# National 5 Chemistry
# Unit 3.2 Plastics

| Lesson | Traffic Light | | |
|---|---|---|---|
| | Red | Amber | Green |

24 25 26

Plastics are examples of materials known as polymers.

- Polymers are long chain molecules formed by joining together a large number of small molecules called monomers.
- Addition polymerisation is the name given to a chemical reaction in which unsaturated monomers are joined, forming a polymer.

| Name | Definition |
|---|---|
| monomer | Small molecules which join together to form polymers |
| polymer | The long chain molecule made by the joining up of monomers |
| polymerisation | The process where monomers join together to form polymers |

27

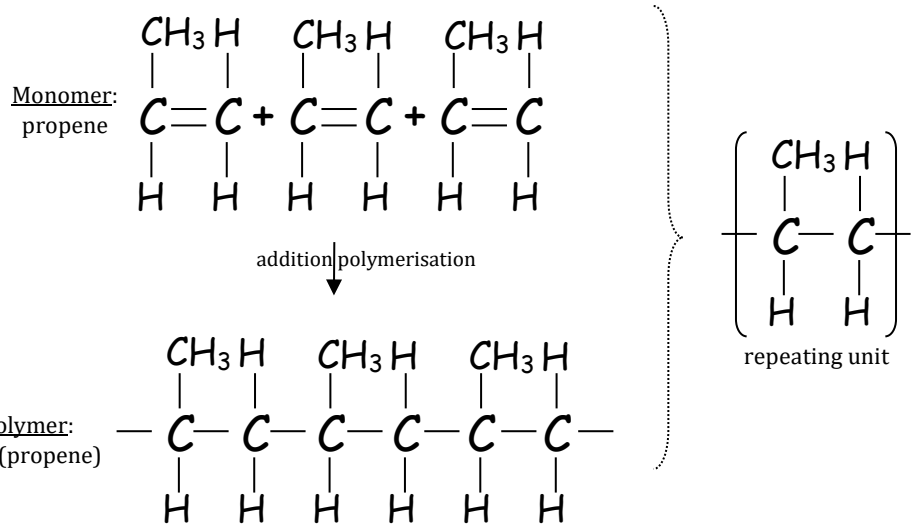
The name of the addition polymer is related to the name of the monomer:

| Monomer | ethene | styrene | propene | chloroethene |
|---|---|---|---|---|
| Polymer | poly(ethene) | poly(styrene) | poly(propene) | poly(chloroethene) |

28 29 30

The structure of a polymer can be drawn given either the structure of the monomer or the repeating unit

- A repeating unit is the shortest section of polymer chain which, if repeated, would yield the complete polymer chain (except for the end-groups)
- From the structure of a polymer, the monomer or repeating unit can be drawn.



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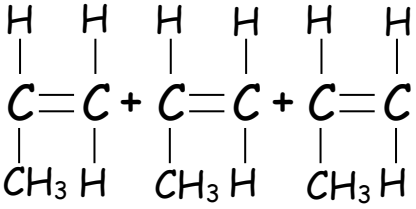
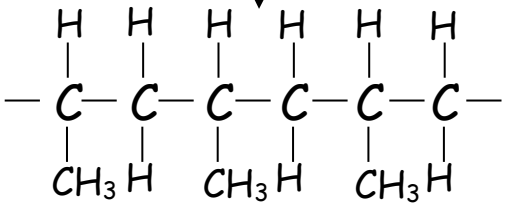
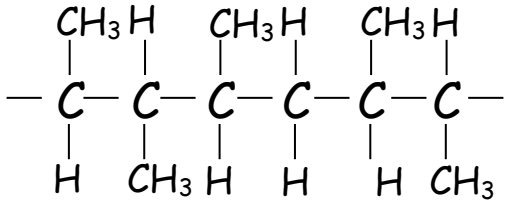
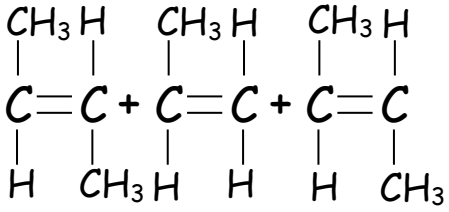
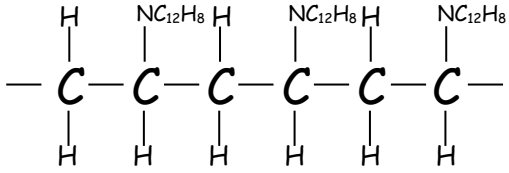
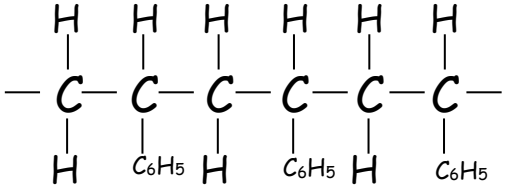
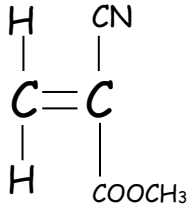
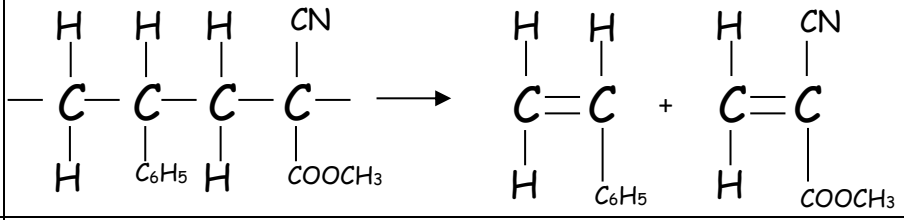
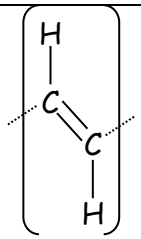
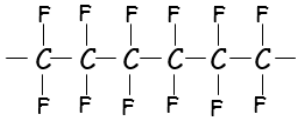
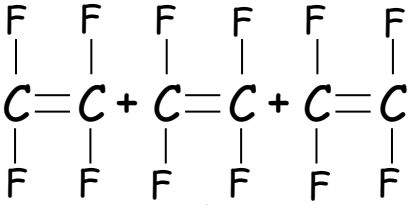
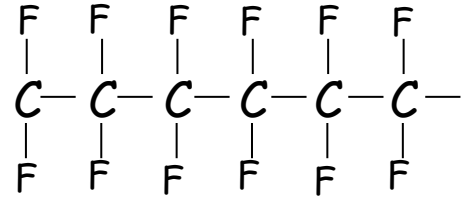
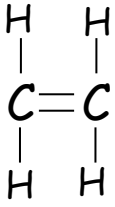
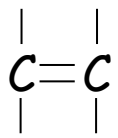
# Past Paper Question Bank
## Unit 3.2 Plastics

