Past Papers Int 2 Chemistry

2000 Marking Scheme

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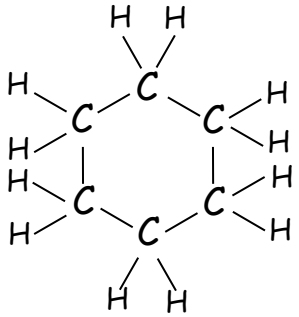
MC Qu	Answer	% Pupils Correct	Reasoning
1	A	67	No. of protons = atomic number = 23 No. of neutrons = mass number – atomic number = 51-23 = 28 No. of electrons = atomic number - charge = 23 – 0 = 23
2	D	55	Isotopes: Same atomic number but different mass number; Same number of protons but different number of neutrons
3	B	27	☒A Sodium is a metal and chlorine is a non-metal ∴ sodium chloride is ionic ☑B Nitrogen and oxygen are both non-metals and form diatomic molecules of NO ☒C Silicon and chlorine are both non-metals and form pentatomic molecules of $SiCl_4$ ☒D Sulphur and oxygen are both non-metals and form triatomic molecules of SO_3
4	D	42	☒A In exothermic reactions, heat is released to the surroundings ☒B In exothermic reactions, heat is released to the surroundings ☒C If products have more chemical energy than the reactants, heat must be taken in (endo) ☑D If products have less chemical energy than the reactants, heat must be taken in (exo)
5	C	48	$\text{Rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{1.00 - 0.25}{20 - 0} = \frac{0.75}{20} = 0.0375 \text{ mol } l^{-1} s^{-1}$
6	A	89	Fractional distillation separates chemicals which have different boiling points.
7	C	36	☒A CH_4 is most likely to be found in natural gas ☒B C_3H_8 is most likely to be found in bottled camping gas ☑C C_8H_{18} is most likely to be found in petrol ☒D $C_{14}H_{30}$ is most likely to be found in kerosene
8	A	38	Hydrocarbon with formula mass = 30 ∴ hydrocarbon is C_2H_6 ☑A C_2H_6 is ethane and is a gas a room temperature with a boiling point of -89°C ☒B Small alkanes have a low viscosity (thickness) ☒C Ethane has no C=C double bond and cannot take part in addition polymerisation ☒D Ethane has non C=C double bond so does not decolourise bromine water
9	D	36	☒A Hydration: Water is added across a C=C double bond ☒B Hydrolysis: Big molecule splits into smaller molecules with water added across the break ☒C Dehydration: Water is removed from a molecule leaving behind a C=C double bond ☑D Condensation: Small molecules join together with water removed at the join
10	A	31	☒A Hydration: Water is added across a C=C double bond ☒B Hydrolysis: Big molecule splits into smaller molecules with water added across the break ☒C Dehydration: Water is removed from a molecule leaving behind a C=C double bond ☑D Condensation: Small molecules join together with water removed at the join
11	A	39	☑A Each molecule of fat contains three ester bonds between glycerol and 3 fatty acids ☒B Protein contains peptide links and not ester links ☒C Starch is a carbohydrate not an ester ☒D Sucrose is a carbohydrate sugar and not an ester
12	D	67	☒A Carbohydrates have hydrogen and oxygen in the ratio of 2:1 (like water) ☒B Carbohydrates have hydrogen and oxygen in the ratio of 2:1 (like water) ☒C Carbohydrates have hydrogen and oxygen in the ratio of 2:1 (like water) ☑D Glucose is a carbohydrate as it has hydrogen and oxygen in a ratio of 2:1
13	C	78	Fats and oils contain ester bonds. On hydrolysis of these ester bonds each molecule of fat/oil releases one molecule of glycerol and 3 molecules of fatty acids

