Past Papers Int 2 Chemistry

2002 Marking Scheme

Grade Awarded	Mark Required (/80)	
A	53+	66%
B	45+	56%
C	37+	46%
D	-	-
No award	-	-

2002 Int2 Chemistry Marking Scheme

MC Qu	Answer	% Pupils Correct	Reasoning
1	A	87	<table><tr><td>Element</td><td>Aluminium</td><td>Hydrogen</td><td>Iodine</td><td>Magnesium</td></tr><tr><td>Date of Discovery</td><td>1825</td><td>1766</td><td>1811</td><td>1808</td></tr></table>
2	D	85	☒A Nitrogen has the formula N_2 ∴ nitrogen is a diatomic molecule ☒B Oxygen has the formula O_2 ∴ oxygen is a diatomic molecule ☒C Fluorine has the formula F_2 ∴ fluorine is a diatomic molecule ☑D Neon is a Noble gas and has formula Ne ∴ Neon is not a diatomic molecule
3	B	77	Number of neutrons = mass number – atomic number = 35-17 = 18
4	B	74	<table><tr><td>Write down Formulae of ions</td><td>Write down Valency below each ion</td><td>Put in Cross-over Arrows</td><td>Follow arrows and cancel down to get formula</td></tr><tr><td>$Mg\ SO_3^{2-}$</td><td>$Mg\ SO_3^{2-}$ 2 2</td><td>Mg SO₃ 2 2</td><td>$MgSO_3$</td></tr></table>
5	C	42	<table><tr><td>Write down Formulae</td><td>Reverse crossover rule from formula</td><td>Work out valency from cross over rule</td><td>Ionic Formula</td></tr><tr><td>$CrCl_3$</td><td>Cr Cl 3 1</td><td><table><tr><td>Element</td><td>Valency</td></tr><tr><td>Cr</td><td>3</td></tr><tr><td>Cl</td><td>1</td></tr></table></td><td>$Cr^{3+}(Cl^-)_3$</td></tr></table>
6	D	67	☒A Chlorine atoms have 17 electrons ∴ Chloride Cl^- ions have 18 electrons ☒B Sulphur atoms have 16 electrons ∴ Sulphide S^{2-} ions have 18 electrons ☒C Argon atoms have 18 electrons ☑D Sodium atoms have 11 electrons ∴ Sodium Na^+ ions have 10 electrons
7	C	84	1 mol of $(NH_4)_2SO_4$ = (2x14)+(8x1)+(1x32)+(4x16) = 28+8+32+64 = 132g
8	C	31	☒A negative ions are attracted to the negative electrode not positive ions ☒B neutral atoms are not attracted to the negative electrode ☑C negative Cl^- ions lose electrons at the negative electrode and form Cl_2 molecules ☒D neutral atoms are not attracted to the negative electrode
9	C	94	Fractional distillation separates chemicals with different boiling points. All the chemicals with similar boiling points evaporate off and are collected by condensing the vapours back into liquids.
10	B	73	☒A Molecule has formula C_6H_{14} and has a different formula from heptane C_7H_{16} ☑B Both molecules have formula C_7H_{16} but are isomers with different structures ☒C Molecule has formula C_7H_{14} and has a different formula from heptane C_7H_{16} ☒D Molecule has formula C_7H_{14} and has a different formula from heptane C_7H_{16}
11	C	78	<table><tr><td>Substance</td><td>A</td><td>B</td><td>C</td><td>D</td></tr><tr><td>Name</td><td>propan-1-ol</td><td>propan-2-ol</td><td>butan-1-ol</td><td>butan-2-ol</td></tr><tr><td>Boiling Point (°C)</td><td>97</td><td>82</td><td>118</td><td>100</td></tr></table>
12	B	87	☒A in catalytic converters: carbon monoxide is turned into carbon dioxide ☑B in catalytic converters: carbon monoxide is turned into carbon dioxide ☒C in catalytic converters: nitrogen dioxide is turned back into nitrogen ☒D oxygen is not a harmful gas ∴ not reacted to get rid of in catalytic converter