JABchem

| Outcome | Original Specimen Paper | New Specimen Paper | Nat5 2014 | Nat5 2015 | Nat5 2016 | Nat5 2017 | Nat5 2018 | Nat5 2019 | Nat5 2020 | Nat5 2021 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24<br>25<br>26 | | | L4b | | | L13b(ii) | L2a(i) | | | | | | | | | |
| 27 | | | | | | | | | | | | | | | | |
| 28<br>29<br>30 | mc20 | mc21 | L4a | mc17 | L2a<br>L2b | L13b(i) | L2a(i)<br>L2b | mc20 | | | | | | | | |

| MC Qu | Answer | % Correct | Reasoning |
|---|---|---|---|
| 2015<br>MC<br>17 | A | 79 | propene  poly(propene)  |
| 2019<br>MC<br>20 | C | - | polymer  Two different monomers  but-2-ene propene but-2-ene |

<table>
<tr><th>Nat5</th><th>Answer</th><th>Reasoning</th></tr>
<tr><td>2014<br>4a</td><td>Diagram Showing:</td><td>  </td></tr>
<tr><td>2014<br>4b</td><td>Addition</td><td>
<table>
<tr><th>Polymerisation</th><th>Description</th></tr>
<tr><td>Addition</td><td>C=C double bonds in monomers join together to form a long chain of C-C single bonds.</td></tr>
<tr><td>Condensation</td><td>Water molecules are removed as monomers join together to make larger polymer.</td></tr>
</table>
</td></tr>
<tr><td>2016<br>2a</td><td>Diagram showing:</td><td>  </td></tr>
<tr><td>2016<br>2b</td><td>  </td><td>  </td></tr>
<tr><td>2017<br>13b(i)</td><td>  </td><td>The repeating units can be joined together and when the brackets are removed the original polymer is drawn.</td></tr>
<tr><td>2017<br>13b(ii)</td><td>Addition</td><td>Addition polymerisation usually involves a C=C double bond opening up to leave a C-C single bond as the monomers join together to form the polymer.<br>The C≡C triple bond in ethyne opens up to leave a C=C double bond as the monomers join together to form the polymer poly(ethyne)</td></tr>
<tr><td>2018<br>2a(i)</td><td>addition</td><td>Addition reactions involve the opening up of the 2nd bond in a C=C double bond and single bonds being formed on either side. Addition Polymerisation is when the C=C double bond in the monomer opens up and joins with other monomers to form a long polymer chain.</td></tr>
<tr><td>2018<br>2a(ii)</td><td>  </td><td>tetrafluoroethene  <br>Addition polymerisation<br>poly(tetrafluoroethene)  </td></tr>
<tr><td>2018<br>2b</td><td>  </td><td>A addition monomer always has the shape:  <br>The monomer given in the question has four fluorine atoms in its corners. The other monomer has four hydrogen atoms in its corners.</td></tr>
</table>