14	B	71	☒A but-2-ene has the formula C_4H_8 but molecule drawn has the formula C_5H_{10} ☑B pent-2-ene: 5 carbons with C=C double bond between C_2 and C_3 ☒C but-3-ene is incorrectly named as C=C double bond must have the lowest numbering system ☒D pent-3-ene is incorrectly names as C=C double bond must have the lowest number system
15	C	74	☒A polystyrene is an insoluble addition polymer ☒B nylon is an insoluble polyamide condensation polymer ☑C poly(ethenol) is a soluble polymer ☒D Kevlar is a very strong insoluble polymer
16	C	80	 Cyclohexane has • Formula = C_6H_{12} • Six carbons is a ring • No C=C double bonds
17	C	52	☒A Redox has both Reduction: $2H^+ + 2e^- \rightarrow H_2$ and Oxidation: $Zn \rightarrow Zn^{2+} + 2e^-$ ☒B Redox has both Reduction: $Br_2 + 2e^- \rightarrow 2Br^-$ and Oxidation: $Fe^{2+} \rightarrow Fe^{3+} + e^-$ ☑C Precipitation Reaction: ions come together to form insoluble solid ☒D Redox has both Reduction: $2H^+ + 2e^- \rightarrow H_2$ and Oxidation: $Zn \rightarrow Zn^{2+} + 2e^-$
18	D	32	☒A calcium oxide (metal oxide) dissolves in water to form an alkali ☒B carbon dioxide (non-metal oxide) dissolves in water to form an acid ☒C sulphur dioxide (non-metal oxide) dissolves in water to form an acid ☑D zinc oxide is insoluble in water so will not change the pH of water from pH=7
19	D	42	☒A At equilibrium, the rate of the forward and reverse reactions are equal ☒B water has little dissociation into ions and the majority stays as molecules ☒C Concentration of water if much greater than hydrogen ions ☑D At equilibrium, concentration of reactants and products are constant
20	A	50	A salt is made by the replacing of the H^+ ion in an acid with a metal ion or ammonium ion. ☑A ammonium chloride is made by neutralisation of ammonia with hydrochloric acid ☒B oxides cannot be made by reaction with an acid ☒C hydrogen chloride is a gas which is not made by reaction with an acid ☒D hydroxides cannot be made by reaction with an acid
21	C	59	☒A soluble gases would not pass through the water and would not be removed ☒B Gases would not be able to escape up the 2nd tube and leave the test tube ☑C Soluble gases would dissolve in water and insoluble gas would leave by 2nd tube ☒D Gases would not be able to escape up the 2nd gas tube and leave the test tube
22	A	22	☑A If oxygen is reacted out of air, nitrogen would make up the vast majority of remaining ☒B Magnesium burns to form solid magnesium oxide not carbon dioxide ☒C Most of the oxygen is used up so no more than 1% would be left ☒D Most of the oxygen is used up so no more than 1% would be left
23	C	45	☒A Glucose $C_6H_{12}O_6$ is covalent molecule so does not speed up corrosion as it is not ionic ☒B Zinc would sacrificially protect the iron for rusting ☑C Adding an electrolyte like potassium nitrate will increase the rate of rusting ☒D Negative terminal of battery will prevent rusting by cathodic protection
24	D	79	☒A electrons will flow from more reactive copper (Z) to less reactive gold (Y) ☒B electrons will flow from more reactive tin (Z) to less reactive copper (Y) ☒C electrons will flow from more reactive tin (Z) to less reactive gold (Y) ☑D electrons will flow from more reactive tin (Y) to less reactive copper (Z)
25	B	73	$\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{0.25 \text{ mol}}{0.5 \text{ litres}} = 0.5 \text{ mol } l^{-1}$

Questions 26 and 27 are Grid Questions.

- This style of question was dropped after the 2002 Int2 exam.
- The style of question is no longer used but the content of the question can still be asked in future exams.