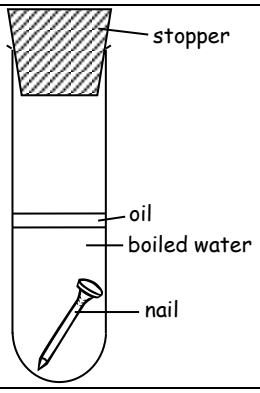
13	D	37	☒A Sugars are not large enough to be classified as polymers ☒B Animal fats are not large enough to be classified as polymers ☒C Marine oils are not large enough to be classified as polymers ☑D Proteins are large polymers made up amino acid building blocks
14	A	55	starch + water ⟶ glucose $(C_6H_{10}O_5)_n$ + nH_2O ⟶ $nC_6H_{12}O_6$
15	C	50	Fats/oils molecules can be hydrolysed into 1 molecule of glycerol and 3 molecules of fatty acid
16	D	20	☒A Test for Hydrogen: burns with a pop ☒B Test for Oxygen: relights a glowing splint ☒C Test for Carbon dioxide: turns lime water milky ☑D Test for Alkenes produced from cracking: rapidly decolourises bromine solution
17	B	62	Action on Acid: Dilution; Effect on pH: Increase to 7; Effect on H^+ concentration: Drecreases
18	A	65	☑A ethanoic acid is a weak acid and has fewest ions ∴ lowest conductivity ☒B hydrochloric acid is a strong acid and has many ions ∴ higher conductivity ☒C nitric acid is a strong acid and has many ions ∴ higher conductivity ☒D sulphuric acid is a strong acid and has many ions ∴ higher conductivity
19	D	67	Ammonia dissolves in water to form the weak alkali ammonium hydroxide ∴ pH >7
20	A	75	Acid: pH<7; Concentration of H^+ > Concentration of OH^- Neutral e.g. pure water: pH=7; Concentration of H^+ = Concentration of OH^- Alkali: pH>7; Concentration of OH^- > Concentration of H^+
21	A	43	A base is a chemical which neutralises an acid: Metal Hydroxide (alkalis) Metal Oxide Metal Carbonate
22	B	28	☒A **n**o of mol = **v**olume x **c**oncentration = 0.1litres x 4mol l^{-1} = 0.4mol ☑B **n**o of mol = **v**olume x **c**oncentration = 0.2litres x 3mol l^{-1} = 0.6mol ☒C **n**o of mol = **v**olume x **c**oncentration = 0.3litres x 1mol l^{-1} = 0.3mol ☒D **n**o of mol = **v**olume x **c**oncentration = 0.4litres x 0.5mol l^{-1} = 0.2mol
23	D	39	☒A Calcium is too reactive: Calcium is made by molten electrolysis ☒B Copper is too reactive: Copper is made by heating copper ore with carbon ☒C Zinc is too reactive: Zinc is made by heating zinc ore with carbon ☑D Silver is unreactive and can be made by heating silver ores to release silver
24	A	57	☑A copper is not a reactive enough metal to react with dilute acid ☒B zinc + hydrochloric acid → zinc chloride + hydrogen ☒C copper carbonate + hydrochloric acid → copper chloride + water + carbon dioxide ☒D zinc carbonate + hydrochloric acid → zinc chloride + water + carbon dioxide
25	A	54	☑A copper hydroxide is insoluble (p8 data booklet) and forms a precipitate ☒B calcium chloride and copper bromide are both soluble (no precipitate formed) ☒C magnesium chloride and copper nitrate are both soluble (no precipitate formed) ☒D lithium chloride and copper sulphate are both soluble (no precipitate formed)

Questions 26 and 27 are Grid Questions.

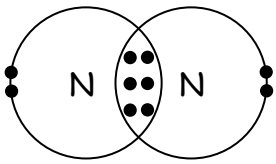
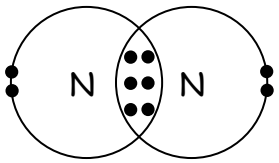
- This style of question was dropped after the 2002 Int2 exam.
- The style of question is no longer used but the content of the question can still be asked in future exams.

