Bridging the Gap between GCSE and A level Chemistry

• You should use your GCSE revision guide and your class notes to complete the following questions
• You can check your answers at the end of the power point, with the answers section
• If you are unsure about anything, you should speak to your Chemistry teacher when you arrive at Upton-by-Chester High School in September
• Please bring a copy of the completed work to your first Chemistry lesson – it will be checked!
If you need to do more preparation......

• Try ‘Head Start’ to AS Chemistry

• Buy on line at: https://www.cgpbooks.co.uk/

• ISBN 978 1 84762 116 0

• Only £4.95!
Make notes on the topics below, using your GCSE Revision Guide

• Atomic Structure
• Atomic Number, Atomic Mass & Isotopes
• Balancing Equations
• Chemical Calculations (inc. Mr, Empirical Formula, Molecular formulas, calculating reacting amounts)
• Ionic Bonding (inc. explaining the properties of giant ionic structures)
• Ionic Formula
• Covalent Bonding (inc. explaining the properties of simple molecules & giant covalent structures)
• Metallic bonding (inc. explaining the properties of giant metallic substances)
• Crude Oil
• Cracking
• Polymers

Now try the questions!
## Atomic Structure – Complete the table below

<table>
<thead>
<tr>
<th>Particle</th>
<th>Relative Mass</th>
<th>Relative charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutron</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electron</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Atomic Number, Mass Number, Ions & Isotopes

<table>
<thead>
<tr>
<th>Element or ion</th>
<th>Symbol</th>
<th>Z</th>
<th>A</th>
<th>Protons</th>
<th>Electrons</th>
<th>Neutrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td></td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>Chlorine</td>
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<td>12</td>
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<tr>
<td>Chlorine</td>
<td></td>
<td>17</td>
<td>37</td>
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<td></td>
<td></td>
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<tr>
<td>Lithium ion</td>
<td>Li⁺</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorine ion</td>
<td>Cl⁻</td>
<td></td>
<td>35.5</td>
<td></td>
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</tr>
</tbody>
</table>

1. Define an isotope.
2. There are 2 isotopes of Cl. $^{35}$Cl and $^{37}$Cl. What would you observe when they react?
Balance the following equations

1) \( \text{Mg} + \text{O}_2 \rightarrow \text{MgO} \)
2) \( \text{F}_2 + \text{KBr} \rightarrow \text{KF} + \text{Br}_2 \)
3) \( \text{Al} + \text{O}_2 \rightarrow \text{Al}_2\text{O}_3 \)
4) \( \text{Na} + \text{Cl}_2 \rightarrow \text{NaCl} \)
5) \( \text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2 \)
6) \( \text{K} + \text{O}_2 \rightarrow \text{K}_2\text{O} \)
7) \( \text{C}_4\text{H}_8 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} \)
8) \( \text{Ba(OH)}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{H}_2\text{O} \)
9) \( \text{FeCl}_3 + \text{NaOH} \rightarrow \text{Fe(OH)}_3 + \text{NaCl} \)
10) \( \text{HCl} + \text{Ba(OH)}_2 \rightarrow \text{BaCl}_2 + \text{H}_2\text{O} \)
Chemical Calculations

1) a) Calculate the $M_r$ of: i) $\text{Br}_2$ ii) $\text{K}_2\text{CO}_3$ iii) $(\text{NH}_4)_2\text{SO}_4$ (3)
   b) Calculate the percentage of oxygen in $\text{K}_2\text{CO}_3$. (1)

2) a) Define the terms empirical formula and molecular formula. (2)
   b) A hydrocarbon was found to contain 82.8% by mass of carbon. It has an $M_r$ of 58. Find the empirical and molecular formulas of this compound. (3)
   c) 1 g of sulphur was burned forming 2.5 g of an oxide. Find the empirical formula of the oxide. (2)

3) What mass of calcium oxide is formed from the decomposition of 180 g of calcium carbonate?
   
   \[
   \text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})
   \] (3)
1) Explain each of the following about melting and boiling points:
   a) Simple molecular substances have low melting and boiling points. (2)
   b) Giant covalent substances have very high melting and boiling points. (2)
   b) Ionic substances have high melting and boiling points. (2)
   c) Metals have quite high melting and boiling points. (2)

