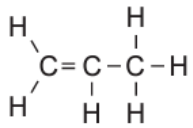
**AS 91165**

**Demonstrate understanding of the properties of selected organic compounds**

**Collated Polymer questions**

**(2023:3)**

Polypropene is the polymer used to make the web-like filters in most N95 and loose-fitting surgical face masks. While filtering out most microbes, air can still pass through. Polypropene is made through the addition polymerisation of the prop-1-ene monomer, shown opposite.


prop-1-ene

(a) (i) Draw three repeating units of the polypropene polymer.

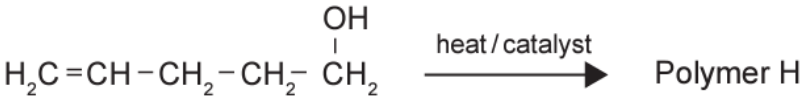
(ii) Explain why this is classified as addition polymerisation.

(iii) Polypropene is a relatively chemically inert (unreactive) substance. Compare the reactivity of polypropene with its monomer. In your answer you should:

- link the structure of the monomer to its reactivity
- outline why polypropene's lower reactivity makes it appropriate for use in face masks.

**(2022:2)**

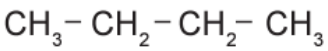
(b) Compound B is able to form Polymer H, as shown below.

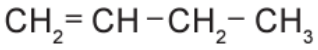



**Compound B**

(i) Draw TWO repeating units of Polymer H.

(ii) Compound A cannot undergo addition polymerisation.


**Compound A**


**Compound F**

Explain the differences in both the structure and reactivity of Compounds A and F to account for this. In your answer you should:

- explain the term addition polymerisation
- identify any differences in the structures of Compounds A and F and link this to the difference in reactivity discussed above.

**(2021:2)**

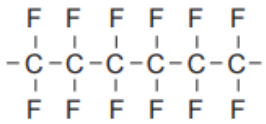
(b) Compound F can undergo addition polymerisation reactions.


**Compound F**

(i) Draw THREE repeat units of the polymer formed from Compound F.

**(2020:2)**

(a) A section of the Teflon polymer chain is shown below. Teflon is best known for its use in coating non-stick frying pans and other cookware.



(i) Draw and name the structure of the monomer used to make this polymer.

(ii) The chemical reactivity of the monomer and polymer are different.

Analyse this difference.

In your answer you should:

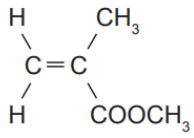
- link the structure of the monomer and polymer to its reactivity
- explain the importance of this difference for Teflon's use as a polymer.

**(2019)**

No question asked

**(2018:1)**

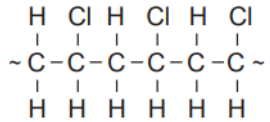
(c) Perspex® is a polymer used as an alternative to glass as it is transparent, lightweight, and shatter resistant. It can be made from the monomer shown below.



(i) Draw THREE repeating units of the polymer formed.

**(2017)**

(a) Polyvinyl chloride (polychloroethene) is often used to make artificial leather. This can then be used to cover chairs, cover car seats, and make clothing. A section of a polyvinyl chloride molecule is shown below.



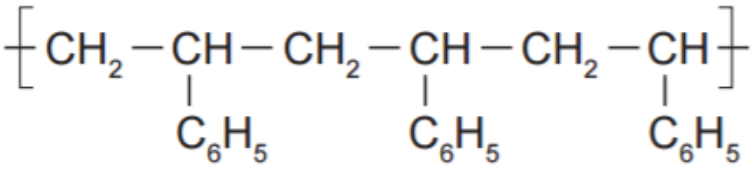
(i) Draw the monomer from which the polymer polyvinyl chloride would be made.

(ii) Explain the difference in the structures and chemical reactivity of the monomer and polymer, and why the difference is important for the uses of the polymer.

(iii) Making polyvinyl chloride (polychloroethene) from its monomer is called 'addition polymerisation'. Explain the term 'addition polymerisation' using polyvinyl chloride as an example. Include an equation in your answer.

**(2016)**

(b) Polystyrene is a polymer with the structure:



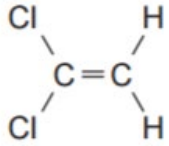
(i) Draw the monomer used to make the polymer polystyrene.

(ii) Explain why the formation of polystyrene from its monomer is classified as an addition polymerisation reaction.

(iii) Making polyvinyl chloride (polychloroethene) from its monomer is called 'addition polymerisation'. Explain the term 'addition polymerisation' using polyvinyl chloride as an example. Include an equation in your answer.