26a	E	☒A Chlorine is a non-metal in group 7 and forms 1 negative Cl^- chloride ions ☒B Calcium is a metal in group 2 and forms 2 positive Ca^{2+} calcium ions ☒C Oxygen is a non-metal in group 6 and forms 2 negative O^{2-} oxide ions ☒D Phosphorous is a non-metal in group 5 and forms 3 negative P^{3-} phosphide ions ☑E Sodium is a metal in group 1 and forms 1 positive Na^+ sodium ions ☒F Sulphur is a non-metal in group 6 and forms 2 negative S^{2-} sulphide ions
26b	B+E (both for 1 mark)	☒A chlorine is a non-metal which does not react with water ☑B metals which react with water form alkalis ☒C oxygen is a non-metal which does not react with water ☒D phosphorus is a non-metal which does not react with water ☑E metals which react with water form alkalis ☒F sulphur is a non-metal which does not react with water
26c	C+E (both for 1 mark)	☒A Chlorine has electron arrangement 2,8,7 and forms Cl^- ions (2,8,8). Neon is 2,8 ☒B Calcium has electron arrangement 2,8,8,2 and forms Ca^{2+} ions (2,8,8). Neon is 2,8 ☑C Oxygen has electron arrangement 2,6 and forms O^{2-} ions (2,8). Neon is 2,8 ☒D Phosphorus has electron arrangement 2,8,5 and forms P^{3-} ions (2,8,8). Neon is 2,8 ☑E Sodium has electron arrangement 2,8,1 and forms Na^+ ions (2,8). Neon is 2,8 ☒F Sulphur has electron arrangement 2,8,6 and forms S^{2-} ions (2,8,8). Neon is 2,8
27a	B	☒A Molecular covalent bonding due to low b.pt. and no conduction as solid or liquid ☑B Ionic bonding due to no conduction as solid but conduction as a liquid ☒C Metallic bonding as substance conducts as both solid and liquid ☒D Molecular covalent bonding due to no conduction as solid or liquid and low(ish) b.pt. ☒E Covalent network bonding due to no conduction as solid or liquid and very high m.pt ☒F Molecular covalent bonding due to low b.pt. and no conduction as solid or liquid
27b	E	☒A Molecular covalent bonding due to low b.pt. and no conduction as solid or liquid ☒B Ionic bonding due to no conduction as solid but conduction as a liquid ☒C Metallic bonding as substance conducts as both solid and liquid ☒D Molecular covalent bonding due to no conduction as solid or liquid and low(ish) b.pt. ☑E Covalent network bonding due to no conduction as solid or liquid and very high m.pt ☒F Molecular covalent bonding due to low b.pt. and no conduction as solid or liquid

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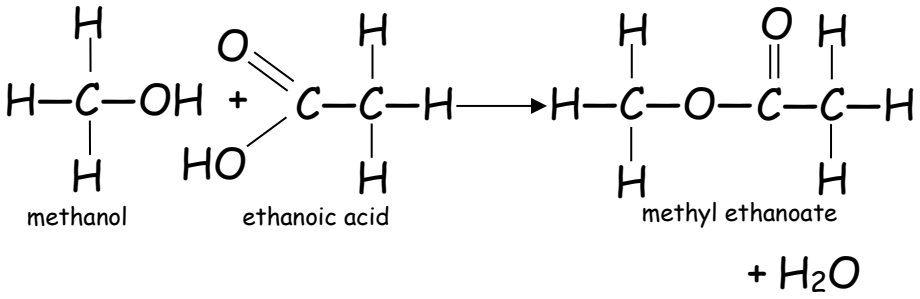
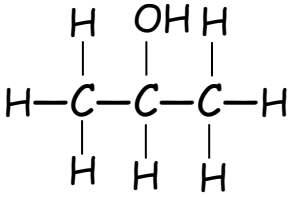
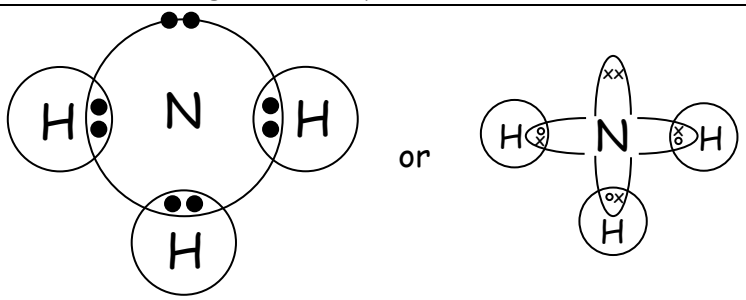
Long Qu	Answer	Reasoning
1a	Methyl ethanoate	
1b		Isomers: Same molecular formula e.g. C_3H_8O; Different structural formula Propan-1-ol: Primary alcohol with –OH group attached to C_1 of 3 carbons Propan-2-ol: Secondary alcohol with –OH group attached to C_2 of 3 carbons
2a	Sulphur dioxide dissolves to from acid rain	Sulphur in fossil fuels burns to form sulphur dioxide. Sulphur dioxide dissolves in rain water to form acid rain
2b	Reduction	Copper ions in $Cu^{2+}O^{2-}$ are reduced to form Cu atoms: $Cu^{2+} + 2e^- \rightarrow Cu$
2c	Any metal from:	potassium | sodium | lithium | calcium | magnesium | aluminium Any metal above zinc in the electrochemical series cannot be made by heating with carbon and is made by (molten) electrolysis
3a	In same group of periodic table	Elements in the same group of the periodic table have the same chemical properties e.g. alkali metals (group 1) and noble gases (group 0)
3b	Answer to include:	The relative atomic mass is the average mass of all the different isotopes of strontium. Each individual isotope has a mass which is a whole number.
4a	Nitrogen Hydrogen Unreacted nitrogen + hydrogen Ammonia Nitric acid Ammonium nitrate	Problem Solving information transfer question
4b	Fertilisers	Fertilisers are soluble compounds containing the following elements: Nitrogen Phosphorus Potassium
4c	Diagram showing:	
5a	Precipitation	Precipitation: When two ions come together and form an insoluble solid.