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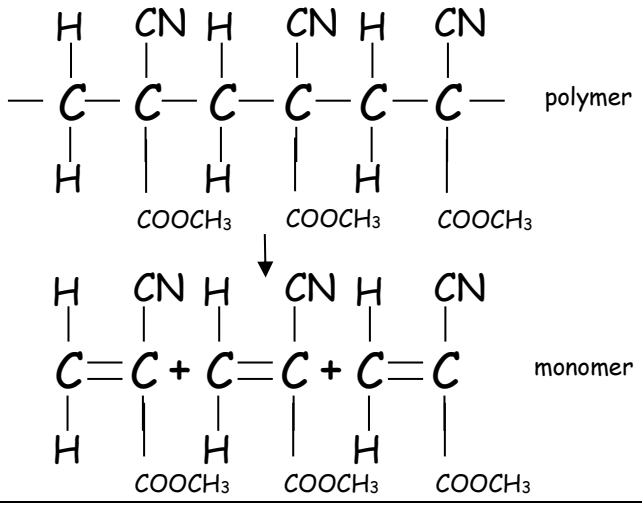
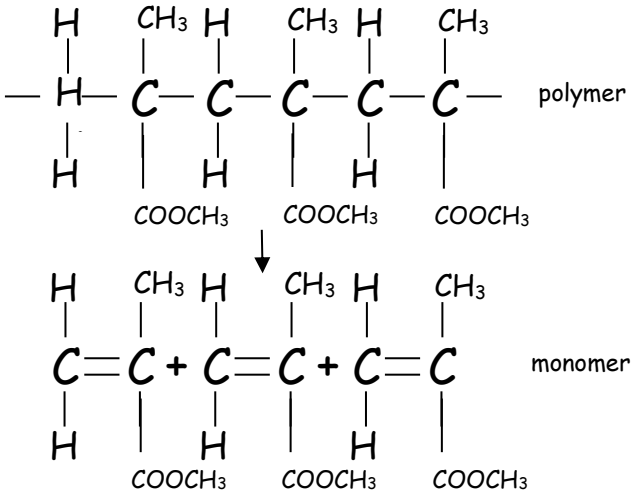
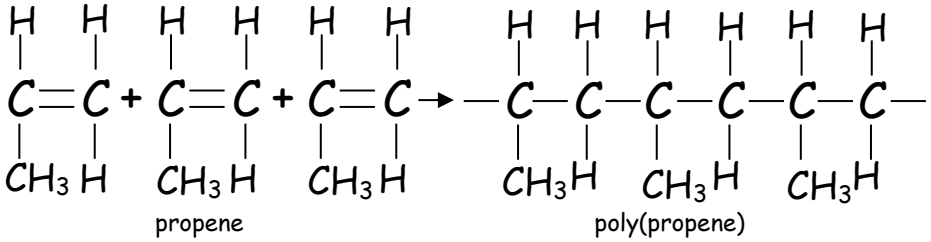
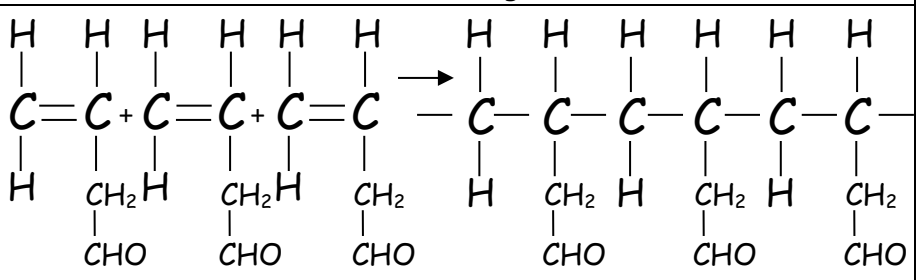
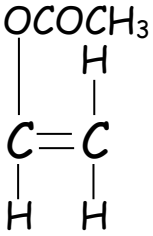
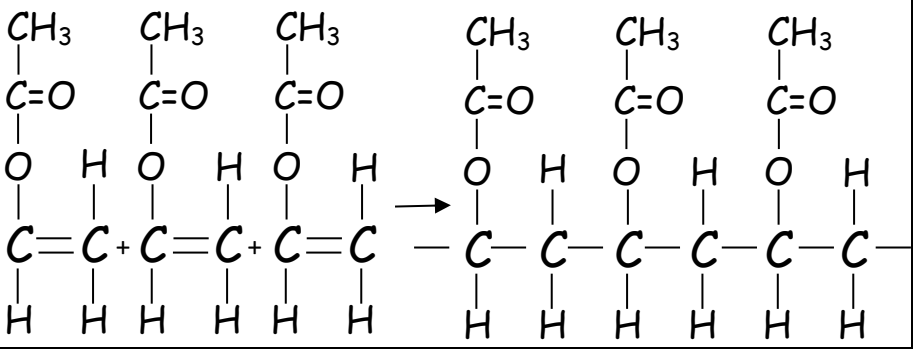
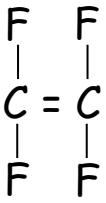
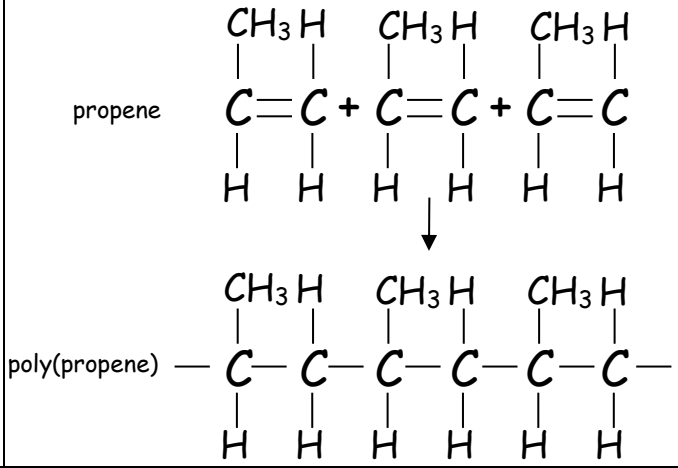