2) Explain each of the following about electrical conductivity:
   a) Simple molecular substances do not conduct at all. (1)
   b) Giant covalent substances do not conduct, apart from graphite. (3)
   c) Ionic substances conduct when melted or dissolved, but not when solid. (3)
   d) Metals conduct as solids and when melted. (2)
<table>
<thead>
<tr>
<th></th>
<th>Melting point (°C)</th>
<th>Boiling point (°C)</th>
<th>Electrical conductivity as solid</th>
<th>Electrical conductivity as liquid</th>
<th>Electrical conductivity as aqueous solution</th>
<th>Type of Structure (simple or giant) &amp; Bonding (covalent, ionic or metallic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>54</td>
<td>120</td>
<td>poor</td>
<td>poor</td>
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<td>poor</td>
</tr>
<tr>
<td>B</td>
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<td>567</td>
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<td>good</td>
<td>not soluble</td>
<td></td>
</tr>
<tr>
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<td>-196</td>
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<td>poor</td>
<td>poor</td>
<td></td>
</tr>
<tr>
<td>D</td>
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<td>2230</td>
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<td>not soluble</td>
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</tr>
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<td>4827</td>
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<td></td>
<td>not soluble</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>56</td>
<td>342</td>
<td>good</td>
<td>good</td>
<td>good</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>934</td>
<td>1568</td>
<td>poor</td>
<td>good</td>
<td>insoluble</td>
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<tr>
<td>I</td>
<td>-105</td>
<td>-45</td>
<td>poor</td>
<td>poor</td>
<td>good</td>
<td></td>
</tr>
</tbody>
</table>
Ionic Formula – Work out the ionic formula of the following:

1. silver nitrate
2. iron (III) hydroxide
3. ammonium chloride
4. lithium oxide
5. copper carbonate
6. sodium sulphate
7. iron (II) sulphate
8. calcium hydroxide

<table>
<thead>
<tr>
<th>Positive ions</th>
<th>Negative Ions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver, Ag⁺</td>
<td>Nitrate, NO₃⁻</td>
</tr>
<tr>
<td>Ammonium, NH₄⁺</td>
<td>Hydroxide, OH⁻</td>
</tr>
<tr>
<td>Lithium, Li⁺</td>
<td>Chloride, Cl⁻</td>
</tr>
<tr>
<td>Sodium, Na⁺</td>
<td>Oxide, O₂⁻</td>
</tr>
<tr>
<td>Copper, Cu²⁺</td>
<td>Carbonate, CO₃²⁻</td>
</tr>
<tr>
<td>Calcium, Ca²⁺</td>
<td>Sulphate, SO₄²⁻</td>
</tr>
<tr>
<td>Iron (II), Fe²⁺</td>
<td></td>
</tr>
<tr>
<td>Iron (III), Fe³⁺</td>
<td></td>
</tr>
</tbody>
</table>
Crude Oil

The alkanes are a homologous series of saturated hydrocarbons.

a) What is a hydrocarbon? (2)
b) What is a homologous series? (2)
c) What is meant by the word saturated in this context? (1)
d) Draw the structure of propane. (1)
e) Octane is a straight chain alkane containing eight carbon atoms.
i) Write its molecular formula. (1)
ii) Draw its structural formula. (1)
f) Write a balanced equation for the complete combustion of propane. (1)
g) Write a balanced equation for the incomplete combustion of propane, where a toxic gas is formed. (1)
Cracking is a thermal decomposition reaction. Define *thermal decomposition*.

What is produced when long alkanes are cracked and explain they are cracked.

Why is the porous pot used in Cracking?

Why would “suck back” have happened if the tube had not been removed at the end?

What happened when bromine water was added to the tube of gas collected?
### Polymers

<table>
<thead>
<tr>
<th>Monomer</th>
<th>Structure</th>
<th>Polymer</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethene</td>
<td><img src="image" alt="Ethene Structure" /></td>
<td>Poly (Ethene)</td>
<td><img src="image" alt="Poly (Ethene) Structure" /></td>
</tr>
<tr>
<td>Propene</td>
<td><img src="image" alt="Propene Structure" /></td>
<td>A</td>
<td><img src="image" alt="Propene Monomer" /></td>
</tr>
<tr>
<td>C</td>
<td><img src="image" alt="C Structure" /></td>
<td>Poly (Tetrafluoroethene)</td>
<td><img src="image" alt="Poly (Tetrafluoroethene) Structure" /></td>
</tr>
</tbody>
</table>