5b — SnF_2

Write down Formulae of elements	Write down Valency below each ion	Put in Cross-over Arrows	Follow arrows and cancel down to get formula
Sn F	Sn F 2 1	Sn F 2 1	SnF_2

5c — 144g

1mol Na_2PO_3F = (2x23) + (1x31) + (3x16) + (1x19) = 46 + 31 + 48 + 19 = 144g

6a — More fossil fuels are burned

CO_2 in increasing due to

a) increased burning of hydrocarbon fossil fuels which form CO_2

b) more trees being cut down preventing photosynthesis reducing CO_2 levels

6b — 145.5kg

gfm CO_2 = (1x12) + (2x16) = 12 + 32 = 44g

$$\textbf{no. of mol} = \frac{\textbf{mass}}{\textbf{gfm}} = \frac{200000}{44} = 4545.5\text{mol}$$

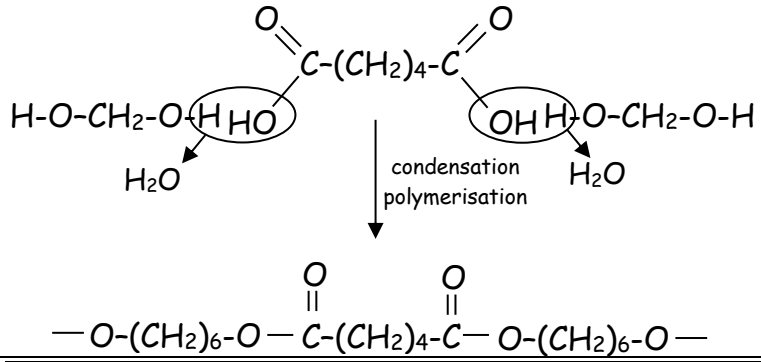
$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

6mol 1mol 4545.5mol — 6mol 1mol 4545.5mol

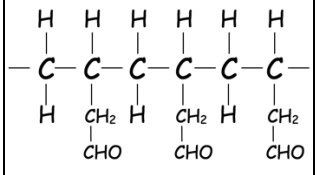
1mol O_2 = 2x16 = 32g

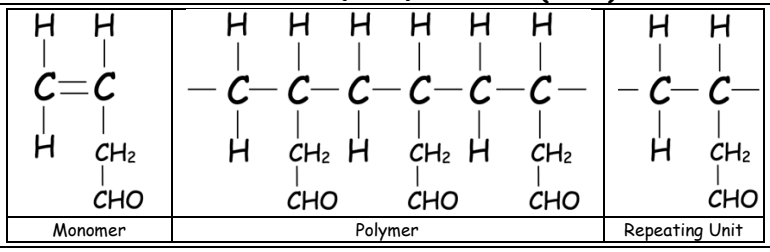
mass = **no.** of mol x **gfm** = 4545.5 x 32 = 145454g = 145.5kg

7a — condensation



7b





8a — Zinc is higher than iron in electrochemical series. Electrons travel from zinc to iron to protect iron

Zinc is higher up the reactivity/electrochemical series than iron.

Zinc sacrificially protects iron as zinc corrodes to form Zn^{2+}

$$Zn \rightarrow Zn^{2+} + 2e^-$$

Electrons from this corrosion prevent the iron from rusting

8b — Answer to include:

Cracking splits less useful larger saturated hydrocarbons into more useful smaller hydrocarbons some of which are unsaturated

$$C_{10}H_{22} \xrightarrow{\text{catalyst}} C_2H_4 + C_5H_{12} + C_3H_6$$

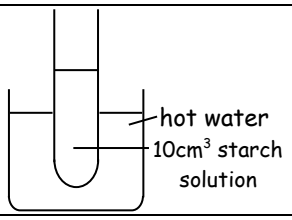
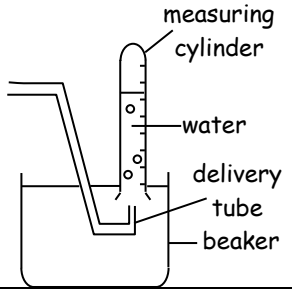
saturated — unsaturated — saturated — unsaturated

