JABchem

Past Papers

Standard Grade

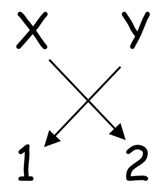
Credit

Chemistry

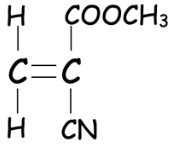
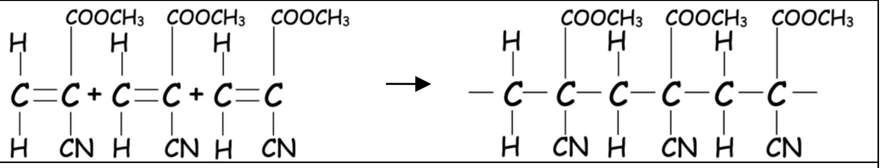
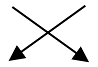
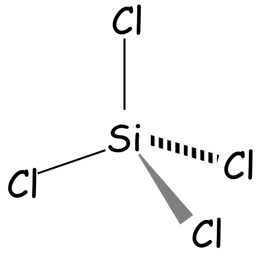
2000

Marking Scheme

2000 Standard Grade Chemistry Credit Marking Scheme

<table>
<tr><th>Question</th><th>Answer</th><th>Chemistry Covered</th></tr>
<tr><td>1a</td><td>D+F
Both for 1 mark</td><td>
<table>
<tr><td>Answer</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr>
<tr><td>Element</td><td>Aluminium</td><td>Sodium</td><td>Phosphorus</td><td>Magnesium</td><td>Oxygen</td><td>Barium</td></tr>
<tr><td>Group</td><td>3</td><td>1</td><td>5</td><td>**2**</td><td>6</td><td>**2**</td></tr>
<tr><td>Electron Arrangement</td><td>2,8,3</td><td>2,8,1</td><td>2,8,5</td><td>2,8,**2**</td><td>2,6</td><td>2,8,18,18,8,**2**</td></tr>
</table>
</td></tr>
<tr><td>1b</td><td>C+E
Both for 1 mark</td><td>
Non-metals atoms form covalent bonds when they bond
<table>
<tr><td>Answer</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr>
<tr><td>Element</td><td>Aluminium</td><td>Sodium</td><td>Phosphorus</td><td>Magnesium</td><td>Oxygen</td><td>Barium</td></tr>
<tr><td>Type of Element</td><td>metal</td><td>metal</td><td>non-metal</td><td>metal</td><td>non-metal</td><td>metal</td></tr>
</table>
</td></tr>
<tr><td>1c</td><td>B+E
Both for 1 mark</td><td>
<table>
<tr><td>Write down Formulae</td><td>Write Down Reverse of Cross Over Rule</td><td>Follow arrows to get formula</td></tr>
<tr><td>X_2Y</td><td>
</td><td>Valency of X=1
Metal X = sodium
Valency of Y=2
Element = oxygen</td></tr>
</table>
</td></tr>
<tr><td>2a</td><td>B+C
Both for 1 mark</td><td>
<table>
<tr><td>Carbohydrate</td><td>fructose</td><td>glucose</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>$\mathbf{C_{12}H_{22}O_{11}}$</td><td>$\mathbf{C_{12}H_{22}O_{11}}$</td><td>$(C_6H_{10}O_5)_n$</td></tr>
<tr><td>Type</td><td>monosaccharide</td><td>monosaccharide</td><td>disaccharide</td><td>disaccharide</td><td>polysaccharide</td></tr>
</table>
</td></tr>
<tr><td>2b</td><td>C</td><td>
<table>
<tr><td>Carbohydrate</td><td>fructose</td><td>glucose</td><td>maltose</td><td>sucrose</td><td>starch</td></tr>
<tr><td>Reaction with Benedict's Solution</td><td>turns brick red</td><td>turns brick red</td><td>turns brick red</td><td>**no change**</td><td>no change</td></tr>
<tr><td>Reaction with Iodine Solution</td><td>no change</td><td>no change</td><td>no change</td><td>**no change**</td><td>turns blue/black</td></tr>
</table>
</td></tr>
<tr><td>3a</td><td>A</td><td>☑A monomer is a butene which polymerises to form poly(butene)
☒B structure lacks C=C double bond so cannot polymerises into a polymer
☒C structure lacks C=C double bond so cannot polymerises into a polymer
☒D monomer is a propene which polymerises to form poly(propene)</td></tr>
<tr><td>3b</td><td>D</td><td>
Isomers have same formula but different structure.
<table>
<tr><td>Answer</td><td>A</td><td>B</td><td>C</td><td>D</td></tr>
<tr><td>Name</td><td>but-2-ene</td><td>propane</td><td>butane</td><td>propene</td></tr>
<tr><td>Formula</td><td>C_4H_8</td><td>C_3H_8</td><td>C_4H_{10}</td><td>$\mathbf{C_3H_6}$</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>A, C
1 mark each</td><td>☑ A reduction is gain of electrons: $Br + e^- \rightarrow Br^-$
☒ B changing the number of electrons does not affect the atomic number
☑ C gaining electrons make atoms become negatively charged ions
☒ D number of electron energy levels is unchanged
☒ E bromine has an electron arrangement of 2,8,18,7 and becomes Br^- with 2,8,18,8</td></tr>
<tr><td>5a</td><td>D</td><td>Condensation Polymerisation: Water removed as small molecules join together.
$$\underset{\text{glucose}}{nC_6H_{12}O_6} \longrightarrow \underset{\text{starch}}{(C_6H_{12}O_5)_n} + \underset{\text{water}}{nH_2O}$$</td></tr>
<tr><td>5b</td><td>A, F
1 mark each</td><td>☑A displacement: Higher up metal displaces a lower down metal from its solution
☒B hydrolysis: molecule splitting up with water added across the break
☒C fermentation: glucose breaking up into ethanol and carbon dioxide
☒D condensation: 2 molecules joining together and water removed where they join
☒E addition: molecule adds across a C=C double bond
☑F redox: $Fe \rightarrow Fe^{2+} + 2e^-$ (oxidation) and $Cu^{2+} + 2e^- \rightarrow Cu$ (reduction)</td></tr>
</table>