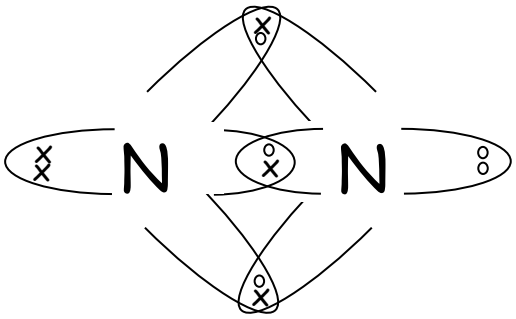
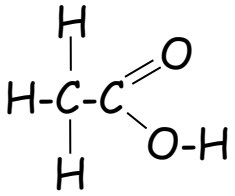
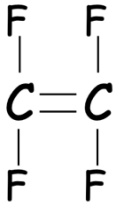
26a	B (1 mark)	The high energy spark in a petrol engine to ignite the petrol/air mixture. This energy is enough to split the N≡N triple bond in N_2 molecules and forms nitrogen dioxide: $N_2 + 2O_2 \rightarrow 2NO_2$
26b	C+D (both for 1 mark)	☒A pure water has pH=7 ☒B non-metal oxides dissolve in water to form acids ☑C metal oxides dissolve in water to form alkalis ☑D metal oxides dissolve in water to form alkalis ☒E carbon monoxide is insoluble in water so is pH neutral ☒F non-metal oxides dissolve in water to form acids
26c	A+E (both for 1 mark)	☑A hydrogen in hydrocarbons burns to form water ☒B hydrocarbons contain no nitrogen so burning does not form nitrogen dioxide ☒C hydrocarbons contain no potassium so burning does not form potassium oxide ☒D hydrocarbons contain no calcium so burning does not form calcium oxide ☑E Incomplete combustion of hydrocarbons forms carbon monoxide ☒F hydrocarbons contain no sulphur so burning does not form sulphur dioxide
27	B,E (1 mark each)	☒A Isotopes have same number of protons but different number of neutrons ☑B Isotopes have same number of protons but different number of neutrons ☒C different isotopes of silver have different mass numbers (^{107}Ag and ^{109}Ag) ☒D Equal numbers of ^{107}Ag and ^{109}Ag isotopes due to relative atomic mass = 108 ☑E In neutral atoms: no. of electrons = no. of protons = atomic number = 47

2002 Int2 Chemistry Marking Scheme

Long Qu	Answer	Reasoning
1a	$BaCl_2$	Write down Formulae of elements: Ba Cl Write down Valency below each atom: Ba (2) Cl (1) Put in Cross-over Arrows: Ba → Cl (2), Cl → Ba (1) Follow arrows to get formula: $BaCl_2$
1b(i)	gas — 1560°C liquid — 963°C solid	Problem Solving: Gathering data from data booklet
1b(ii)	Solid	At 900°C, Barium chloride has yet to melt (m.pt. = 961°C) Barium chloride must still be a solid at 900°C
2a	CSi or SiC	There are equal numbers of Si atoms and C atoms: ratio of Si:C is 1:1 ∴ formula SiC
2b(i)	Covalent bonding or electrons not free to move in silica	Silica is made of silicon and oxygen bonded together with formula SiO_2. • Compounds containing only non-metals have covalent bonding • Covalent compounds to not conduct electricity in any state
2b(ii)	Covalent bonds must be broken to melt covalent network substance	Silica is a covalent network substance due to the strong covalent bonds between atoms. To melt a covalent network, all covalent bonds must be broken. This requires a great deal of energy ∴ high melting point
3a	$Fe \rightarrow Fe^{2+} + 2e^-$	Iron atoms oxidise (lose electrons) to become Fe^{2+} ions and further oxidise to become Fe^{3+} ions during the process of rusting.
3b	Ferroxyl Indicator	Ferroxyl indicator turns blue in the presence of Fe^{2+} ions Ferroxyl indicator turns pink in the presence of OH^- ions
3c		Boiling water removes dissolved air from the water. Adding a layer of oil on top of the boiling water prevents air dissolving back into the water again.
4a	$C_4H_{10} + 13N_2O$ ↓ $4CO_2 + 5H_2O + 13N_2$	$C_4H_{10} + 13N_2O \longrightarrow 4CO_2 + 5H_2O + 13N_2$

Bonding	Solid	Liquid	Solution
Metallic (metals only)	✓	✓	-
Covalent (non-metals only)	×	×	×
Ionic (metals + non-metals)	×	✓	✓

