Past Papers Int 2 Chemistry

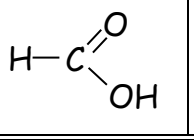
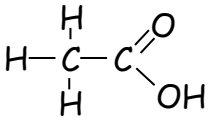
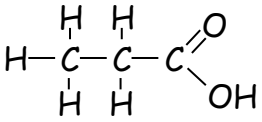
2014 Marking Scheme

Grade Awarded	Mark Required (/80)	%	% candidates achieving grade
A	56+	70%+	33.6%
B	48+	60%+	16.6%
C	40+	50%+	20.0%
D	36+	%40+	9.7%
No award	<36	<40%	20.2%

Section:	Multiple Choice	Extended Answer
Average Mark:	20.0 /30	28.7 /50

2014 Int2 Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	D	84	☒A Aluminium is in the block between groups 2 & 3 and is a transition metal ☒B Calcium is in group 2 and is an Alkaline Earth Metal ☒C Copper is in the block between groups 2 & 3 and is a transition metal ☑D Sodium is in group 1 and is an Alkali Metal
2	A	76	☑A water is the liquid which does the dissolving ∴ water is the solvent ☒B sugar is a solid which is dissolved ∴ sugar is a solute ☒C lemon juice is a liquid which is dissolved ∴ lemon juice is a solute ☒D carbon dioxide is a gas which is dissolved ∴ carbon dioxide is a solute
3	B	39	☒A Products are higher on diagram ∴ have more energy than reactants ☑B diagram shown is an endothermic reaction and the temperature will fall ☒C diagram shown is an endothermic reaction and heat is absorbed from surroundings ☒D diagram shown is an endothermic reaction as products are higher than reactants
4	B	97	☒A Carbohydrate is a food group made from carbon, hydrogen and oxygen ☑B Enzymes are proteins which act as biological catalyst in living organisms ☒C Sugars is a food group made from carbon, hydrogen and oxygen ☒D Fats is a food group made from carbon, hydrogen and oxygen
5	D	92	☒A Electron arrangement 2,4 = carbon ∴ group 4 element ☒B Electron arrangement 2,5 = nitrogen ∴ group 5 element ☒C Electron arrangement 2,6 = oxygen ∴ group 6 element ☑D Electron arrangement 2,7 = fluorine ∴ group 7 element ∴ element is a halogen
6	A	54	Phosphate PO_4^{3-} is listed in data booklet page 8 ∴ Total negative charge in $Zn_3(PO_4)_2$ formula is 6- as there are two phosphate ions All ionic compounds are neutral over all so the total positive charge must be 6+ ∴ Total positive charge in 3 zinc ions = 6+ ∴ Positive charge on zinc ion = $^{6+}/_{3}$ = 2+
7	B	47	☒A Covalent Molecular: does not conduct as solid or liquid and has low bpt ☑B Covalent Network: does not conduct as solid or liquid and has high mpt ☒C Ionic: Does not conduct as solid but does conduct as a liquid ☒D Metallic: Conducts as both as a solid and as a liquid
8	A	56	☑A H^+ ions move to the negative electrode and form H_2 gas ☒B H_2 is formed in the reaction at the -ve electrode but not present at the start ☒C Cl^- ions move to the positive electrode and form Cl_2 gas ☒D Cl_2 is formed in the reaction at the +ve electrode but not present at the start
9	C	90	$Fe_2O_3 + CO \rightarrow Fe + CO_2$ Fe: 2xFe before arrow but 1xFe after arrow ∴ *double Fe after arrow* $Fe_2O_3 + CO \rightarrow \mathbf{2}Fe + CO_2$ O: 4xO before arrow but 2xO after arrow ∴ *double CO_2 after arrow* $Fe_2O_3 + CO \rightarrow 2Fe + \mathbf{2}CO_2$ C: 1xC before arrow but 2xC after arrow ∴ *double CO before arrow* $Fe_2O_3 + \mathbf{2}CO \rightarrow 2Fe + 2CO_2$ O: 5xO before arrow but 4xO after arrow ∴ *increase CO to 3 before arrow* $Fe_2O_3 + \mathbf{3}CO \rightarrow 2Fe + 2CO_2$ C: 3xC before arrow but 2xFe after arrow ∴ *increase CO_2 to 3 after arrow* $Fe_2O_3 + 3CO \rightarrow 2Fe + \mathbf{3}CO_2$