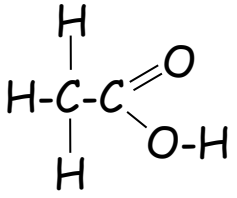
9a — $C_5H_{12}O$

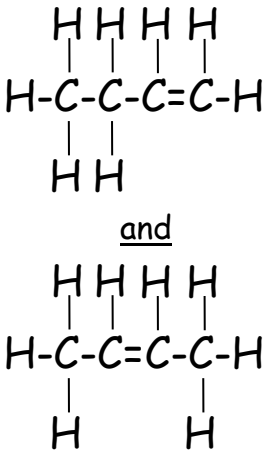
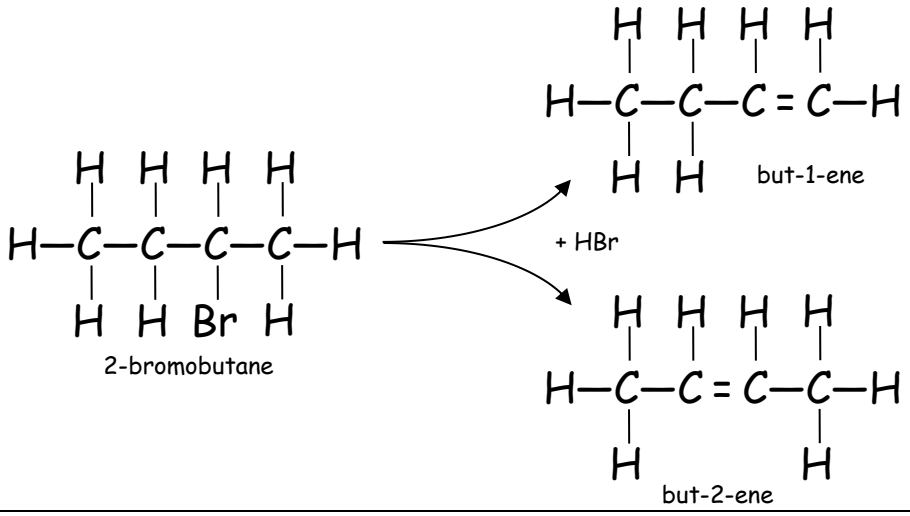
Molecular formula is the ratio of atoms but gives no clues to the structure of the compound

9b — Carbon monoxide or soot (carbon)

Carbon monoxide, soot (carbon) and unburnt hydrocarbons are all formed due to incomplete combustion, caused by not enough air being present for complete combustion

<table>
<tr><td>9c</td><td>Lead poisons the catalytic convertor</td><td>Catalytic convertors catalyse the cleaning up of pollutant gases in exhaust gases:
Carbon monoxide → Carbon dioxide
Nitrogen oxides → Nitrogen
Unburnt hydrocarbons → Carbon dioxide + water</td></tr>
<tr><td>9d</td><td>Answers to include:</td><td>(i) As the distance from the road increases, the mass of lead decreases
(ii) As the soil depth increases, the mass of lead decreases</td></tr>
<tr><td>10a</td><td>blue → brick red</td><td>Starch + Water → Glucose
$(C_6H_{10}O_5)_n$ + nH_2O → $nC_6H_{12}O_6$
Hydrochloric acid hydrolyses starch into glucose molecules.
<table>
<tr><td>Carbohydrate</td><td>Glucose</td><td>Fructose</td><td>Maltose</td><td>Sucrose</td><td>Starch</td></tr>
<tr><td>Formula</td><td>$C_6H_{12}O_6$</td><td>$C_6H_{12}O_6$</td><td>$C_{12}H_{22}O_{11}$</td><td>$C_{12}H_{22}O_{11}$</td><td>$(C_6H_{10}O_5)_n$</td></tr>
<tr><td>Reaction with Benedict's Solution</td><td>blue
↓
brick red</td><td>blue
↓
brick red</td><td>blue
↓
brick red</td><td>no change</td><td>no change</td></tr>
</table></td></tr>
<tr><td>10b</td><td> 
</td><td>In a fair test
• same volume of starch solution
• same concentration of starch solution
• same temperature of hot water
• same time each tube in water bath</td></tr>
<tr><td>11a</td><td>Substance which burns to give out energy</td><td>A fuels is any substance which burns to give out energy e.g. heat energy</td></tr>
<tr><td>11b</td><td>$4Al + 3O_2 \rightarrow 2Al_2O_3$</td><td>$4Al + 3O_2 \rightarrow 2Al_2O_3$</td></tr>
<tr><td>11c</td><td>Neutralisation</td><td>Neutralisation: H^+ ions in acid react to become H_2O water:
acid + metal hydroxide (alkali) → salt + water
acid + metal oxide → salt + water
acid + metal carbonate → salt + water + carbon dioxide</td></tr>
<tr><td>12a</td><td> 
</td><td>Gases which are insoluble in water can be collected under water as shown opposite e.g. oxygen, nitrogen, noble gases