<table>
<tr><td>4b</td><td> 
</td><td> 

or

</td></tr>
<tr><td>5a</td><td>D→C→A→B</td><td>
<table>
<tr><th>Order</th><th>Letter</th><th>Name</th><th>Reasoning</th></tr>
<tr><td>1st</td><td>D</td><td>Steam Generator</td><td>Steam must be made and transferred to C</td></tr>
<tr><td>2nd</td><td>C</td><td>Oil Extraction</td><td>Lavender oil vapour is extracted from leaves</td></tr>
<tr><td>3rd</td><td>A</td><td>Condensation</td><td>Lavender oil vapour is condensed back to liquid</td></tr>
<tr><td>4th</td><td>B</td><td>Oil Collection</td><td>Lavender oil liquid collects in beaker</td></tr>
</table>
</td></tr>
<tr><td>5b(i)</td><td>Wear gloves or react bromine spillage with thiosulphate solution</td><td>PPA Safety Question</td></tr>
<tr><td>5b(ii)</td><td>—O–H</td><td>Alcohols contain the hydroxyl –OH functional group</td></tr>
<tr><td>5b(iii)</td><td>ester</td><td>Condensation Reaction: Alcohol + Carboxylic Acid ⟶ Ester + Water</td></tr>
<tr><td>5b(iv)</td><td>  </td><td>Ethanoic acid has two carbons and a carboxyl -COOH functional group</td></tr>
<tr><td>6a</td><td>Rods should be cleaned and dried</td><td>PPA Technique Question</td></tr>
<tr><td>6b</td><td>Any two from:</td><td>Same electrolyte concentration,
Same electrolyte compound
Same electrolyte volume
Depth of rods in solution
Same temperature</td></tr>
<tr><td>6c</td><td>Voltage above 0.5V
e.g. 0.7V</td><td>The further apart metals are from each other on the electrochemical series, the higher the voltage of the cell. A zinc is further from copper than iron is from copper, the zinc-copper cell will have a high voltage than an iron-copper cell</td></tr>
<tr><td>7a</td><td>acid rain
or nitric acid</td><td>Non-metal oxides dissolve in water to form acids
e.g. sulphur dioxide, nitrogen dioxide and carbon dioxide</td></tr>
<tr><td>7b</td><td>Neutralisation</td><td>acid + metal hydroxide (alkali) ⟶ salt + water
acid + metal oxide ⟶ salt + water
acid + metal carbonate ⟶ salt + water + carbon dioxide</td></tr>
<tr><td>7c</td><td>  </td><td>
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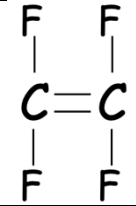
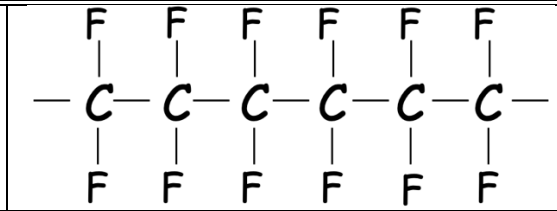
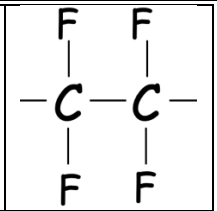
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Monomer</td><td>Polymer</td><td>Repeating Unit</td></tr>
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</td></tr>
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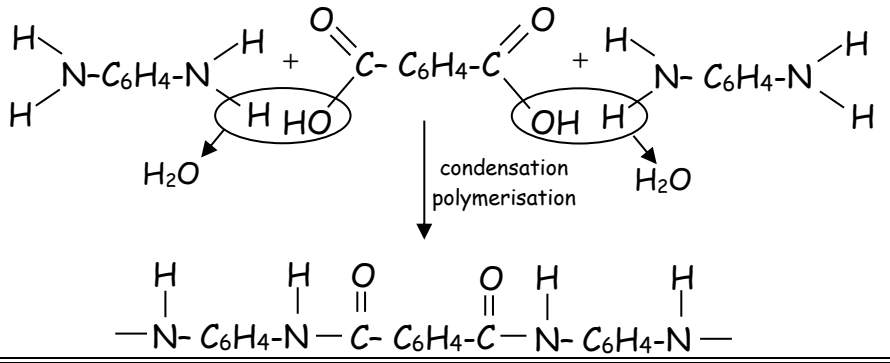
8a	Filtration	Filtration: Insoluble solid is removed from a liquid
8b	Carbon Dioxide CO_2 or Ammonia NH_3	Carbon dioxide is produced by *heating* $NaHCO_3$ (bottom right corner) and is recycled to back into the Solvay Reactor (top left) Ammonia is released in the *Reactor* and goes back into the Solvay Process (middle left side)
8c	Calcium chloride $CaCl_2$	Calcium Chloride is the product from the Reactor
8d	0.0448	HCl **n**o. of mol = **v**olume x **c**oncentration = 0.0224litres x 0.1mol l^{-1} = 0.00224mol $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + CO_2 + H_2O$ 1mol 2mol 0.00112mol 0.00224mol $\text{concentration} = \frac{\text{no. of mol}}{\text{volume}} = \frac{0.00112 \text{ mol}}{0.025 \text{ litres}} = 0.0448 \text{ mol } l^{-1}$
9a	$S_2O_3^{2-} + 2H^+ \downarrow S + SO_2 + H_2O$	$(Na^+)_2S_2O_3^{2-} + 2H^+Cl^- \rightarrow 2Na^+Cl^- + S + SO_2 + H_2O$ Split up compounds into separate ions $2Na^+ + S_2O_3^{2-} + 2H^+ + 2Cl^- \rightarrow 2Na^+ + 2Cl^- + S + SO_2 + H_2O$ Cancel out any spectator ions which appear on both sides $\cancel{2Na^+} + S_2O_3^{2-} + 2H^+ + \cancel{2Cl^-} \rightarrow \cancel{2Na^+} + \cancel{2Cl^-} + S + SO_2 + H_2O$ Re-write equation omitting spectator ions $S_2O_3^{2-} + 2H^+ \rightarrow S + SO_2 + H_2O$
9b(i)	When X on paper disappears, stop timing	PPA 1.2 Question The "X" on the paper allows the observer to accurately judge the end-point of the reaction consistently as long as the same "X" and same observer are used.
9b(ii)	SO_2 produced is a harmful gas	PPA 1.2 Question Sulphur dioxide is a toxic gas released in small quantities during the reaction.
9c(i)	50	From graph: if concentration = 0.1 mol l^{-1} then rate = 0.02s^{-1} $\text{rate} = \frac{1}{\text{time}} \qquad \text{time} = \frac{1}{\text{rate}} = \frac{1}{0.02} = 50s$
9c(ii)	Increased concentration increases the no. of collisions increasing reaction rate	The reaction rate is dependent on the number of successful collisions between reactants. Increasing concentration of reactants makes the likelihood of a successful collision more likely.
10a	High strength	Kevlar is a extremely strong, lightweight plastic used in bullet-proof vests
10b	2 functional groups on each monomer	For a monomer to become a large condensation polymer, the monomers must have 2 functional groups each. If the monomer only had 1 functional group, the polymer would no longer be able to extend any further.
10c		
11a	Halogens	<table><tr><td>Name</td><td>Alkali Metals</td><td>Halogens</td><td>Noble gases</td><td>Transition Metals</td></tr><tr><td>Location</td><td>Group 1</td><td>Group 7</td><td>Group 0</td><td>Between Group 2 + 3</td></tr></table>