**(2015)**

Cling Wrap is a polymer that can be made from the monomer 1,1-dichloroethene.


1,1-dichloroethene

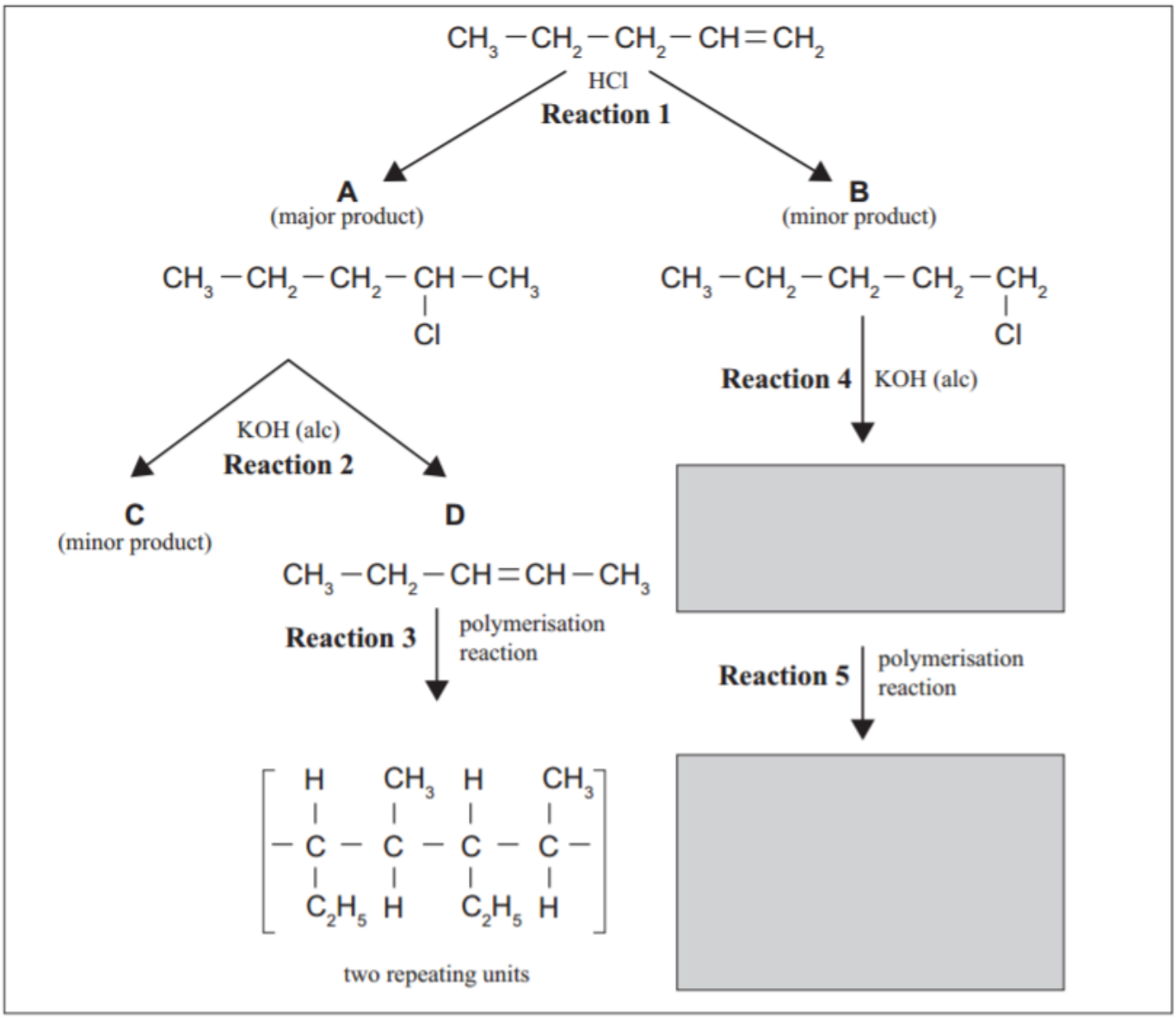
(a) (i) Draw THREE repeating units of the polymer formed.

**(2014)**

(c) (i) Draw TWO repeating units of the polymer formed in Reaction 5.

(ii) Compare and contrast the polymer formed in Reaction 5 to the polymer formed in Reaction 3. In your answer you should explain why the polymers formed in these two reactions are different.

A reaction scheme is shown below.