6	A, D 1 mark each	☑A Magnesium is oxidised and loses electrons: $Mg \rightarrow Mg^{2+} + 2e^-$ ☒B Magnesium corrodes to protect the attached iron ☒C Iron would corrode slower attached to the more reactive magnesium ☑D Magnesium corrodes to protect the attached iron from corroding ☒E Electrons from the corroding magnesium flow to the iron
7a	B, F 1 mark each	☒A Redox reaction: $Mg + 2HCl \rightarrow MgCl_2 + H_2$ ☑B Neutralisation reaction: $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\mathbf{H_2O}$ ☒C No Reaction: Copper not reactive enough to react with dilute acids ☒D Displacement/Redox Reaction: $Zn + 2AgNO_3 \rightarrow Zn(NO_3)_2 + 2Ag$ ☒E Precipitation reaction: $CuSO_{4(aq)} + Na_2CO_{3(aq)} \rightarrow Na_2SO_{4(aq)} + CuCO_{3(s)}$ ☑F Neutralisation reaction: $CaCO_3 + 2HCl \rightarrow CaCl_2 + \mathbf{H_2O} + CO_2$
7b	C	copper metal is below hydrogen in electrochemical series and will not react with dilute acids.
8a	D	☒A $(H^+)_2SO_4^{2-}$ contains two H^+ ions but only one SO_4^{2-} ion per formula unit ☒B barium hydroxide and hydrochloric acid produces no precipitate ($BaCl_2$ is soluble) ☒C H^+ ion concentration decreases when water is added to acid ☑D Positive H^+ ions move to negative electrode: $2H^+ + 2e^- \rightarrow H_2$ ☒E 1 mole of NaOH neutralises 0.5 mol of H_2SO_4 but neutralises 1 mol of HCl
8b	B, E 1 mark each	☒A $(H^+)_2SO_4^{2-}$ contains two H^+ ions but only one SO_4^{2-} ion per formula unit ☑B barium hydroxide + sulphuric acid gives insoluble barium sulphate precipitate. ☒C H^+ ion concentration decreases when water is added to any acid ☒D all acids produce hydrogen gas at the negative electrode during electrolysis ☑E 1mol of NaOH neutralises 0.5 mol of H_2SO_4 but neutralises 1 mol of HCl

