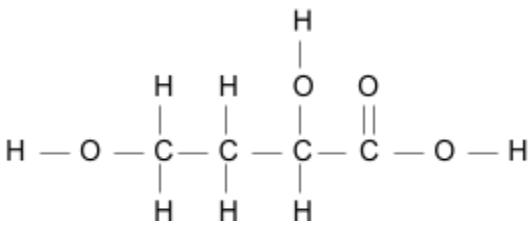
Pure Chemistry Intensive: Organic Chemistry

Quick Exercise

A complex organic compound **K** is as shown below:



Given the reactions and/or conditions provided, draw the full structural formula of the organic product that is formed.

Reaction Name	Conditions	Full structural formula
Bromination		
Oxidation		
	Nickel catalyst, 200 °C	
Esterification with methanoic acid		
		

TUITION CLASS Pte Ltd (UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Polymerisation: (Forming of _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ when monomers are reacted together.)

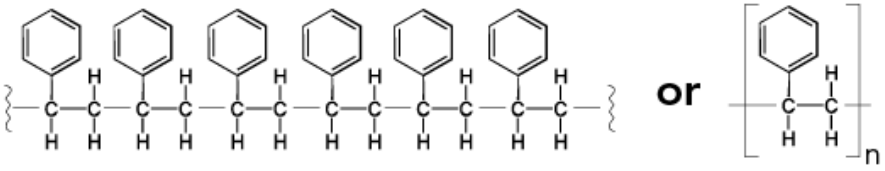
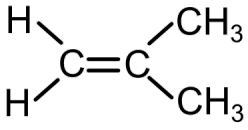
Addition Polymerisation

Occurs when monomer units are covalently bonded without losing any molecules (or atoms).

Monomers	Polymers (2-repeat units)	Uses
Ethene	Poly(ethene)	
Propene	Poly(propene)	
Chloroethene	_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ (PVC)	

Quick Exercise:

Complete the table to show the structural formula of the respective monomers & polymers.

Monomer	Polymer
	
	

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Condensation Polymerisation:

Occurs when monomers are covalently bonded to form a large molecule with the removal of small molecules like water.

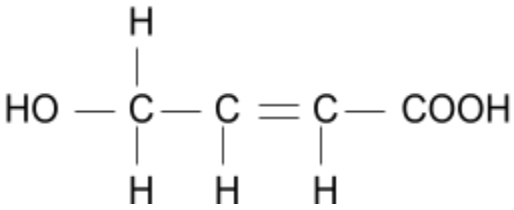
Monomers	Polymers (1-repeat unit)	Examples
Dicarboxylic acid Diol		Terylene (Synthetic fibre) - Clothing - Curtain - Fishing Line - Parachute - Sleeping bags Fats
Monomer with hydroxyl group and carboxyl group		
Dicarboxylic acid Diamine	Polyamide	Nylon (Synthetic fibre) - Clothing - Curtain - Fishing Line - Parachute - Sleeping bags Proteins
Monomer with hydroxyl group and carboxyl group		

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Quick Exercise:

A complex organic compound **K** is as shown below:



(a) Draw a polymer with 2-repeat units when compound **K** undergoes addition polymerisation

(b) Draw a polymer with 2-repeat units when compound **K** undergoes condensation polymerisation

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Addition Polymerisation	Condensation Polymerisation
No _ _ - _ _ _ _ _ _ _ _	_ _ - _ _ _ _ _ _ _ _ produced (e.g. H_2O or HCl)
Only 1 functional group required (_ _ _ _ _ _ - _ _ _ _ _ _ _ _ _ _ _ _ bond)	2 functional groups are required
Empirical formula is the same for both monomers and polymer	Empirical formula is not the same for monomers and polymers
Monomers are unsaturated	Monomers might not be unsaturated

Advantages of Polymers (Plastics):

1. Durable and long lasting
2. Cheap
3. Easily moulded into various shapes
4. Waterproof

Disadvantages of Polymers (Plastics):

1. Non-biodegradable (occupies space and causes land pollution)
2. Burning of polymers release toxic gases

TUITION CLASS
Pte Ltd
(UEN: 202223967E)