1. Complete the table opposite
2. What is meant by the term ‘Monomer’?
3. What is meant by the term ‘Polymer’?
4. What is the formula of tetrafluoroethane?
5. What feature allows these molecules to be polymerised?
Answer section

Remember, if you are still unsure after checking your answers, speak to your Chemistry Teacher!
Atomic Structure – Complete the table below

<table>
<thead>
<tr>
<th>Particle</th>
<th>Relative Mass</th>
<th>Relative charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td>1</td>
<td>$^+1$</td>
</tr>
<tr>
<td>Neutron</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>Electron</td>
<td>$\frac{1}{1840}$ or negligible</td>
<td>$^-1$</td>
</tr>
</tbody>
</table>
# Atomic Number, Mass Number, Ions & Isotopes

<table>
<thead>
<tr>
<th>Element or ion</th>
<th>Symbol</th>
<th>Z</th>
<th>A</th>
<th>Protons</th>
<th>Electrons</th>
<th>Neutrons</th>
</tr>
</thead>
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<td>Chlorine</td>
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<td>37</td>
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<td>20</td>
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<tr>
<td>Lithium ion</td>
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<td>4</td>
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<tr>
<td>Chlorine ion</td>
<td>Cl⁻</td>
<td>17</td>
<td>35.5</td>
<td>17</td>
<td>18</td>
<td>18.5</td>
</tr>
</tbody>
</table>

1. Define an isotope. **Same number of protons and electron, but a different number of neutrons**
2. There are 2 isotopes of Cl. $^{35}\text{Cl}$ and $^{37}\text{Cl}$. What would you observe when they react? **There is no difference because both isotopes have the same number of electrons in their outer shell**
Balance the following equations

1) \[ 2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO} \]
2) \[ \text{F}_2 + 2\text{KBr} \rightarrow 2\text{KF} + \text{Br}_2 \]
3) \[ 4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3 \]
4) \[ 2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl} \]
5) \[ \text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2 \] \[ \text{already balanced!} \]
6) \[ 4\text{K} + \text{O}_2 \rightarrow 2\text{K}_2\text{O} \]
7) \[ \text{C}_4\text{H}_8 + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 4\text{H}_2\text{O} \]
8) \[ \text{Ba(OH)}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O} \]
9) \[ \text{FeCl}_3 + 3\text{NaOH} \rightarrow \text{Fe(OH)}_3 + 3\text{NaCl} \]
10) \[ 2\text{HCl} + \text{Ba(OH)}_2 \rightarrow \text{BaCl}_2 + 2\text{H}_2\text{O} \]
1) a) Calculate the \( M_r \) of:  
   i) \( \text{Br}_2 \quad 160 \)  
   ii) \( \text{K}_2\text{CO}_3 \quad 132 \)  
   iii) \( (\text{NH}_4)_2\text{SO}_4 \quad 134 \)  

b) Calculate the percentage of oxygen in \( \text{K}_2\text{CO}_3 \).  
   \( \frac{(16 \times 3)}{132} = 0.36 \times 100 = 36\% \)

2) a) Define the terms **empirical formula**: Simplest ratio of atoms  
   **molecular formula**: Actual number of Atoms

b) A hydrocarbon was found to contain 82.8% by mass of carbon. It has an \( M_r \) of 58. Find the **empirical** (see working below) \( \text{C}_2\text{H}_5 \) and **molecular** formulas of this compound. The empirical formula has a mass of 29. \( \frac{58}{29} = 2 \), so we need double the molecular formula \( \text{C}_4\text{H}_{10} \)

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass (g)</td>
<td>82.8g</td>
<td>100 – 82.8 = 17.2</td>
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<tr>
<td>Divide by Mr</td>
<td>82.8/12</td>
<td>17.2/1</td>
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<tr>
<td></td>
<td>6.9</td>
<td>17.2</td>
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<tr>
<td>Divide by smallest no.</td>
<td>6.9/6.9 = 1</td>
<td>17.2 / 6.9 = 2.5</td>
</tr>
<tr>
<td>Answer</td>
<td>2C</td>
<td>5H</td>
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</table>
c) 1 g of sulphur was burned forming 2.5 g of an oxide. Find the empirical formula of the oxide.