<table>
<tr><th>Question</th><th>Answer</th><th>Chemistry Covered</th></tr>
<tr><td>9a</td><td>Low density</td><td>Low density is a desirable property to reduce the mass of the cables</td></tr>
<tr><td>9b</td><td>High strength</td><td>High Strength is a desirable property to ensure the cables do not break</td></tr>
<tr><td>10a</td><td><table><tr><th>Atom</th><th>protons</th><th>neutrons</th></tr><tr><td>^{28}Si</td><td>14</td><td>14</td></tr><tr><td>^{29}Si</td><td>14</td><td>15</td></tr><tr><td>^{30}Si</td><td>14</td><td>16</td></tr></table></td><td><table><tr><th>Particle</th><th>Location</th><th>Charge</th><th>Mass</th></tr><tr><td>Proton</td><td>in nucleus</td><td>+1</td><td>1 amu</td></tr><tr><td>Neutron</td><td>in nucleus</td><td>0</td><td>1 amu</td></tr><tr><td>Electron</td><td>outside nucleus</td><td>–1</td><td>approx zero</td></tr></table></td></tr>
<tr><td>10b</td><td>isotopes</td><td><table><tr><td rowspan="2">Isotopes</td><td>Same atomic number but different mass number</td></tr><tr><td>Same number of protons but different number of neutrons</td></tr></table></td></tr>
<tr><td>10c</td><td>^{28}Si</td><td>Relative (average) Atomic Mass (28.11) is closest to 28 so ^{28}Si must be the most common isotope.</td></tr>
<tr><td>11a</td><td>Naphtha</td><td>Pentane boils at 36°C (p9 of data booklet) which is within the boiling range of naphtha.</td></tr>
<tr><td>11b</td><td>Fraction has longer carbon chains in it.</td><td>The higher the boiling range of a fraction the longer the chains, the higher the viscosity, the lower the flammability.</td></tr>
<tr><td>11c(i)</td><td>Gives smaller compounds or gives unsaturated compounds</td><td>Cracking turns less useful larger factions into smaller more useful fractions so of which are unsaturated and can be used for making plastics.</td></tr>
<tr><td>11c(ii)</td><td>Less energy used or lower temperature required for reaction</td><td>Catalyst speed up reactions without being used up in the reaction. A catalyst can reduce the temperature required to achieve a successful reaction (so can be safer)</td></tr>
<tr><td>12a</td><td></td><td></td></tr>
<tr><td>12b</td><td>hydrogen cyanide
or carbon monoxide</td><td>Polymers with –CN groups burn to release poisonous hydrogen cyanide gas
Polymers burn to form the poisonous gas carbon monoxide</td></tr>
<tr><td>13a</td><td>SiO_2</td><td>Si in group 4 has valency = 4, O in group 6 has valency = 2
Use cross over rule and cancel down to achieve formula SiO_2<table><tr><th>Write down Valency below each ion's symbol</th><th>Put in Cross-over Arrows</th><th>Follow arrows and cancel down to get formula</th></tr><tr><td>Si O
4 2</td><td>Si O

4 2</td><td>Si_2O_4
$\downarrow$
SiO_2</td></tr></table></td></tr>
<tr><td>13b</td><td>Chlorine Cl_2 gas</td><td>Problem Solving Question: $Si + 2Cl_2 \rightarrow SiCl_4$</td></tr>
<tr><td>13c</td><td>distillation</td><td>distillation separates liquids of different boiling points</td></tr>
<tr><td>13d</td><td></td><td>$SiCl_4$ has the same tetrahedral shape of methane CH_4
Si can substitute for carbon as they are both in group 4
Chlorine can substitute for hydrogen as they both have a valency of 1</td></tr>
<tr><td>13e</td><td>$SiCl_4 + 2H_2 \rightarrow Si + 4HCl$</td><td>$SiCl_4 + 2H_2 \rightarrow Si + 4HCl$</td></tr>
</table>