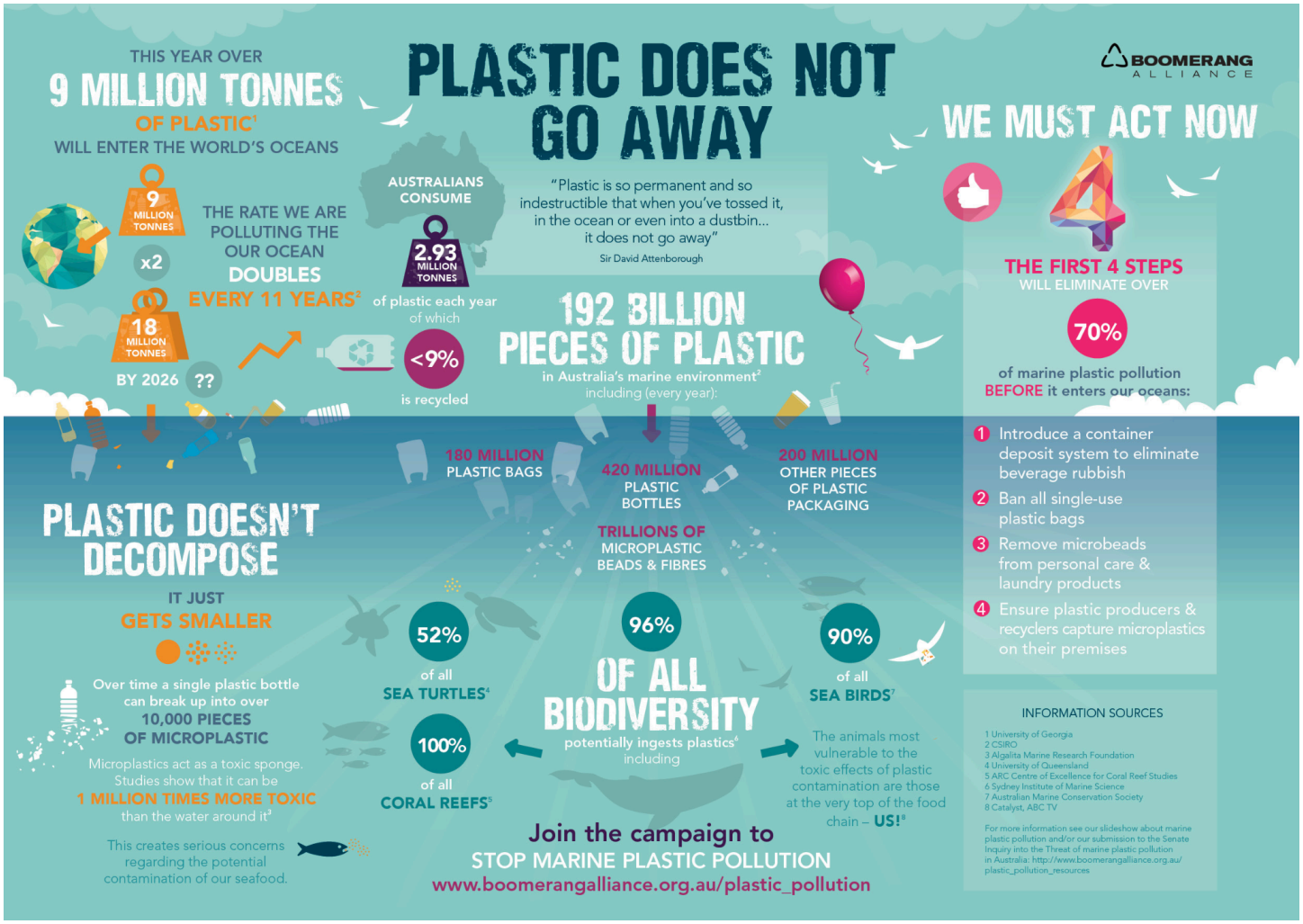
Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Plastics

Keywords	Definitions/ Remarks
Non-biodegradable	A substance that cannot be broken down by the action of living organisms. - Cannot decay naturally - Cannot decay in a way that is not harmful to the environment

Pollution Problems:



Effects on Biodiversity

Effects on Human Health

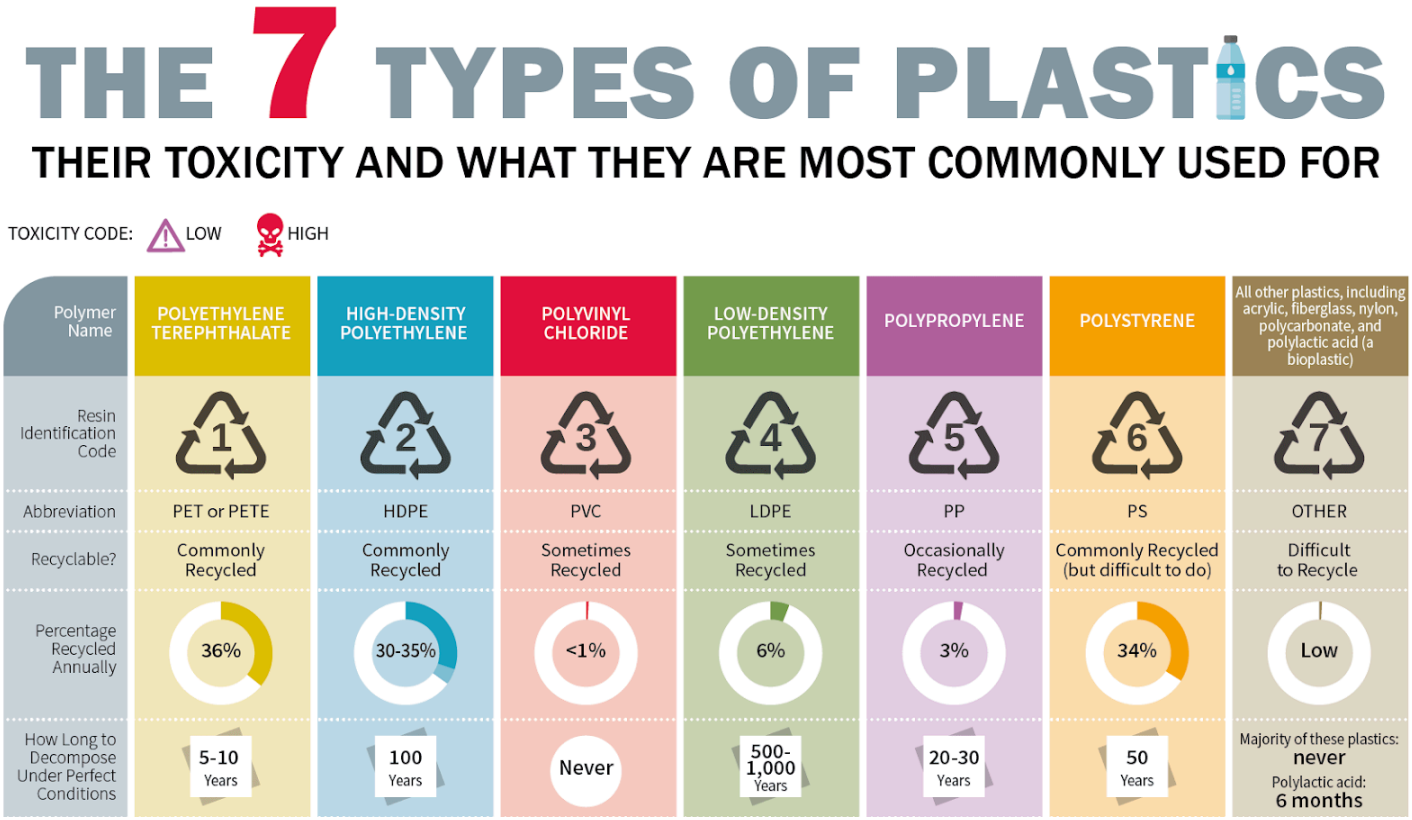
TUITION CLASS
Pte Ltd
(UEN: 202223967E)

Address: Primz Bizhub Tel: 9225 5217 / 8892 8513 Email: tuitionclass.primz@gmail.com

Pure Chemistry Intensive: Organic Chemistry

Physical Methods to Recycle Plastics:

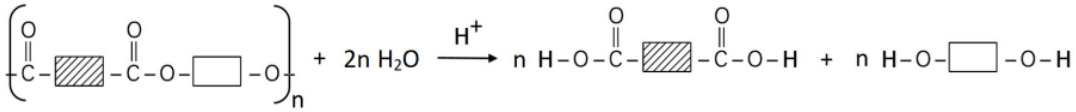
Steps	Details & Remarks
Collection	Plastics are collected
Sorting	Plastics are sorted based on their respective RIC (Resin Identification Code) and colours. (*Only RIC 1, 2, 4 and 5 are recyclable.)
Washing	Plastics are washed & cleaned. Debris & Contaminants are removed.
Grinding	Plastics are crushed & shredded into flakes. Some are melted into pellets.
Manufacture	Flakes or pellets are melted and moulded into new products.



Top 5 Challenges in Plastics Recycling – Seastainable

Pure Chemistry Intensive: Organic Chemistry

Chemical Methods to Recycle Plastics:

Depolymerisation (Hydrolysis)	Hydrolysis process in which polymers (i.e. polyesters) are broken down into their monomers using acid as a catalyst.  Method only applies to condensation polymers (polyesters & polyamide)
Cracking (Pyrolysis)	Process where polymers are heated in the absence of air at high temperatures and breaking it down to smaller hydrocarbon molecules. Smaller hydrocarbons are separated by fractional distillation and used to make fuels & chemical feedstock.
Extra: Feedstock Recycling	Any thermal process that converts polymers into simpler molecules to form petrochemical-type processing (e.g. pyrolysis & gasification)

Challenges/Limitations in Plastic Recycling:

Economic	- Recycling facilities require high capital and technical capability with government support. - Cooperation from organisations to use easily-recyclable plastics may be difficult (due to cost, etc.)
Social	- Difficulties in sorting: Not all plastics are recyclable, many products are made from multiple materials (e.g. phone is made from different plastics, metals and other materials such as silicon) - Education required for the public in plastic recycling efforts.
Environmental	- Plastic production far exceeds recycling rates resulting in plastic landfills. - Microplastics contamination cannot be eliminated with recycling efforts.