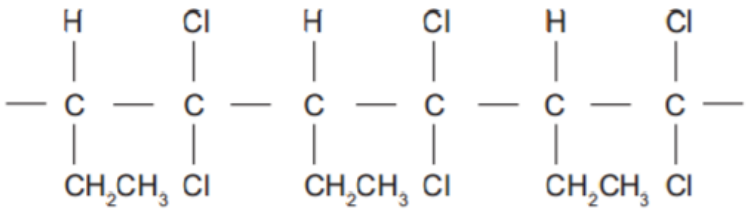



**(2013)**

(a) (i) The molecule tetrafluoroethene, shown below, is the monomer for the polymer commonly known as Teflon. $CF_2=CF_2$

Draw TWO repeating units for the Teflon polymer.

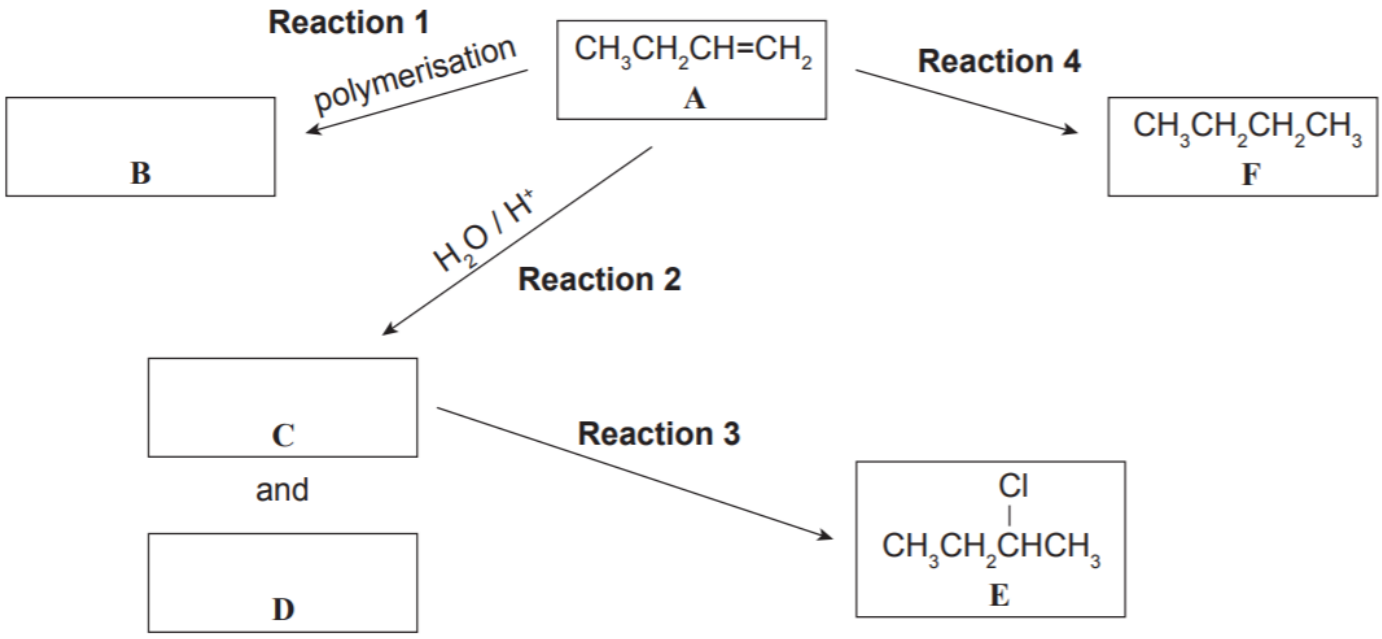
(ii) The following diagram shows three repeating sections of another polymer.



Draw the structural formula of the monomer molecule used to make this polymer.

**(2012)**

But-1-ene is used in the reaction sequence shown below.

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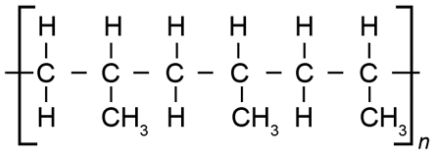
(a) (i) Draw two repeating units of the polymer, B, formed in Reaction 1.

**Collated Polymer questions - answers**

**(2023:3)**

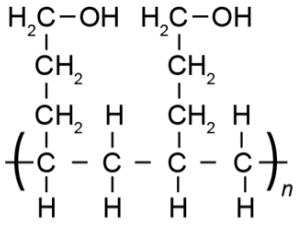
(i)  *Square brackets and the 'n' are probably not essential.*

(ii) The double bond in each propene unit is broken leaving a single C–C bond and enabling two new single C–C bonds to form between monomer units, therefore connecting many of the monomers into long repeating polymer chains.

