JABchem

Past Papers Int 2 Chemistry

2011

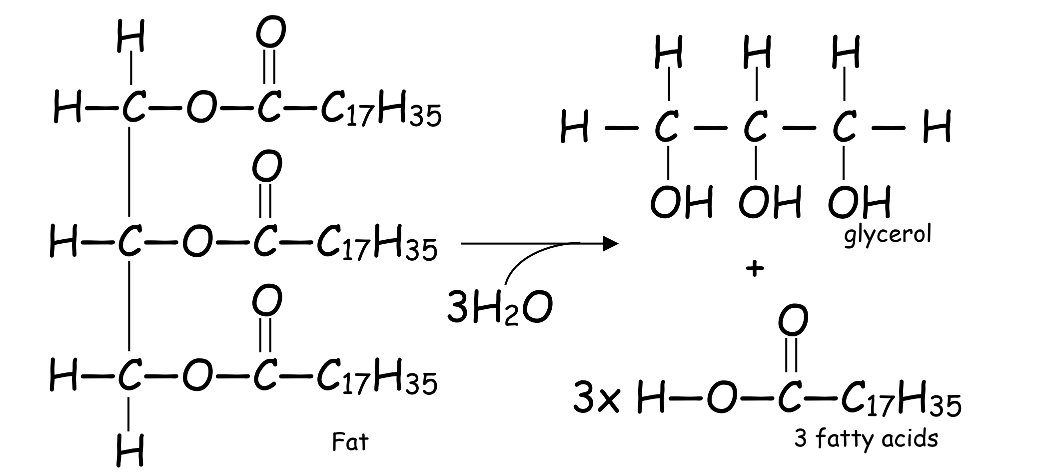
Marking Scheme

Grade Awarded	Mark Required (/80)	%	% candidates achieving grade
A	+51	63.8%+	36.9%
B	+43	53.8%+	22.5%
C	+36	45%+	18.6%
D	+32	40%+	8.4%
No award	<32	<40%	13.6%