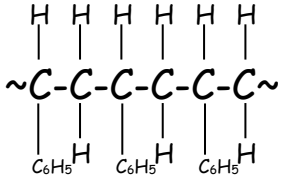
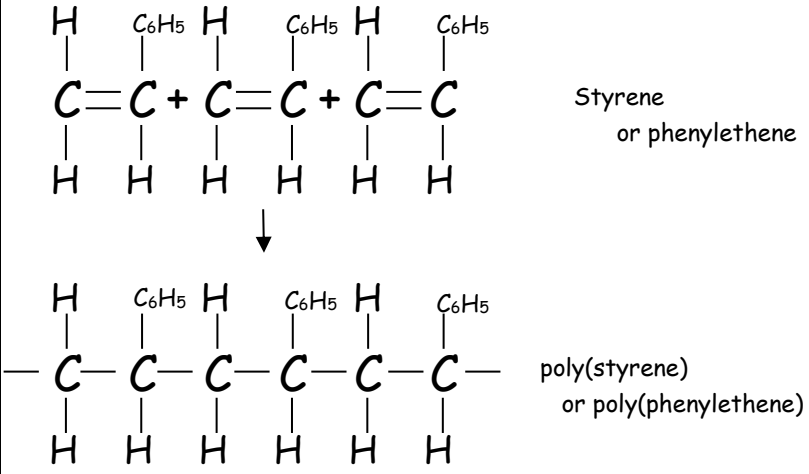
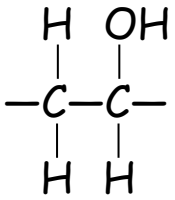
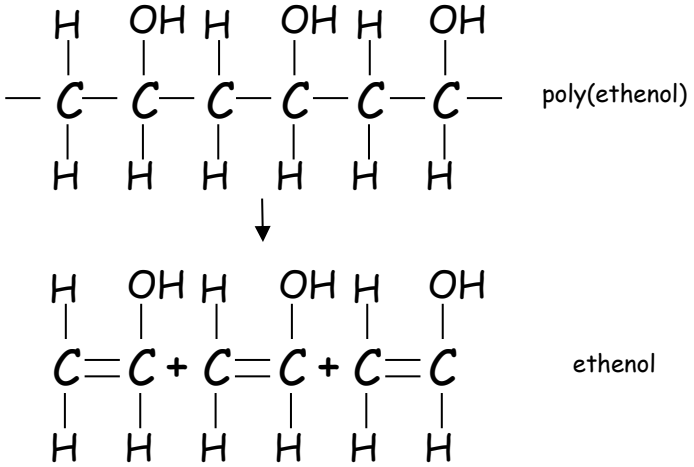
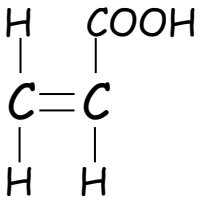
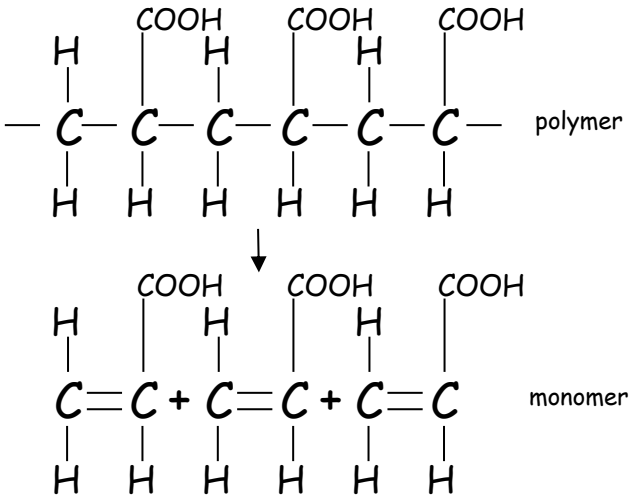
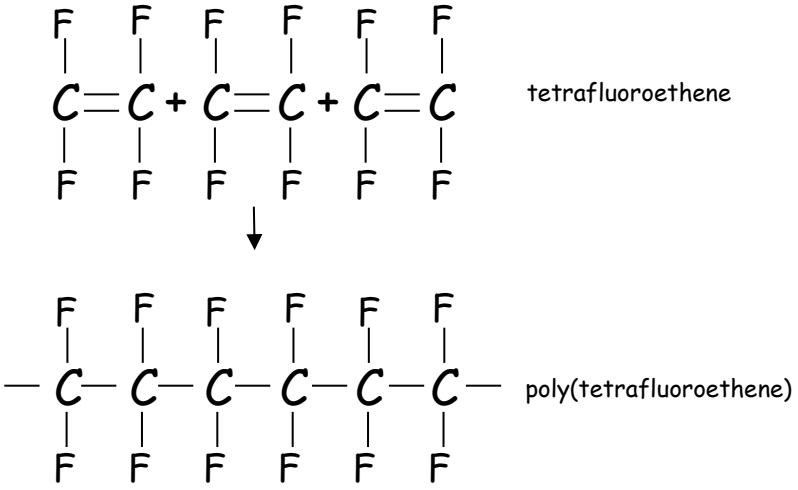
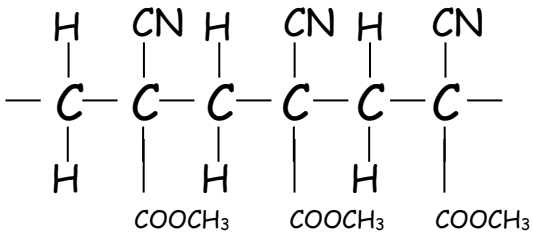
# Past Paper Question Bank
## Unit 3.2 Plastics