(iii) Polypropene is a saturated molecule containing only single C–C bonds, which are much less reactive compared to the unsaturated double C=C bond present in each propene unit. The unreactive nature of this polymer means it is a suitable material for use in a face mask, as it will not react with moisture / water in breath or oils in the skin.

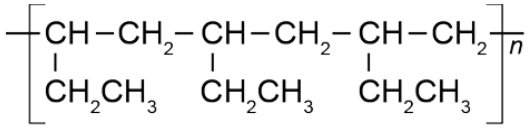
**(2022:2)**

(b) (i)



**(2021:2)**

(b) (i)



(ii) In an addition polymerisation reaction, C=C double bonds are broken in order for new bonds to form between monomers as they link into long repeating chains called polymers. Compound F is unsaturated, as it contains a reactive C=C double bond, and is therefore able to undergo this reaction type. Compound A is saturated, so only contains unreactive C–C single bonds, and therefore is unable to undergo this type of polymerisation.

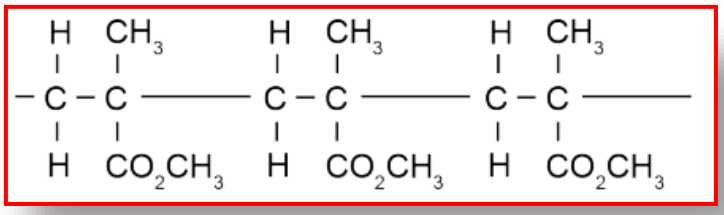
**(2020:2)**

(a) (i) $CF_2=CF_2$ 1.1.2.2-tetrafluoroethane

(ii) Each monomer contains a reactive double bond between the two carbons. The polymer has only single carbon-carbon bonds, which are not as reactive. Therefore, the polymer is less reactive, which is important when cooking using Teflon cookware, as it won't react with any food or liquid or ability to withstand heat whilst cooking.

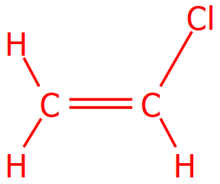
**(2018:1)**

(c) (i)



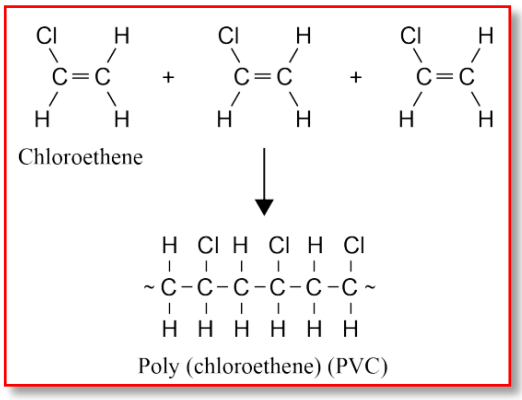
**(2017)**

(a) (i)



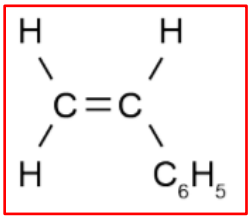
(i) Each monomer contains a reactive double bond, the polymer has none in its structure. Therefore, the polymer is less chemically active than the monomer (or discusses physical property such as melting point). This means polymers are less reactive, so they can be used in many ways such as seat covers or clothing because they do not react with water.

(ii) Addition reactions involve two (or more in the case of the polymers) molecules combining to make one molecule. An addition reaction occurs when double bonds are broken to form a single C–C bond, and two new single covalent bonds. In addition polymerisation, the monomers, chloroethene / vinyl chloride join in a long chain polymer, polyvinyl chloride, as the double bonds break and the C-atoms from each monomer are able to bond to C-atoms in other monomers




**(2016)**

(b) (i)

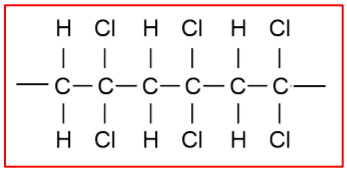


(ii) Since the monomer for this reaction, styrene, is an alkene, when polymerisation occurs, the double bond in each styrene molecule is broken, freeing up a bonding space on each

of the C atoms that was part of the double bond. This allows the monomers to join together by forming covalent bonds to make polystyrene. Since double bonds in styrene are being broken and molecules added into the freed-up bonding spaces to make polystyrene, this is an addition reaction. Polymerisation reactions occur when many monomers are chemically joined.