Section:	Multiple Choice	Extended Answer
Average Mark:	19.8 /30	26.5 /50

2011 Int2 Chemistry Marking Scheme

<table>
<tr><th>MC Qu</th><th>Answer</th><th>% Pupils Correct</th><th>Reasoning</th></tr>
<tr><td>1</td><td>B</td><td>71</td><td>☒A aluminium is in group 3 and is not a transition metal
☑B cobalt is a transition metal and chlorine is a group 7 halogen
☒C oxygen is in group 6 and not a halogen (halogen atoms form halide ions)
☒D sodium is in group 1 and is not a transition metal</td></tr>
<tr><td>2</td><td>D</td><td>71</td><td>☒A magnesium hydroxide contains 3 elements (magnesium, hydrogen and oxygen)
☒B magnesium phosphate contains 3 elements (magnesium, phosphorus and oxygen)
☒C magnesium sulphite contains 3 elements (magnesium, sulphur and oxygen)
☑D magnesium nitride contains 2 elements (magnesium and nitrogen)</td></tr>
<tr><td>3</td><td>A</td><td>84</td><td>☑A increasing the volume of acid would not change the rate of reaction
☒B decreasing the size of marble chips would increase the rate of reaction
☒C decreasing the concentration of acid would decrease the rate of reaction
☒D increasing the temperature would increase the rate of reaction</td></tr>
<tr><td>4</td><td>D</td><td>72</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>5</td><td>A</td><td>88</td><td>Atomic number = number of protons = 26
Mass number = number of protons + number of neutrons = 26 + 30 = 56</td></tr>
<tr><td>6</td><td>A</td><td>15</td><td>Air contains approx 20% oxygen, 79% nitrogen and 0.03% carbon dioxide.
Burning magnesium will react with oxygen in air to form magnesium oxide. Excess burning magnesium will remove virtually all the oxygen from the air but this gas is not replaced as magnesium oxide is a solid.
The 79% nitrogen in the air at the start becomes 98% of the remaining gas when the oxygen is removed.</td></tr>
<tr><td>7</td><td>D</td><td>74</td><td>☒A All atoms are free to vibrate, not just atoms in conducting materials like copper
☒B The ability to conduct needs more than atoms to be in close contact to work
☒C This electron arrangement is not the key factor in electrical conduction
☑D The conduction of electricity is dependent on the ability of electrons to jump from atom to atom</td></tr>
<tr><td>8</td><td>C</td><td>54</td><td><table><tr><th>Chromium chloride has the formula</th><th>Chloride ions have the formula</th><th>3 chloride ions per chromium chloride</th><th>Chromium ion must have 3+ charge to balance charge</th></tr><tr><td>$CrCl_3$</td><td>Cl^-</td><td>$Cr^{n+}(Cl^-)_3$</td><td>$Cr^{3+}(Cl^-)_3$</td></tr></table></td></tr>
<tr><td>9</td><td>A</td><td>41</td><td>☑A Combustion is the burning a substance in oxygen
☒B Condensation joins together two molecules removing water at the join point
☒C Dehydration removes water from a molecule leaving a C=C double bond behind
☒D Hydrolysis is breaking down a larger compound adding water across the break</td></tr>
<tr><td>10</td><td>C</td><td>94</td><td>Fractional Distillation involves the separation of compounds due to their different boiling points. The compounds are collected by condensing the vapours back into liquids.</td></tr>
<tr><td>11</td><td>C</td><td>32</td><td>☒A CH_4 is methane and is the main constituent of natural gas
☒B C_3H_8 is propane and is a major constituent of LPG (liquefied petroleum gas)
☑C C_8H_{18} is octane and is found in petrol.
☒D $C_{14}H_{30}$ is most likely to be found in kerosene or diesel</td></tr>
<tr><td>12</td><td>C</td><td>81</td><td>☒A cyclobutane C_4H_8 is in a different homologous series from propane C_3H_8
☒B but-2-ene C_4H_8 is in a different homologous series from propane C_3H_8
☑C 2-methylbutane C_5H_{12} is in the same homologous series as propane C_3H_8
☒D 2-methylbut-1-ene C_5H_{10} is in a different homologous series from propane C_3H_8</td></tr>
<tr><td>13</td><td>B</td><td>78</td><td>☒A but-2-ene has 4 carbons only
☑B pent-2-ene has 5 carbons and C=C double bond between C_2 and C_3
☒C but-3-ene has 4 carbons only (and should be renumbered to but-2-ene)
☒D pent-3-ene is an incorrectly named compound as lowest number system has not been used</td></tr>
</table>