JABchem

| Outcome | Int2 2000 | Int2 2001 | Int2 2002 | Int2 2003 | Int2 2004 | Int2 2005 | Int2 2006 | Int2 2007 | Int2 2008 | Int2 2009 | Int2 2010 | Int2 2011 | Int2 2012 | Int2 2013 | Int2 2014 | Int2 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24<br>25<br>26 | | | | | | | | L7a | | | | | | L10b(ii) | | |
| 27 | | | | | | | | L7c | | | | | | | | |
| 28<br>29<br>30 | L7b | L3a | L7c | mc14 | mc15 | L6c | mc19 | mc14<br>L7b | L6b | mc18 | mc15 | L10a(i) | | L10b(i) | L5b | mc21 |

| Int2 | Answer | % Correct | Reasoning |
|---|---|---|---|
| 2003 MC 14 | A | 44 | There are two monomers used to create this polymer. The 1st 2 carbons (from either end) are from an ethane monomer. The 3rd and 4th carbons have a $-CH_3$ side group making the monomer for this group propene |
| 2004 MC 15 | B | 85 | ☒A $-CH_3$ and $-COOCH_3$ groups must be on the same carbon<br>☑B monomer has $-CH_3$ and $-COOCH_3$ on the same carbon & has a C=C double bond<br>☒C $-CH_3$ and $-COOCH_3$ groups must be on the same carbon<br>☒D molecule lacks C=C double bond to be the monomer which joins together |
| 2006 MC 19 | A | 85 |  |
| 2007 MC 14 | B | 100 | ☒A Cannot be a repeating unit as the molecule contains a C=C double bond<br>☑B Although this is the answer – the question had a mistake ∴ mark awarded to all<br>☒C Cannot be a repeating unit as the molecule contains a C=C double bond<br>☒D Side group has 2 carbons but in polymer side groups only have 1 carbon |
| 2009 MC 18 | A | 37 | ☑A 2 carbon monomer (ethene) and 3 carbon monomer (propene)<br>☒B Largest monomer in plastic has 3 carbons (-$CH_3$ group off main chain)<br>☒C Largest monomer in plastic has 3 carbons (-$CH_3$ group off main chain)<br>☒D Largest monomer in plastic has 3 carbons (-$CH_3$ group off main chain) |
| 2010 MC 15 | B | 87 |  |
| 2015 MC 21 | A | 76 |  |

| Int2 | Answer | Reasoning |
|---|---|---|
| 2000<br>7b | Diagram showing: |  |
| 2001<br>3a |  |  |
| 2002<br>7c |  | Take a 2 carbon portion of the polymer and redraw with C=C double bond in the middle of the 2 carbons. |
| 2005<br>6c | Diagram showing: |  |
| 2007<br>7a | C=C double bond | Styrene forms poly(styrene) by addition polymerisation. Addition reactions require a C=C double bond for a reaction to occur. |
| 2007<br>7b | Structure showing:<br>  |  |

| | | |
|---|---|---|
| 2007<br>7c | Poly(phenylethene) | Styrene is also known as phenylethene<br>∴ poly(styrene) is also known as poly(phenylethene) |
| 2008<br>6b |  |  |
| 2011<br>10a(i) |  |  |
| 2013<br>10b(i) | Diagram showing product: |  |
| 2013<br>10b(ii) | Addition | Addition polymerisation has monomers with C=C double bonds which open up and join up with each other to form a long chain of C-C single bonds in a polymer. |
| 2014<br>5b | Diagram Showing: |  |