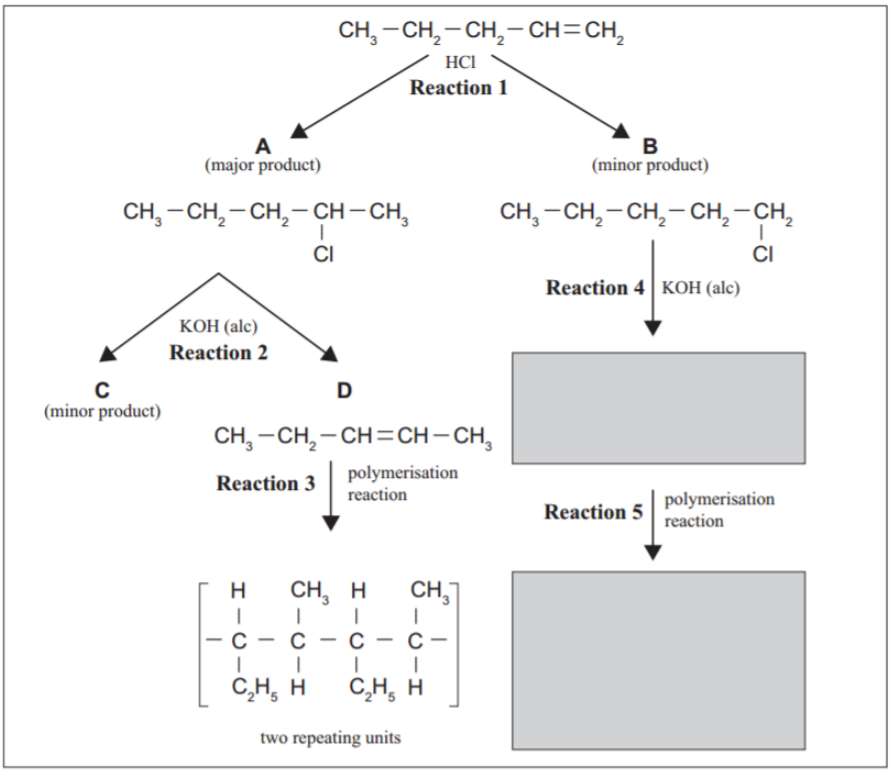
**(2015)**

(a) (i)

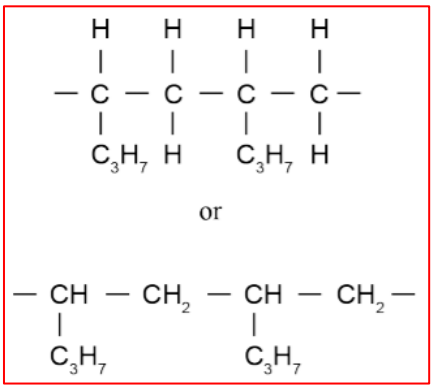


**(2014)**

A reaction scheme is shown below.



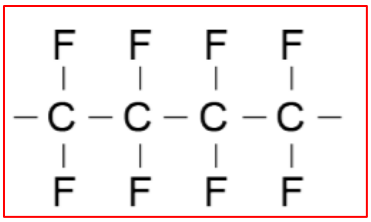

(c) (i)



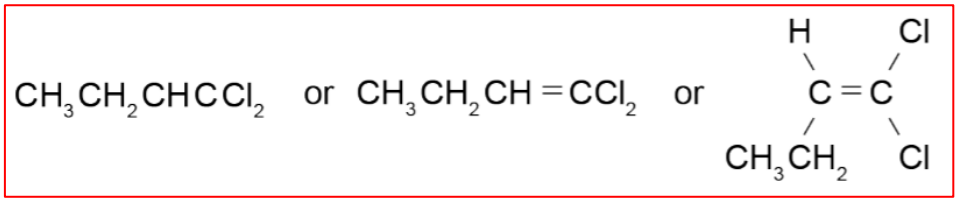
**(iii)** The molecular formulae of the two repeating units of both polymers are the same, but the structural formulae are different. OR States repeating units are structural isomers. Addition polymerisation occurs when the C=C breaks and the carbon atoms in this double bond join to each other from adjacent molecules to form long chains. In Reaction 3, the polymer formed will have a carbon with one hydrogen and a methyl group, and a carbon with one hydrogen and an ethyl group, as its repeating unit, due to the double bond being on the C2 position. In Reaction 5, since the double bond is in a different position (the C1 position), the polymer formed will have as its repeating unit a carbon atom with 2 hydrogen atoms attached, and a carbon atom with one hydrogen attached and a propyl group attached.

**(2013)**

(a) (i)



(ii)




**(2012)**

(a) (i)