14	B	40	☒A ethene would only produce 1-bromoethane ☑B but-1-ene would produce 1-bromobutane and 2-bromobutane ☒C but-2-ene would only produce 2-bromobutane ☒D hex-3-ene would only produce 3-bromohexane
15	A	86	☑A C=O group in middle of compound so reaction *stays orange* ☒B C=O group is on end of molecule so reaction mixture *turns green* ☒C C=O group is on end of molecule so reaction mixture *turns green* ☒D C=O group is on end of molecule so reaction mixture *turns green*
16	D	79	☒A Isomers: same molecular formula but different structural formula ☒B Hydrocarbons: compounds which contain carbon and hydrogen only ☒C Alkanols: homologous series of alcohols with the general formula $C_nH_{2n+1}OH$ ☑D Carbohydrate: carbon, hydrogen and oxygen compounds with H:O in ratio 2:1
17	C	51	☒A Amine groups are found in amino acids but not in proteins ☒B C=C double bonds are rarely found in protein molecules ☑C Peptide link: Found in all proteins and formed as amino acids join together ☒D Ester link: found in esters, polyesters, fats and oils but not in proteins
18	D	40	☒A Sugars: not polymers but are monosaccharides $C_6H_{12}O_6$ or disaccharides $C_{12}H_{22}O_{11}$ ☒B Animal Fats: triglycerides with ester links between 3 fatty acids and glycerol ☒C Marine Oils: triglycerides with ester links between 3 fatty acids and glycerol ☑D Vegetable Proteins: polymers formed as amino acids join together
19	B	57	☒A oils have low melting points as they are liquids at room temperature ☑B oils have low melting points and high degree of unsaturation (contain C=C bonds) ☒C oils have high degree of unsaturation as they have C=C double bonds ☒D oils have high degree of unsaturation as they have C=C double bonds
20	C	49	
21	A	60	☑A Sodium oxide is a metal oxide ∴ dissolves in water to form an alkali (pH>7) ☒B Aluminium oxide is insoluble in water (p8 of data booklet) ☒C Sulphur dioxide is a non-metal oxide ∴dissolves in water to form an acid (pH<7) ☒D Silver oxide is insoluble in water (p8 of data booklet)
22	B	74	☒A H^+ ion concentration decreases as acid is diluted with water ☑B H^+ ion concentration decreases and pH of acid increases to pH=7 when diluted. ☒C pH of acid will increase up to pH=7 when diluted with water ☒D pH of acid will increase up to pH=7 when diluted with water
23	D	53	☒A ammonia is a weak alkali ∴ not the highest pH ☒B pH of hydrochloric acid is below 7 ∴ not the highest pH ☒C pH of sodium chloride is equal to 7 ∴ not the highest pH ☑D sodium hydroxide is a strong alkali ∴ highest pH
24	A	88	☑A calcium carbonate + hydrochloric acid ⟶ calcium chloride + water + carbon dioxide ☒B copper oxide + sulphuric acid ⟶ copper sulphate + water ☒C copper is not reactive enough to react with hydrochloric acid ☒D magnesium + sulphuric acid ⟶ magnesium sulphate + hydrogen

25	D	90	$H^+ + NO_3^- + K^+ + OH^- \rightarrow K^+ + NO_3^- + H_2O$ Cancel out any spectator ions which appear on both sides $H^+ + \cancel{NO_3^-} + \cancel{K^+} + OH^- \rightarrow \cancel{K^+} + \cancel{NO_3^-} + H_2O$ Re-write equation omitting spectator ions $H^+ + OH^- \rightarrow H_2O$
26	D	85	☒A copper is below zinc in electrochemical series ∴ no displacement reaction ☒B gold is below zinc in electrochemical series ∴ no displacement reaction ☒C iron is below zinc in electrochemical series ∴ no displacement reaction ☑D Magnesium is above zinc in electrochemical series ∴ displacement reaction
27	B	63	Z is the *most* reactive as it is the only metal to react with water. — Z comes **last** Y is the *least* reactive as it is the only metal not to react with acid — Y comes **first**
28	D	56	☒A Calcium is only made from calcium oxide by molten electrolysis ☒B Copper can be made by heating copper oxide with carbon ☒C Zinc can be made by heating zinc oxide with carbon ☑D silver is unreactive and can be made by heating silver oxide alone
29	C	86	☒A Both air <u>and</u> water are needed for rusting/corrosion to take place ☒B Both air <u>and</u> water are needed for rusting/corrosion to take place ☑C Both air <u>and</u> water are needed for rusting/corrosion to take place ☒D Salt is not necessary for rusting to take place (salt speeds up rusting)
30	B	64	☒A Scratched plastic coating does not speed up the rusting ☑B Scratched zinc coating prevents the rusting of iron (zinc on iron is galvanising) ☒C Scratched tin coating would speed up rusting as iron is higher than tin in ECS ☒D Scratched paint coating does not speed up the rusting