Gases which are soluble in water should be collected in a syringe
e.g. nitrogen dioxide, ammonia, sulphur dioxide and carbon dioxide
• Carbon Dioxide is slightly soluble in water so the best way to collect it is in a syringe and not over water</td></tr>
<tr><td>12b</td><td>Nitrogen dioxide in U-tube
Oxygen above water in tube</td><td>Nitrogen dioxide collects in the U-tube as NO_2 condenses on the cold surface due to the ice/salt mixture. Oxygen does not condense at this temperature as passes through the delivery tube to the tube above the water.</td></tr>
<tr><td>13a</td><td>Colour change to blue/black</td><td>PPA 1.1 Technique Question
Starch turns blue/black in response to the iodide ions turning into iodine</td></tr>
<tr><td>13b</td><td>Line graph showing:</td><td>½mark: labelling axes ½mark: correct scales ½mark: plotting points ½mark: drawing line</td></tr>
<tr><td>13c</td><td>Time taken decreases</td><td>Catalysts speed up a chemical reaction without being used up in the reaction. If the reaction rate is increased, the time taken is reduced.</td></tr>
<tr><td>13d</td><td>$2I^- \rightarrow I_2 + 2e^-$</td><td>$2I^-$ → I_2 + $2e^-$
Iodine ions → Iodine molecule</td></tr>
<tr><td>14a</td><td>  </td><td>Ethanoic acid as is an carboxylic acid with
• 2 carbons in the main chain
• a –COOH carboxyl functional group</td></tr>
</table>

<table>
<tr><td>14b</td><td>Molecules do not fully dissociate into ions</td><td>Strong Acid: full dissociation of molecules to form H^+ ions
Weak Acid: partial dissociation of molecules to form H^+ ions</td></tr>
<tr><td>14c</td><td>Answer to include:</td><td><table><tr><td>0-30 days</td><td>pH falls (acidity increases) as carbohydrates turn into ethanoic acid</td></tr><tr><td>30-60 days</td><td>pH increases (acidity decreases) as ethanoic acid turns into biogas</td></tr></table></td></tr>
<tr><td>15a</td><td>Neutralised when adding further solid it doesn't start fizzing again</td><td>$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$ <u>or</u> $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$
When the sulphuric acid runs out, $MgCO_3$ or Mg is in excess. To be sure no acid is left, a little extra solid is added to check there is no fizzing (which would indicate there is still acid left)</td></tr>
<tr><td>15b</td><td>Filter excess solid
Evaporate solution to get crystals</td><td>Filtration: Filtering removes the excess solid added in the neutralisation
Evaporation: Boiling the solution removes the water leaving crystals of $MgSO_4$</td></tr>
<tr><td>16</td><td>0.18mol l^{-1}</td><td>**n**o. of mol = **v**olume x **c**oncentration = 0.0225litres x 0.1mol l^{-1} = 0.00225mol
$2NaOH + H_2SO_4 \longrightarrow NaSO_4 + 2H_2O$
2mol 1mol
0.00450mol 0.00225mol
concentration = $\frac{\text{**n**o. of mol}}{\text{**v**olume}} = \frac{0.00450\ \text{mol}}{0.025\ \text{litres}} = 0.18\ \text{mol}\ l^{-1}$</td></tr>
<tr><td>17</td><td> 
<u>and</u>
</td><td> 
2-bromobutane
+ HBr
but-1-ene
but-2-ene</td></tr>
</table>