10	C	81	☒A 1mol CH_4 = (1x12)+(4x1) = 12+4 = 16g ∴ 0.5mol = 8g ☒B 1mol CO_2 = (1x12)+(2x16) = 12+32 = 44g ∴ 0.5mol = 22g ☑C 1mol NO_2 = (1x14)+(2x16) = 14+32 = 46g ∴ 0.5mol = 23g ☒D 1mol NH_3 = (1x14)+(3x1) = 14+3 = 17g ∴ 0.5mol = 8.5g
11	B	92	☒A carbon monoxide is a poisonous gas and must not be formed by the converter ☑B carbon monoxide is a poisonous gas which is converted into carbon dioxide ☒C nitrogen monoxide is a poisonous gas and must not be formed by the converter ☒D oxygen is a harmless gas and there is no need for the converter to remove it
12	C	45	☒A nitrogen compound formed comes from nitrogen in compound being burned ☒B hydrogen compound formed comes from hydrogen in compound being burned ☑C compounds of nitrogen, hydrogen and carbon formed mean all three must be in compound being burned ☒D oxygen could have come from the air that the compound was burned in
13	A	75	A carboxylic acid can be identified from the carboxyl group (-COOH) and '-oic' name ending. methanoic acid  ethanoic acid  propanoic acid 
14	B	42	☒A reaction would form 1-bromobutane and 2-bromobutane ☑B reaction would form 2-bromobutane *only* ☒C reaction would form 1-bromopentane and 2-bromopentane ☒D reaction would form 2-bromobutane and 3-bromobutane
15	C	81	☒A addition: molecule added across a C=C double bond ☒B cracking: bigger saturated molecules break down into smaller unsaturated molecules ☒C distillation: separation of molecules with different boiling points ☑D hydrolysis: splitting polymers into smaller monomers with water added at the break
16	D	74	☒A polyethene is a synthetic polymer as it is not found in nature ☒B polyethene is a synthetic polymer as it is not found in nature ☒C polyethene is a thermoplastic polymer as is reshapes on heating ☑D polyethene is synthetic polymer which is thermoplastic
17	B	60	☒A fructose is not the monomer to make starch by condensation polymerisation. ☑B starch is made by the condensation polymerisation of glucose monomer units ☒C starch is made by condensation where H_2O is removed as the monomers join up ☒D starch is made by condensation where H_2O is removed as the monomers join up
18	C	74	☒A Glucose turns Benedict's solution blue→brick red ☒B Maltose turns Benedict's solution blue→brick red ☑C Sucrose does not react with either iodine solution or Benedict's solution ☒D Starch turns iodine solution yellow→blue/black
19	C	77	☒A Esters are made from an alcohol and a carboxylic acid joining together ☒B Fats are made from glycerol and three fatty acids joining together ☑C Proteins are made from amino acid joining together ☒D Starch is made from glucose molecules joining together
20	C	79	☒A All aqueous solutions contain both hydrogen and hydroxide solutions ☒B All aqueous solutions contain both hydrogen and hydroxide solutions ☑C Acids contain more hydrogen ions than hydroxide ions ☒D Alkalis contain more hydroxide ions than hydrogen ions
21	B	63	☒A Ammonia solution is a weak alkali and typically gives a pH of around pH=11 ☑B Sodium hydroxide is a strong alkali and 0.1mol l^{-1} $NaOH_{(aq)}$ has a pH=13 ☒C ethanoic acid is acidic and would give an acidic pH below pH=7 ☒D hydrochloric acid is acidic and would give an acidic pH below pH=7

22 — A — 68

☑A calcium oxide is a soluble metal oxide which dissolves to form an alkali
☒B nickel oxide is a non-soluble metal oxide so has no effect on pH
☒C nitrogen dioxide is a soluble non-metal oxide and dissolves to form an acid
☒D sulphur dioxide is a soluble non-metal oxide and dissolves to form an acid