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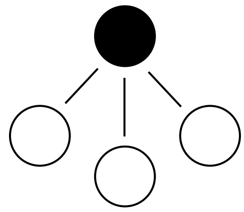
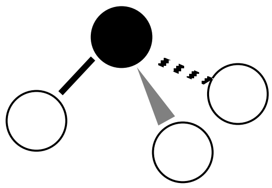
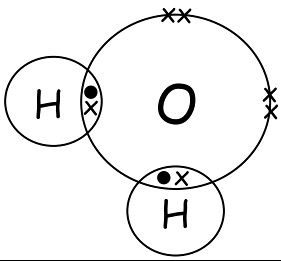
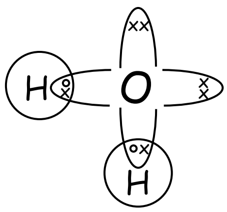
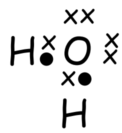
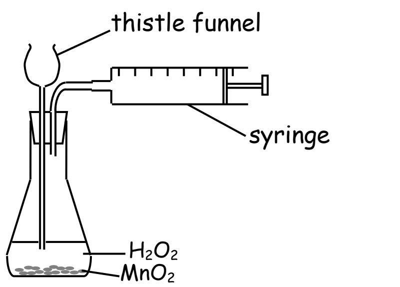
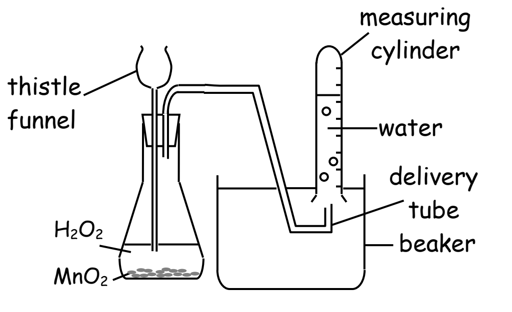
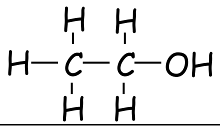
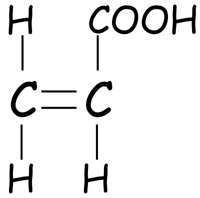
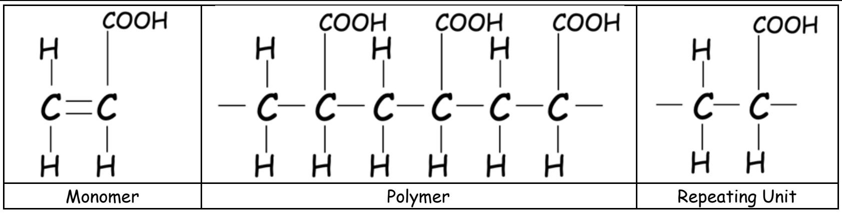
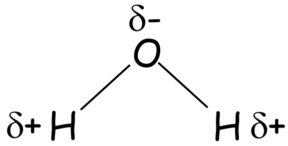
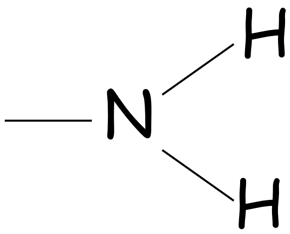
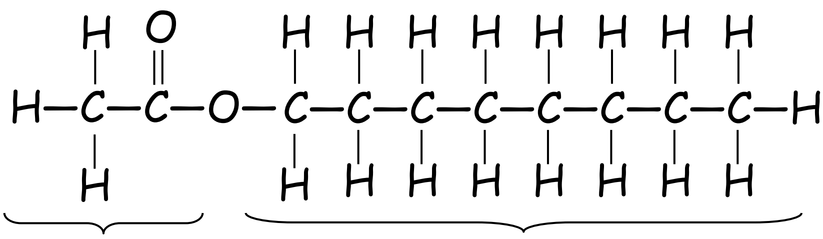
Long Qu	Answer	Reasoning
1a	Covalent Network Ionic Lattice Metallic Lattice Discrete Covalent Molecular	Covalent Network – Covalent as it does not conduct in any state and network due to high m.pt. Ionic Lattice – Ionic do not conduct when solid but do conduct when molten or in solution Metallic Lattice – Metallic substances conduct when solid Discrete Covalent Molecular – Covalent as it does not conduct in any state and molecular due to low m.pt.
1b	SiO_2	Total number of Si shown = 8 Total number of O shown = 16 Ratio of Si:O = 8:16 = 1:2 ∴ Formula = SiO_2
2a		Any three dimensional trigonal pyramidal shape: 
2b		Also Acceptable:  
3a	$2H_2O_2 \rightarrow O_2 + 2H_2O$	$2H_2O_2 \longrightarrow O_2 + 2H_2O$
3b	syringe or collection under water	 
3c	Relights a glowing splint	Gas: Hydrogen / Oxygen / Carbon Dioxide Gas Test: Burns with a pop / Relights glowing splint / Turns lime water milky
3d	0.6	$2H_2O_2 \longrightarrow O_2 + 2H_2O$ 34g → 12litres 1.7g → 12litres x $^{1.7}/_{34}$ = 0.6litres
4a(i)	In same state as reactants	**Type of Catalyst** – **Definition** Homogeneous – Catalyst in same state as reactants Heterogeneous – Catalyst in different state from reactants
4a(ii)	$RuCl_2$	Write down Valency below each element's symbol: Ru Cl / 2 1 Put in Cross-over Arrows: Ru Cl / 2 ✕ 1 Follow arrows to get formula: $RuCl_2$