Nat5
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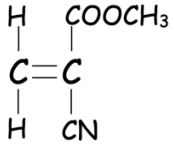
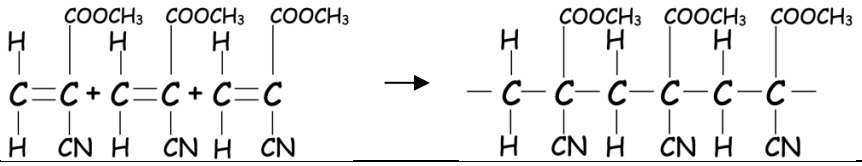
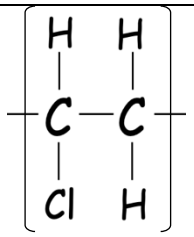
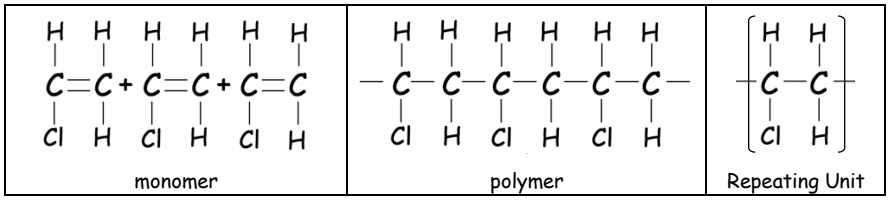
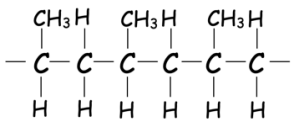
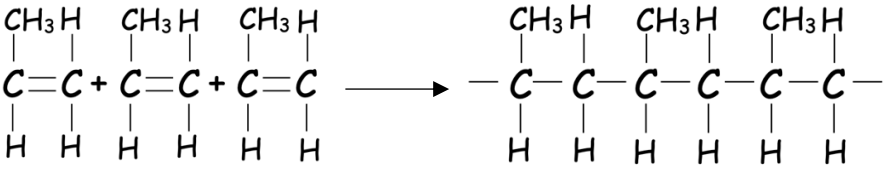
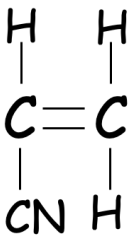
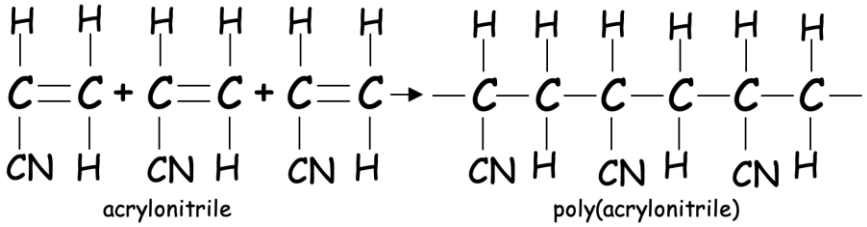
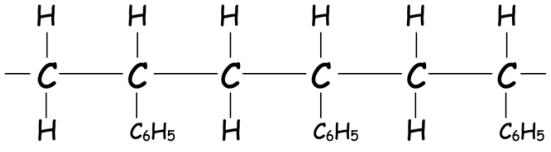
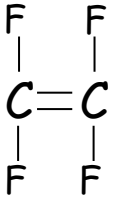
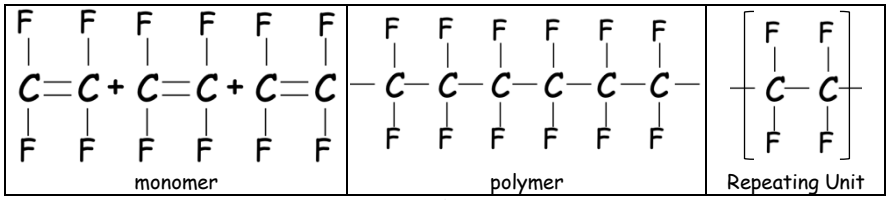
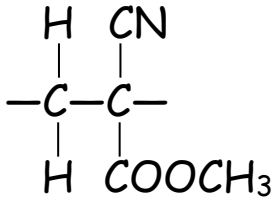
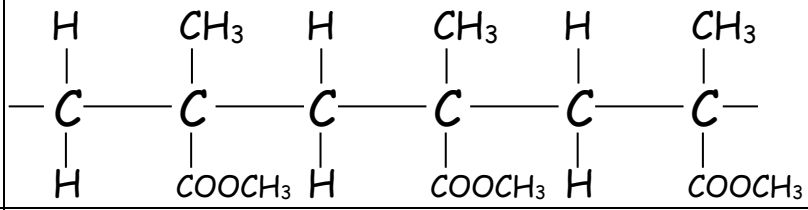
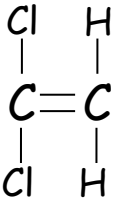
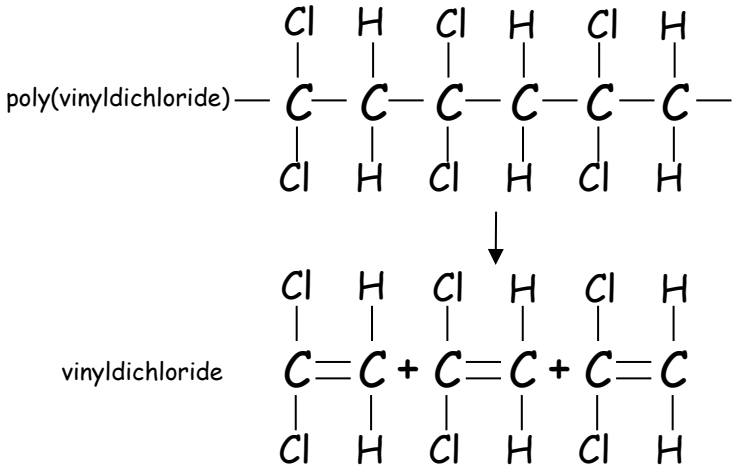
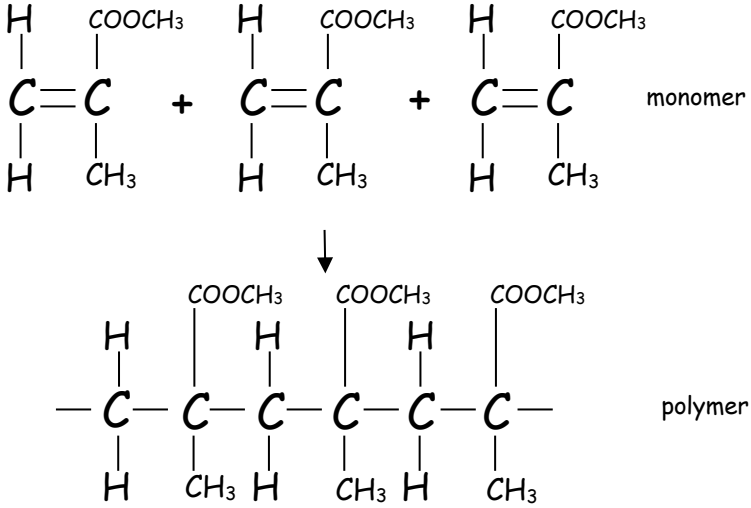
# Past Paper Question Bank
## Unit 3.2 Plastics