<table>
<thead>
<tr>
<th>Mass (g)</th>
<th>S</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1g</td>
<td>1</td>
<td>2.5 - 1 = 1.5</td>
</tr>
<tr>
<td>Divide by Mr</td>
<td>1/32</td>
<td>1.5 / 16</td>
</tr>
<tr>
<td>=</td>
<td>0.03</td>
<td>0.09</td>
</tr>
<tr>
<td>Divide by smallest no.</td>
<td>0.03/0.03 = 1</td>
<td>0.03 / 0.09 = 3</td>
</tr>
<tr>
<td>Answer</td>
<td>1 S</td>
<td>3 O</td>
</tr>
</tbody>
</table>

3) What mass of calcium oxide is formed from the decomposition of 180 g of calcium carbonate?

\[
\text{CaCO}_3(s) \rightarrow \text{CaO}(s) + \text{CO}_2(g)
\]

\[
n\text{CaCO}_3 = \frac{M}{Mr} = \frac{180}{(40 + 12 + 16 \times 3)} = 1.8 \text{ moles}
\]

\[
n\text{CaCO}_3 = n\text{CaO} = 1.8 \text{ moles}
\]

\[
M \text{ CaO} = n \times Mr = 1.8 \times (40 + 16) = 100.8 \text{g}
\]
Structure and Bonding Question 1

Explain each of the following about melting and boiling points:

a) Simple molecular substances have low melting and boiling points. 
Weak forces (1) between the molecules (not atoms!) (1)

b) Giant covalent substances have very high melting and boiling points. 
Many strong (1) covalent bonds between the atoms (not molecules!) (2)

b) Ionic substances have high melting and boiling points. 
Ionic compounds are held together by many strong electrostatic 
attractions or attractions between oppositely charged ions(1) 
Lots energy is needed to overcome them (1) (no mention of molecules!)

c) Metals have quite high melting and boiling points. 
Metals are held together by many strong electrostatic attractions or 
attractions between positive ions and negative electrons(1) 
Lots of energy is needed to overcome these attractions(1) (no mention of 
molecules!)
Structure and Bonding Question 2

Explain each of the following about electrical conductivity:

a) Simple molecular substances do not conduct at all.
   No free electrons or movement of charge (1)

b) Giant covalent substances do not conduct, apart from graphite.
   No free electrons or movement of charge (1)
   In graphite only 3 electrons are used in bonding (1)
   Leaves a free electron to conduct electricity (1)

c) Ionic substances conduct when melted or dissolved, but not when solid.
   When solid the ions are in fixed positions, so there is no movement of charge (1)
   when the ions are dissolved in water or melted they are free to move (1)
   This allows charge to flow (1)
   **No mention of moving electrons – there are no free electrons**

d) Metals conduct as solids and when melted.
   Have delocalised / free moving electrons (1)
   charge can be carried through the structure (1)
### What type of Structure is it?

<table>
<thead>
<tr>
<th></th>
<th>Melting point (°C)</th>
<th>Boiling point (°C)</th>
<th>Electrical conductivity as solid</th>
<th>Electrical conductivity as liquid</th>
<th>Electrical conductivity as aqueous solution</th>
<th>Type of structure &amp; bonding</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>54</td>
<td>120</td>
<td>poor</td>
<td>poor</td>
<td>poor</td>
<td>Simple molecular, covalent</td>
</tr>
<tr>
<td>B</td>
<td>403</td>
<td>567</td>
<td>good</td>
<td>good</td>
<td>not soluble</td>
<td>Giant metallic</td>
</tr>
<tr>
<td>C</td>
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<td>-196</td>
<td>poor</td>
<td>poor</td>
<td>poor</td>
<td>Simple molecular, covalent</td>
</tr>
<tr>
<td>D</td>
<td>1610</td>
<td>2230</td>
<td>poor</td>
<td>poor</td>
<td>not soluble</td>
<td>Giant covalent</td>
</tr>
<tr>
<td>E</td>
<td>615</td>
<td>876</td>
<td>poor</td>
<td>good</td>
<td>good</td>
<td>Giant ionic</td>
</tr>
<tr>
<td>F</td>
<td>3727</td>
<td>4827</td>
<td>good</td>
<td>not soluble</td>
<td>Giant metallic</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>56</td>
<td>342</td>
<td>good</td>
<td>good</td>
<td>good</td>
<td>Giant ionic</td>
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<tr>
<td>H</td>
<td>934</td>
<td>1568</td>
<td>poor</td>
<td>good</td>
<td>insoluble</td>
<td>Giant ionic</td>
</tr>
<tr>
<td>I</td>
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<td>-45</td>
<td>poor</td>
<td>poor</td>
<td>good</td>
<td>Simple molecular, covalent</td>
</tr>
</tbody>
</table>
Ionic Formula – Work out the ionic formula of the following:

1. silver nitrate
2. iron (III) hydroxide
3. ammonium chloride
4. lithium oxide
5. copper carbonate
6. sodium sulphate
7. iron (II) sulphate
8. calcium hydroxide

1. AgNO₃
2. Fe(OH)₃
3. NH₄Cl
4. Li₂O
5. CuCO₃
6. Na₂SO₄
7. FeSO₄
8. Ca(OH)₂
Crude Oil

a) What is a hydrocarbon? Only 1 Compound containing H & C - 1

b) What is a homologous series? series of compounds that have similar properties - 1 and the same general formula. - 1

c) What is meant by the word saturated in this context? No C=C bond

d) Draw the structure of propane.

```
\[ \begin{array}{c}
\text{H} \\
\text{C} - \text{C} - \text{C} - \text{H} \\
\text{H} - \text{H} - \text{H} \\
\end{array} \]
```

e) Octane is a straight chain alkane containing eight carbon atoms.
i) Write its molecular formula. \( \text{C}_8\text{H}_{18} \)

ii) Draw its structural formula.

```
\[ \begin{array}{c}
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\end{array} \]
```

iii) f) Write a balanced equation for the complete combustion of propane.

\[
\text{C}_3\text{H}_8 + 4.5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O} \quad \text{to get rid of halves, double everything!} \quad 2\text{C}_3\text{H}_8 + 9\text{O}_2 \rightarrow 6\text{CO}_2 + 8\text{H}_2\text{O}
\]

g) Write a balanced equation for the incomplete combustion of propane, where a toxic gas is formed.

\[
\text{C}_3\text{H}_8 + 3.5\text{O}_2 \rightarrow 3\text{CO} + 4\text{H}_2\text{O} \quad \text{to get rid of halves, double everything!} \quad 2\text{C}_3\text{H}_8 + 7\text{O}_2 \rightarrow 6\text{CO} + 8\text{H}_2\text{O}
\]
Cracking

1) Cracking is a thermal decomposition reaction. Define thermal decomposition. *Thermal – using heat (1)*

   *To break down the compound (1)*

2) What is produced when long alkanes are cracked and explain they are cracked. Short chain alkane (1) Short chain Alkenes (1) These molecules are in higher demand than long chain alkanes (1)

3) Why is the porous pot used in Cracking? Catalyst (1)

4) Why would “suck back” have happened if the tube had not been removed at the end? The hot air in the heated test tube would have contracted (1) this would have sucked cold water into the hot test tube, causing it to shatter (1)

5) What happened when bromine water was added to the tube of gas collected? Turned colourless (NOT clear!) (1)
1. Complete the table opposite

<table>
<thead>
<tr>
<th>monomer</th>
<th>structure</th>
<th>polymer</th>
<th>structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>ethene</td>
<td>H H</td>
<td>poly (ethene)</td>
<td>- H H C=C H H n</td>
</tr>
<tr>
<td>propene</td>
<td>H CH₃</td>
<td>polypropene</td>
<td>- [CH₃ H] C=C H H n</td>
</tr>
<tr>
<td>Tetrafluoro ethane</td>
<td>D</td>
<td>poly(tetrafluoroethene)</td>
<td>- [F C=CF ] C=C F n</td>
</tr>
</tbody>
</table>

2. What is meant by the term ‘Monomer’?
Identical small molecules, than often contain a C=C bond

3. What is meant by the term ‘Polymer’?
Large molecule made up of many identical repeat units called monomers

4. What is the formula of tetrafluoroethane? $C_2H_4$

5. What feature allows these molecules to be polymerised?
C=C double bond