23 — B — 56

☒A no gas produced: magnesium hydroxide + hydrochloric acid → magnesium chloride + water
☑B CO_2 produced: magnesium carbonate + hydrochloric acid → magnesium chloride + water + CO_2
☒C no gas produced: magnesium oxide + hydrochloric acid → magnesium chloride + water
☒D flammable gas produced: magnesium + hydrochloric acid → magnesium chloride + hydrogen

24 — D — 57

☒A sodium nitrate is suitable as a fertiliser as it is soluble and contains nitrogen
☒B ammonium nitrate is suitable as a fertiliser as it is soluble and contains nitrogen
☒C ammonium sulphate is suitable as a fertiliser as it is soluble and contains nitrogen
☑D sodium sulphate is not a fertiliser as it has no nitrogen, phosphorus or potassium

25 — A — 79

Metal	Potassium	Sodium	Lithium	Calcium	Magnesium	Aluminium	Zinc	Iron	Tin	Lead	Copper	Mercury	Silver	Gold	Platinum
Reaction With Oxygen	Burn In Oxygen to Form Metal Oxide								Slowly React With Oxygen			No Reaction With Oxygen			
Reaction With Water	Fast Reaction With Water				Slow Reaction With Water Faster Reaction With Steam							No Reaction with Water or Steam			
Reaction With Acids	Violent Reaction With dilute acids				React With dilute acids				Slow Reaction			No Reaction With dilute acids			

26 — D — 59

☒A addition: molecule added across a C=C double bond
☒B displacement: higher up metals displace lower down ions from compounds
☒C neutralisation: Hydrogen H^+ ions react to become water H_2O
☑D precipitation: insoluble solid formed when two solutions are mixed

27 — C — 46

The two stages in the rusting of iron are:

$$Fe_{(s)} \longrightarrow Fe^{2+}_{(aq)} + 2e^- \text{ followed by } Fe^{2+}_{(aq)} \longrightarrow Fe^{3+}_{(aq)} + e^-$$

28 — C — 48

☒A hexane C_6H_{14} is covalent and cannot be used as an electrolyte
☒B copper(II) oxide is ionic but cannot be used as an electrolyte as it is insoluble
☑C Calcium chloride is ionic and soluble and can be used as an electrolyte
☒D carbon chloride CCl_4 is covalent and cannot be used as an electrolyte

29 — B — 49

❶ $H_2O_{(l)} + SO_3^{2-}{}_{(aq)} \rightarrow SO_4^{2-}{}_{(aq)} + 2H^+_{(aq)} + 2e^-$
❷ $Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$

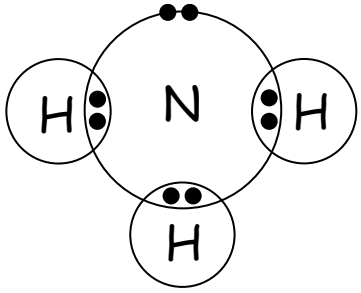
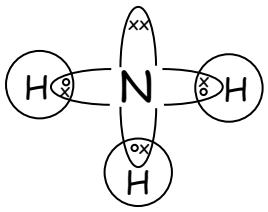
❶ $H_2O_{(l)} + SO_3^{2-}{}_{(aq)} \rightarrow SO_4^{2-}{}_{(aq)} + 2H^+_{(aq)} + 2e^-$
❷x2 $2Fe^{3+}_{(aq)} + 2e^- \rightarrow 2Fe^{2+}_{(aq)}$

Add ❶+❷′ (cancelling $2e^-$) $H_2O_{(l)} + SO_3^{2-}{}_{(aq)} + 2Fe^{3+}_{(aq)} \rightarrow SO_4^{2-}{}_{(aq)} + 2H^+_{(aq)} + 2Fe^{2+}_{(aq)}$

30 — B — 68

Method	Electrolysis		Heat With Carbon		Heat Alone	
Metals Made This Way	Potassium	Sodium	Zinc	Iron	Mercury	Silver
	Lithium	Calcium	Nickel	Tin	Gold	Platinum
	Magnesium	Aluminium	Lead	Copper		
Reason	most reactive metals		medium reactive metals		least reactive metals	