4b(i)	Line graph:	½mark labelling axes; ½mark correct scales; ½mark plotting points; ½mark drawing line
4b(ii)	34-35	Problem Solving: Estimation of end of reaction
4b(iii)	0.1	Rate = $\frac{\Delta quantity}{\Delta time} = \frac{2.2 - 1.2}{20 - 10} = \frac{1}{10}$ = 0.1 bar min^{-1}
5a	precipitation	A precipitation reaction is when two soluble solution come together and two ions meet and form an insoluble salt.
5b	9.6	1mol $(NH_4)_2SO_4$ = (2x14) + (8x1) + (1x32) + (4x16) = 28+8+32+64 = 132g no of mol = $\frac{\textbf{mass}}{\textbf{gfm}} = \frac{13200g}{132g\ mol^{-1}}$ = 100 mol $(NH_4)_2CO_3 + CaSO_4 \longrightarrow (NH_4)_2SO_4 + CaCO_3$ 1mol → 1mol 100mol → 100mol 1mol $(NH_4)_2CO_3$ = (2x14) + (8x1) + (1x12) + (3x16) = 28+8+12+48 = 96g **mass** = **no**. of mol x **gfm** = 100 x 96 = 9600g = 9.6kg
6a	To neutralise the acid	Sodium hydrogencarbonate (also known as sodium bicarbonate) neutralises acid by a neutralisation reaction producing water and carbon dioxide gas
6b	10cm^3 starch solution + 1cm^3 water water	PPA Technique Question: The conditions in the control experiment must replicate the original except for the presence of acid. The volume of acid must be replaced with water.
7	1 Crude oil 2 Styrene 3 polyethenol	**1:** Crude oil is the main *feedstock* from which plastics come from **2:** Polymer – Monomer: poly(ethene) – ethene; poly(propene) – propene; poly(styrene) – styrene; poly(chloroethene) – chloroethene **3:** Polymer – Property: poly(ethenol) – soluble in water; kevlar – very strong; poly(ethyne) – conducts electricity; biopol – biodegreadable
8a	Carbon monoxide is produced	Carbon monoxide gas is produced by incomplete combustion when there is a limited oxygen/air supply.
8b	Less than 3%	Catalytic convertors turn nitrogen oxides back into nitrogen
8c	Forms acid rain	Acid rain is formed when SO_2 dissolves in rain water. Acid rain damages the environment by: Killing plant life | Killing marine life | Corroding metal structures | Reacting with carbonate rocks | Decreasing soil pH
9a	Photosynthesis	$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2$ carbon dioxide, water, glucose, oxygen
9b	enzymes or biological catalyst	Enzymes in yeast catalyse fermentation: $C_6H_{12}O_6 \xrightarrow[\text{(no oxygen available)}]{\text{enzymes in yeast}} 2C_2H_5OH + 2CO_2$ glucose, ethanol, carbon dioxide
9c		<u>*Eth*</u>anol is a 2 carbon structure. Ethan<u>*ol*</u> is an alcohol with a hydroxyl –OH functional group
9d	2.96	Volume of Alcohol = $\frac{9 \times 1.25}{3.8} = \frac{11.25}{3.8}$ = 2.96