14a	to complete the circuit	ions move from one beaker to the other beaker to balance movement of electrons through the wires.
14b	any soluble tin compound	soluble tin (II) compounds examples found on p8 of data booklet: e.g. Tin (II) bromide/chloride/iodide/sulphate
14c	Any metal below tin in electrochemical series	The further apart the metals on the electrochemical series, the greater the voltage produced
15a	20.9%	Volume of air removed = 60.0 – 47.5 = 12.5cm^3 % Oxygen = $\frac{\text{volume removed}}{\text{total volume}} \times 100 = \frac{12.5}{60} \times 100 = 20.9\%$
15b	to ensure all oxygen is reacted with the copper	Hot copper metal will react with oxygen to form copper oxide: $2Cu_{(s)} + O_{2(g)} \rightarrow 2CuO_{(s)}$
15c	The oxygen removed will be replaced by the carbon dioxide produced	The syringe will move to equalise pressure inside and outside the syringe. When oxygen is removed, the pressure decreases inside the syringe and the syringe moves to equalise the pressure
16a	To be able to identify the products or so that electrode is positive	DC (direct current) is a flow of electrons in one direction. AC (alternating current) changes direction many times in one second. This switching of direction swaps the positive and negative electrode meaning the +ve and –ve ions will not move towards one particular electrode and the circuit will not be complete.
16b	Line graph with:	½ mark both labels with units ½ mark both scales ½ mark points plotted correctly ½ mark points joined
16c	~ 17cm^3 (from graph)	On graph, find 10 on x-axis and find the point on graph directly above 10min. AT his point, move horizontally to find the value on the y-axis for volume of gas in cm^3
16d	$2H^+ + 2e^- \rightarrow H_2$	equation found on p10 of data booklet
17a	Haber Process	Nitrogen + Hydrogen $\xrightarrow{\text{iron}}$ Ammonia
17b	Ammonia breaks down or yield decreases	The Haber Process does not give 100% ammonia as it starts to breaks down as fast as it is produced. The higher the temperature the less ammonia is produced.
17c	Ammonia used to make fertilisers and fertilises need to feed increased population	Ammonia is used to make nitric acid in the Ostwald process and then produces nitrate fertilisers. More population means more food required to feed larger population.
18a	family of compounds with similar chemical properties and a general formula	Homologous Series: Alkane, Alkene, Cycloalkane, Alcohol, Carboxylic Acids General Formula: C_nH_{2n+2}, C_nH_{2n}, C_nH_{2n}, $C_nH_{2n+1}OH$, $C_nH_{2n+1}COOH$
18b	36g	1mol C_3H_8 = (3x12) + (8x1) = 36 + 8 = 44g **no.** of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{22g}{44g\ mol^{-1}}$ = 0.5mol $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ 1mol 4mol 0.5mol 2mol 1mol H_2O = (2x1)+(1x16) = 2 + 16 = 18g **mass** = **no.** of mol x **gfm** = 2mol x 18g mol^{-1} = 36g
19a	Water in test tube would not turn iodine blue/black	Starch molecules are too big to fit through the small holes in the visking tube. Any starch getting through holes would turn the water in the test tube blue/black.
19b(i)	Breaking down adding water at the breaks	Hydrolysis: starch + water $\rightarrow$ glucose $(C_6H_{10}O_5)n + nH_2O \rightarrow nC_6H_{12}O_6$

<table>
<tr><td>19b(ii)</td><td>Answer to include:</td><td>1. Starch and amylase solution mixed and placed into Visking tubing.
2. Visking tubing tied at end and washed on outside.
3. Visking tubing placed in test tube of water and incubated at 37°C in water bath
4. After some time, water outside Visking tubing is tested with warm Benedict's solution. When it turns brick red it indicated glucose and has travelled through the visking tubing.</td></tr>
<tr><td>20a</td><td>Fermentation</td><td>$\text{glucose} \xrightarrow[\text{(no air)}]{\text{yeast enzymes}} \text{ethanol} + \text{carbon dioxide}$
$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$</td></tr>
<tr><td>20b(i)</td><td>higher the no. of carbons, the higher the amount of heat released</td><td>Increased number of carbons methanol → butanol gradual increase in the amount of heat energy increased</td></tr>
<tr><td>20b(ii)</td><td>~3311 kJ</td><td><table>
<tr><td>Alkanol</td><td>Methanol</td><td>Ethanol</td><td>Propanol</td><td>Butanol</td><td>Pentanol</td></tr>
<tr><td>Heat Released (kJ)</td><td>726</td><td>1367</td><td>2017</td><td>2665</td><td>-</td></tr>
<tr><td>Difference:</td><td>▨</td><td>641</td><td>650</td><td>648</td><td>Average 646</td><td>▨</td></tr>
<tr><td>Prediction:</td><td>-</td><td>-</td><td>-</td><td>-</td><td>3311</td></tr>
</table></td></tr>
</table>