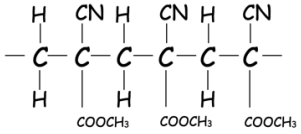
2014 Int2 Chemistry Marking Scheme

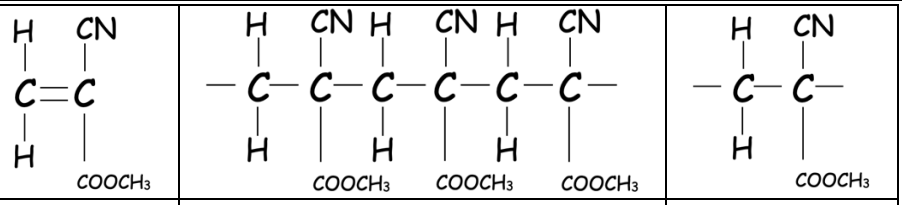
Long Qu	Answer	Reasoning
1a	Hydrogen	ACID + METAL → SALT + HYDROGEN hydrochloric acid + magnesium → magnesium chloride + hydrogen
1b(i)	Use syringe to collect gas	All gases can be collected in a gas syringe and their volumes measured against the scale on the gas syringe. Gases which are insoluble can also be collected over water as shown in the diagram.
1b(ii)	Line graph showing:	½mark: labelling axes ½mark: correct scales ½mark: plotting points ½mark: drawing line
1b(iii)	10	Rate = $\frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{86 - 46}{6 - 2} = 10\ cm^3\ min^{-1}$
2a	Repulsion/deflection by (positive) nucleus	Positive (alpha) particles mainly travel straight through the layer of gold. Some of the positive (alpha) particles travel close to the nuclei of the gold atoms. The nuclei of the gold atoms are also positive and deflect the passing positive (alpha) particles by repulsion of positives charges.
2b(i)	79 79 118	Number of protons = atomic number = 79 Number of electrons = atomic number – charge = 79 – 0 = 79 Number of neutrons = mass no – atomic no. = 197 - 79 = 118
2b(ii)	Answer from:	Same atomic number / number of protons but different mass number / number of neutrons
3a	Oxygen Argon Nitrogen	When the temperature falls below the boiling point of a substance the substance condenses from a gas to a liquid. As temperature decreases, oxygen will be the first gas to condense into a liquid (at -183°C), then argon condenses (at -186°C) and finally nitrogen condenses (at -196°C)
3b	Distillation	Distillation is the process which separates chemicals with different boiling points.
3c	Air has too low a percentage of oxygen	Oxygen gas will relight a glowing splint because the splint glows so bright that the heat released will reignite the splint.
4a	Diagram showing:	 or 
4b	Weak	Covalent molecular substances are often gases or liquids at room temperature because there are only weak attractions/bonds between the molecules.
4c(i)	Partial dissociation into ions	Weak acids and alkali do not fully dissociate into ions.
4c(ii)	1490	1mol NH_3 = (1x14)+(3x1) = 14+3 = 17g **n**o of mol = $\frac{\textbf{m}ass}{\textbf{gfm}} = \frac{510}{17} = 30$ mol $3NH_3 + H_3PO_4 \longrightarrow (NH_4)_3PO_4$ 3mol 1mol 30mol 10mol 1mol $(NH_4)_3PO_4$ = (3x14)+(12x1)+(1x31)+(4x16) = 42+12+31+64 = 149g **m**ass = **n**o. of mol x **gfm** = 10 x 149 = 1490g

5a — Exothermic

Type	Description	ΔH sign
Exothermic	Reaction which gives off heat/energy to surroundings	negative
Endothermic	Reaction which absorbs heat/energy from the surroundings	positive

5b





Monomer	Polymer	Repeating Unit

5c — Carbon monoxide or hydrogen cyanide

All carbon-based molecules will release poisonous carbon monoxide in a limited supply of air. Molecules that contain the –CN nitrile group will also release poisonous hydrogen cyanide HCN gas on burning.

6a — Less fructose is required for same sweetness

Because fructose is twice as sweet as glucose, half the mass of fructose is required to achieve the same level of sweetness in a food compared to glucose. Because glucose and fructose have very similar energy contents (calories), this halves the calories in foods if fructose is used.

6b(i) — Isomers

Isomers have the same molecular formula but different structural formulae.

6b(ii) — Hydroxyl

The –OH group found in alcohols is called the hydroxyl group.