| Outcome | 2000 Credit | 2001 Credit | 2002 Credit | 2003 Credit | 2004 Credit | 2005 Credit | 2006 Credit | 2007 Credit | 2008 Credit | 2009 Credit | 2010 Credit | 2011 Credit | 2012 Credit | 2013 Credit | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24<br>25<br>26 | | | | | | | | | | | 10b(ii) | | | | | |
| 27 | | | | | | | | | | | | | | | | |
| 28<br>29<br>30 | 12a | | 10b(i) | 14b | 10a | 11a | 8a | | | 18a | 10b(i) | 13a | 20a | | | |

| SG Credit | Answer | Reasoning |
|---|---|---|
| 2000C<br>12a |  |  |
| 2002C<br>10b(i) |  |   |
| 2003C<br>14b |  | Draw propene into a 'H' shape, draw three and polymerise them into polymer  |
| 2004C<br>10a |  |   |
| 2005C<br>11a | Diagram showing: |  |
| 2006C<br>8a |  |   |

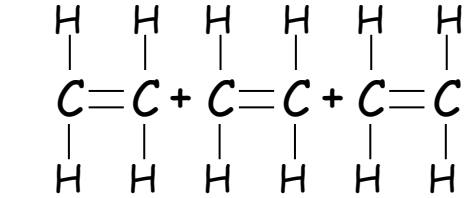
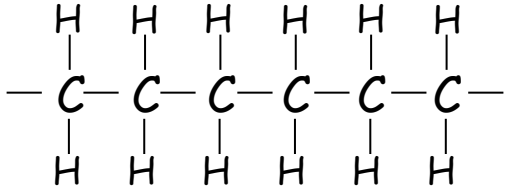
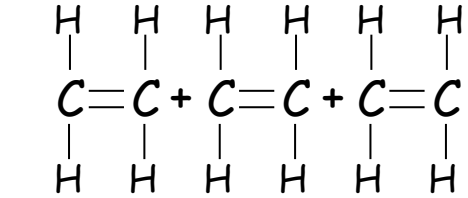
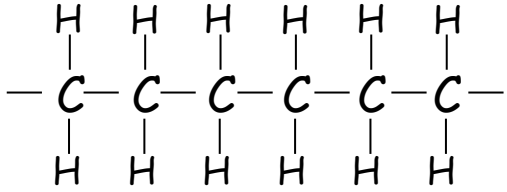
| | | |
|---|---|---|
| 2009C<br>18a |  | A repeating unit is a 2 carbon segment of the main chain |
| 2010C<br>10b(i) | Man-made or not found in nature | Synthetic materials are not found naturally on Earth and are made by the chemical industry. |
| 201C<br>10b(ii) | Diagram showing: |  |
| 2011C<br>13a |  |  |
| 2012C<br>20a | Diagram showing the polymer shown: |  |