11a(i) — Reaction is Exothermic

Reactants have more energy than the products. During a chemical reaction, the energy not transferred from the reactants to the products is released as heat energy. This is an exothermic reaction.

11a(ii) — Only partial dissociation of H^+ ions

Strong Acid: full dissociation of molecules to form H^+ ions
Weak Acid: partial dissociation of molecules to form H^+ ions

12a(i) — Alkenes

Alkenes are a homologous series with a C=C double bond and general formula of C_nH_{2n}

12a(ii) — Addition

Addition Reactions: Molecules are added across a C=C double bond

12b — 605g

gfm C_3H_6 = (3x12) + (6x1) = 36 + 6 = 42g

$$\text{no. of mol} = \frac{\textbf{m}\text{ass}}{\textbf{gfm}} = \frac{100}{42} = 2.38\text{mol}$$

$$\underset{\substack{1\text{mol}\\2.38\text{mol}}}{I_2} + \underset{\substack{1\text{mol}\\2.38\text{mol}}}{C_3H_6} \longrightarrow C_3H_6I_2$$

gfm I_2 = (2x127) = 254g

mass = **n**o. of mol x **gfm** = 2.38 x 254 = 605g

12c — Oils have more C=C double bonds than fats

The number of C=C double bonds in a fat/oil is directly linked to the number of I_2 molecules it will react with. Oils have more C=C double bonds than fats.

12d — heterogeneous

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

13a — 31.9

no. of mol = **v**olume x **c**oncentration = 0.4litres x 0.50mol l^{-1} – 0.2 mol

mass = **n**o. of mol x **gfm** = 0.2mol x 159.5g mol^{-1} = 31.9g

13b(i) — $Zn+Cu^{2+}\rightarrow Zn^{2+}+Cu$

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

Add together equations cancelling out electrons

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$

13b(ii) — 0.0015

$$\text{Rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}} = \frac{0.50 - 0.41}{60 - 0} = \frac{0.09}{60} = 0.0015 \text{ mol } l^{-1} s^{-1}$$

14a — Longer the chain the higher the critical temp

Alkane	Propane	Butane	Pentane	Hexane
Critical Temp	97°C	152 °C	197 °C	234 °C

14b — Answer between 187°C and 234°C

Formula	C_4H_{10}	C_5H_{12}	C_6H_{14}
Alkane	butane	pentane	hexane
Critical Temp	152 °C	197 °C	234 °C
Branched Alkane	2-methylpropane	2-methylbutane	2-methylpentane
Critical Temp	135°C	187°C	unknown

2-methylpentane should have critical temperature approx 220-230°C.

NB higher than 187°C (2-methylbutane) but lower than 234°C (hexane)