7a(i) — Heterogeneous

Type of Catalyst	Definition
Homogeneous	Catalyst in same. state as reactants
Heterogeneous	Catalyst in different state from reactants

7a(ii) — 3-methylheptane

Longest chain in structure = 7 carbons ∴ name ends in ……heptane
$-CH_3$ side group in structure ∴ name ends in … methylheptane
Side group on carbon 3 from right ∴ name is 3-methylheptane

7a(iii) — Any C_8H_{18} structure other than 3-methylheptane.

Structure must have
8 carbons
18 hydrogens
4 bonds per carbon
1 bond per hydrogen

All the isomers of octane are listed below. Be sure not to redraw 3-methylheptane again.

octane	2-methylheptane
~~3-methylheptane~~	4-methylheptane
2,2-dimethylhexane	2,3-dimethylhexane
2,4-dimethylhexane	2,5-dimethylhexane
3,3-dimethylhexane	3,4-dimethylhexane
3-ethylhexane	2,3,4-trimethylpentane
2,2,3-trimethylpentane	2,2,4-trimethylpentane
2,3,3-trimethylpentane	3-ethyl-2-methylpentane
3-ethyl-3-methylpentane	2,2,3,3-tetramethylbutane

7b(i) — Heat catalyst then heat paraffin

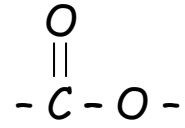
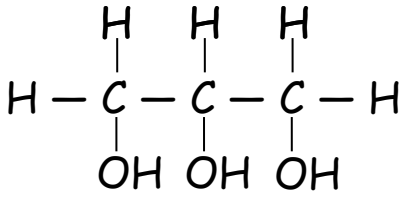
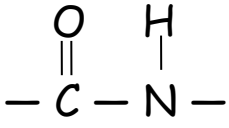
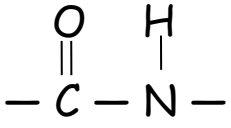
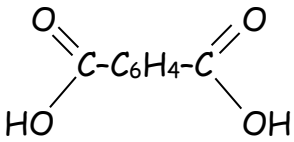
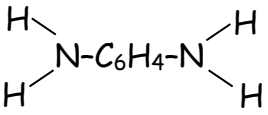
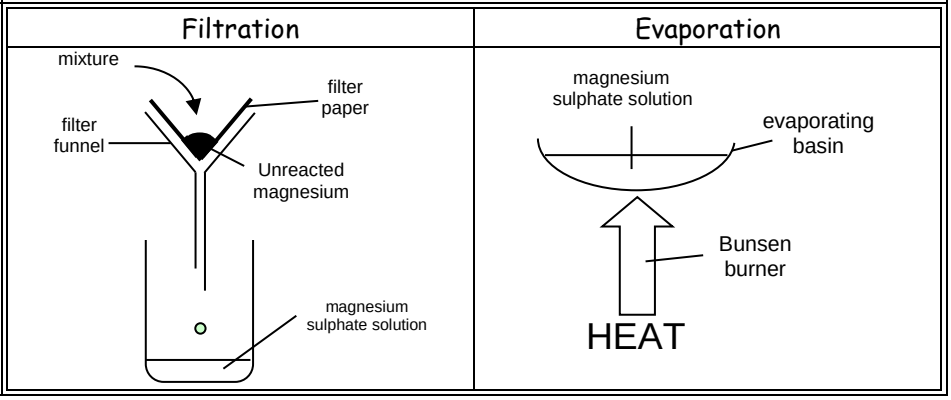
The catalyst must be at a high temperature before it will work efficiently. The Bunsen burner initially heats only the catalyst and when it is hot the Bunsen burner is then moved under the paraffin with the heating shared between the paraffin and the catalyst to keep both warm.

7b(ii) — Bromine decolourises

The alkenes produced during the cracking reaction react with bromine solution and the yellow colour decolourises. The Br_2 molecule adds across the C=C double bonds in the cracking reaction.

7b(iii) — Remove test tube before heating stops

When the test tube is heated, the air inside expands and bubbles leave the delivery tube. When heating is stopped, the air inside contracts back to its original size but gas cannot re-enter the delivery tube so liquid is sucked up instead. Cold liquid can cause hot glass to crack.