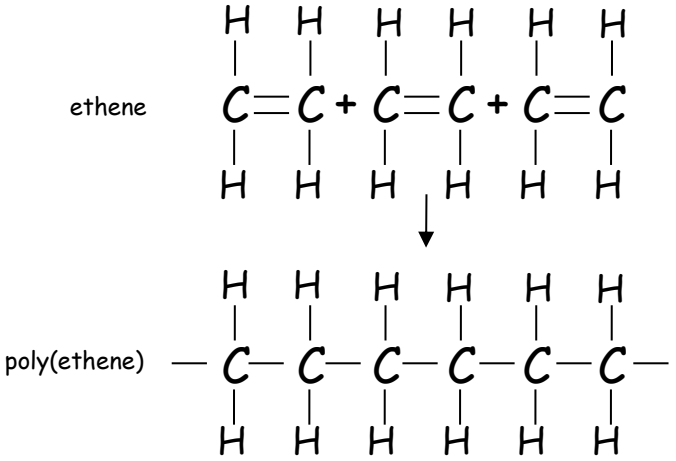
Nat5
Traffic Lights

# Past Paper Question Bank
# Unit 3.2 Plastics



| Outcome | 2000 General | 2001 General | 2002 General | 2003 General | 2004 General | 2005 General | 2006 General | 2007 General | 2008 General | 2009 General | 2010 General | 2011 General | 2012 General | 2013 General | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24<br>25<br>26 | 20b(i) | | | | | | | | | 11e | | | 14b | | | |
| 27 | 20b(ii) | | | | | 14b(i) | | 10c | 17a | 11d | 17b(iii) | | 14a | | | |
| 28<br>29<br>30 | | 10a | | | 11b | | | | | | | 15a(ii) | | | | |

| SG General | Answer | Reasoning |
|---|---|---|
| 2000G<br>20b(i) | addition polymerisation | Addition polymers like poly(tetrafluoroethene) is made when C=C double bonds open out to form a long chain of C-C singles bonds |
| 2000G<br>20b(ii) | tetrafluoroethene | Monomer: ethene \| propene \| chloroethene \| tetrafluoroethene<br>Polymer: poly(ethene) \| poly(propene) \| poly(chloroethene) \| poly(tetrafluoroethene) |
| 2001G<br>10a | diagram showing the product: |  ethene<br>  poly(ethene) |
| 2004G<br>11b | diagram showing the following product: |  ethene<br>  poly(ethene) |
| 2005G<br>14b(i) | poly(butene) | Addition Polymerisation: butene (monomer) ⟶ poly(butene) (polymer) |

<table>
<tr><td>2007G<br>10c</td><td>ethene</td><td><table><tr><td>Polymer</td><td>poly(ethene)</td><td>poly(propene)</td><td>poly(chloroethene)</td><td>poly(styrene)</td></tr><tr><td>Monomer</td><td>ethene</td><td>propene</td><td>chloroethene</td><td>styrene</td></tr></table></td></tr>
<tr><td>2008G<br>17a</td><td>chloroethene</td><td><table><tr><td>Monomer</td><td>ethene</td><td>propene</td><td>chloroethene</td><td>styrene</td></tr><tr><td>Polymer</td><td>poly(ethene)</td><td>poly(propene)</td><td>poly(chloroethene)</td><td>poly(styrene)</td></tr></table></td></tr>
<tr><td>2009G<br>11d</td><td>styrene</td><td><table><tr><td>Polymer</td><td>poly(ethene)</td><td>poly(propene)</td><td>poly(chloroethene)</td><td>poly(styrene)</td></tr><tr><td>Monomer</td><td>ethene</td><td>propene</td><td>chloroethene</td><td>styrene</td></tr></table></td></tr>
<tr><td>2009G<br>11e</td><td>Polymerisation or Addition Polymerisation</td><td>Polymerisation: process where monomers join together to make a bigger molecule (polymer)</td></tr>
<tr><td>2010G<br>17b(iii)</td><td>poly(propene)</td><td>$C_3H_6$ is the formula of both propene and cyclopropane. To be turned into a plastic, the monomer must have a C=C double bond $\therefore$ $C_3H_6$ is propene. If monomer is propene then the name of the polymer is poly(propene).</td></tr>
<tr><td>2011G<br>15a(ii)</td><td>Diagram showing the following product:</td><td> 
</td></tr>
<tr><td>2012G<br>14a</td><td>Styrene</td><td><table><tr><td>Monomer</td><td>ethene</td><td>propene</td><td>styrene</td><td>chloroethene</td></tr><tr><td>Polymer</td><td>poly(ethene)</td><td>poly(propene)</td><td>poly(styrene)</td><td>poly(chloroethene)</td></tr></table></td></tr>
<tr><td>2012G<br>14b</td><td>addition polymerisation</td><td><u>Addition</u>: C=C double bonds open up join together to form long chain of C-C<br><u>Polymerisation</u>: monomers join together to form polymer</td></tr>
</table>