10a(i)		
10a(ii)	polar covalent bonding	The –OH bonds in both water and the polymer are polar bonds because the attraction for the bonded electrons is different between the atoms in the bond. (The question specifies that the bonding type is **IN** the water molecules.) 
10b	partial dissociation or does not fully ionise	Strong Acid: full dissociation of ions e.g. hydrochloric acid Weak Acid: partial dissociation of molecules into ions e.g. ethanoic acid
11a	Amine	Functional Group of amines: 
11b	Octyl ethanoate	 2C carboxylic acid Ester ends in ETHANOATE 8C alcohol side Ester starts with OCTYL
11c(i)	colourless → orange/red	Colourless → Orange/Red Bromine added from burette reacts with Limonene in flask and flask stays colourless When Limonene has completely reacted with bromine, bromine remains in the flask and flask is orange/red.
11c(ii)	16.0	Average volume always ignores rough (1st) titration. The 1st titration is used to work out roughly the volume the colour change takes place at so the following titration can be carried out extremely accurately. Average = $\frac{16.1 + 15.9}{2} = \frac{32.0}{2} = 16.0\text{cm}^3$
11c(iii)	0.2	**no.** of mol Br_2 = **volume** x **concentration** = 0.016$_{\text{litres}}$ x 0.5$_{\text{mol l}^{-1}}$ = 0.008$_{\text{mol}}$ $C_{10}H_{16}$ + $2Br_2$ → $C_{10}H_{16}Br_4$ 1mol 2mol 0.004mol 0.008mol concentration = $\frac{\text{no. of mol}}{\text{volume}} = \frac{0.004 \text{ mol}}{0.020 \text{ litres}}$ = 0.2 mol l^{-1}

12a	reduction	Metal compounds contain metal ions. When metals are extracted from metal compounds the metal ions turn into metal atoms. This involves the reduction of metals ions into metal atoms as the metal ions must gain electrons to become metal atoms. Cu^{2+} (copper (II) ions) + $2e^-$ (gain of electrons) $\rightarrow$ Cu (copper atoms)
12b(i)	Positive / Negative	Bubbles of Gas = Chlorine gas $2Cl^- \rightarrow Cl_2 + 2e^-$ Positive electrode picks up electrons Brown Solid = copper metal $Cu^{2+} + 2e^- \rightarrow Cu$ Negative electrode supplies electrons
12b(ii)	Bleaching of litmus paper	Chlorine gas bleaches litmus paper and pH paper
13a	C	Alkaline solutions have pH above 7 ∴ Methyl orange is yellow at pH above 4.4 ∴ Bromothymol Blue is blue at pH above 7.6
13b	4.5 – 5.9	Methyl Orange is yellow ∴ pH is above 4.4 Bromothymol Blue is yellow ∴ pH is below 6.0
14a	3	Metal 3 is above copper in electrochemical series as electrons flow to copper Metal 3 gives biggest voltage so is furthest from copper in electrochemical series
14b	2 + 3	Metals furthest apart in electrochemical series give biggest voltage • Metal 3 is the highest metal in electrochemical series (see above) • Metal 2 is the lowest metal in the electrochemical series o Metal 2 is below copper in electrochemical series as electrons flow from copper o Metal 2 gives bigger voltage of metals below copper in ECS
14c	0 or zero	Same metal attached to itself gives zero voltage in a cell
14d	Glucose is covalent and has no ions	A solution containing ions is required for the electrolyte. Glucose ($C_6H_{12}O_6$) is covalent as it only contains non-metal atoms and therefore does not complete the circuit as it contains no ions.
15a	pH increases	H^+ ions are used up during reaction ∴ as concentration of H^+ ions decreases, pH increases
15b	$Ca_{10}(PO_4)_6F_2$	As OH^- ions can be directly replaced by F^- ions: calcium hydroxyapatite $\rightarrow$ calcium fluoroapatite $Ca_{10}(PO_4)_6(OH)_2$ $\rightarrow$ $Ca_{10}(PO_4)_6F_2$