8a(i)	Ester	Esters are formed by the condensation of alcohols and carboxylic acids. All esters have an ester link: 
8a(ii)	No C=C double bonds	Saturated hydrocarbons contain C-C single bonds in the carbon chain of the molecule. Unsaturated hydrocarbons contain C=C double bonds (or C≡C triple bonds) which are detected by the decolourisation of bromine solution.
8b	Glycerol	Glycerol is also known as propane-1,2,3-triol and has the structure: 
8c	3.344	$E_h = c \times m \times \Delta T$ Energy = specific heat capacity × mass × change in temperature Energy = 4.18 × 0.1 × 8 Energy = 3.344kJ
9a	Strong or high strength	Plastic: Kevlar | Poly(ethenol) | Poly(ethyne) | Biopol Property: Strong | Soluble in water | Electrical conductor | Biopdegradable
9b(i)		Amide links are found in polyamide polymers while peptide links are found in proteins. Both have the structure: 
9b(ii)	One from:	 or 
10a	1	1mol CH_3COOH = (2x12)+(4x1)+(2x16) = 24+4+32 =60g **n**o. of mol = **mass** / **gfm** = 6 / 60 = 0.1 mol **c**oncentration = **n**o. of mol / **v**olume = 0.1mol / 0.1litres = 1 mol l^{-1}
10b	slower lower	Magnesium reacts faster with hydrochloric acid than ethanoic acid as hydrochloric acid is a fully dissociated strong acid. Ethanoic acid is a partially dissociated weak acid which contains much less H^+ ions at any one time to react with magnesium. Strong acids are fully ionised and the higher degree of ionisation provides the additional ions to increase the conductivity of the solution.
11a	Sulphuric acid	ACID + METAL → SALT + HYDROGEN sulphuric acid + magnesium → magnesium sulphate + hydrogen H_2SO_4 + Mg → $MgSO_4$ + H_2
11b	2. Filtration 3. Evaporation	

<table>
<tr><td>12a</td><td>Nickel is higher up the electrochemical series</td><td>Higher up metals in the electrochemical series corrode to protect lower down metals in the electrochemical series. This is sacrificial protection.</td></tr>
<tr><td>12b</td><td>$Ni \rightarrow Ni^{2+} + 2e^-$</td><td>Equation is on page 10 of data booklet but in the reverse direction.</td></tr>
<tr><td>12c</td><td>Prevents air or water getting to metal</td><td>Air/oxygen and water are <u>both</u> required for corrosion to take place. Prevent one or both getting to metal then corrosion is prevented.</td></tr>
<tr><td>13a</td><td>To complete the circuit</td><td>The ions in an electrolyte complete the circuit by moving charge to balance the movement of electrons through the cell.</td></tr>
<tr><td>13b(i)</td><td>10.92</td><td>
<table>
<tr><td>Number of Pairs of Discs</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>Voltage (V)</td><td>1.56</td><td>3.12</td><td>4.68</td><td>6.24</td><td>7.80</td><td>9.36</td><td>-</td></tr>
<tr><td>Difference</td><td></td><td>1.56</td><td>1.56</td><td>1.56</td><td>1.56</td><td>1.56</td><td>(1.56)</td></tr>
<tr><td>Prediction (V)</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>10.92</td></tr>
</table>
</td></tr>
<tr><td>13b(ii)</td><td>Decrease in voltage</td><td>Copper and silver are closer together on the electrochemical series</td></tr>
<tr><td>14a</td><td>Ore</td><td>Metal ores are compounds of metals from which the metal can be extracted by chemical reaction</td></tr>
<tr><td>14b</td><td>$Al(OH)_3$</td><td>
<table>
<tr><td>Write down Valency below each ion's symbol
$Al \quad OH^-$
3 1</td><td>Put in Cross-over Arrows
$Al \quad OH^-$
3 1</td><td>Follow arrows and cancel down to get formula
$Al(OH)_3$</td></tr>
</table>
</td></tr>
<tr><td>14c</td><td>Reduction</td><td>Al_2O_3 contains Al^{3+} ions which are reduced to form atoms of Al
$Al^{3+} + 3e^- \rightarrow Al$</td></tr>
</table>