NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1, 2004

Chemistry

Describe chemical reactions (90171)

Describe atomic structure and bonding (90172)

Describe selected non-metals and their compounds (90173)

Describe properties and reactions of metals, acids and bases (90640)

Describe properties and reactions of carbon and its compounds (90648)

National Statistics

Assessment Report

Assessment Schedule

Chemistry, Level 1, 2004

General Comments

Candidates gaining Achievement had learned what they were required to know from the standards. They showed an ability to use their knowledge in different contexts, and did not try to use 'rote-learned' answers.

Successful candidates answered all the questions provided, recognising that most questions contained an achievement component and were required for Achievement. They also understood that only one correct answer was required, and that simply repeating the information from the question was of no benefit to them. They did not confuse observations with inferences, and they did not repeat the same observation with different wording. They also demonstrated they could use correct notation in writing formulae; and showed correct usage of upper and lower case letters and correct usage of subscripts within formulae.

Candidates gaining Achievement with Merit or Achievement with Excellence were able to write complete and detailed answers that did not repeat information to fill up space, and showed a logical sequence of ideas. Their answers showed a depth of chemical knowledge and understanding. Where appropriate, successful candidates showed their understanding with the inclusion of diagrams or balanced equations in their explanations and discussions.

The use of texting language or unexplained abbreviations is not appropriate in an examination.

Chemistry: Describe chemical reactions (90171)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
3,774	30.2%	30.0%	26.8%	13.1%

Assessment Report

Candidates who gained Achievement, successfully interpreted what to do from key words used in the standard and the questions. They were able to use their knowledge to **describe** chemical reactions.

This was demonstrated by the candidates' ability to:

- correctly classify reactions
- correctly identify the products of the thermal decomposition of a metal hydroxide
- write word equations
- use upper and lower case letters and brackets appropriately in writing chemical formulae
- predict the precipitate formed when two solutions are mixed
- write accurate and specific observations for experiments, rather than an inference. For example they were able to correctly identify colours in observations, "a grey deposit forms on the piece of metal" as opposed to "a silver precipitate forms". Also these candidates were aware that "clear" was not an acceptable alternative for "colourless" when describing a colour in solutions
- recognise the difference between atomic mass and atomic number and use the information given without unnecessary rounding when calculating the relative molecular masses of given substances
- use the information provided in the Resource Booklet
- recognise the symbols of the first 20 elements on the periodic table. For example, successful candidates knew that P was phosphorus
- recognise that copper does not, never has and never will RUST!

Candidates who gained Achievement with Merit or Achievement with Excellence were able to **interpret** information about chemical reactions, and they were able to **apply** an understanding of chemical reactions.

This was demonstrated by the candidates' ability to:
- write accurately-balanced equations from given reactants or products
- justify the classification of the redox reaction in terms of observations, balanced equations, and the exchange of electrons involving an element and a simple monatomic ion
- write explanations that were not poorly understood 'rote-learned answers'
- write explanations without use of UNEXPLAINED abbreviations such as WIDH
- calculate the mass of a reactant or product from the mass provided with the balanced equation given in a 1:1 mole ratio and a 2:1 mole ratio or determine the formula of a compound
- show a logical progression in the working in calculations; they were able to use units and round numbers appropriately and accurately in calculations.

Many candidates are using triangles and columns or tables which may help them plot their way through the calculation but this is of little benefit to them if they do not **demonstrate the working** involved in gaining each answer. Working must be shown.

Chemistry: Describe atomic structure and bonding (90172)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
4,619	22.2%	52.2%	16.6%	9.0%

Assessment Report

Candidates who gained Achievement, successfully interpreted what to do from key words used in the standard and the questions. They were able to use their knowledge to **describe** atomic structure and bonding.

This was demonstrated by the candidates' ability to:
- describe atomic structure
- demonstrate their understanding of the difference between atoms, ions and molecules
- describe or draw electron arrangements
- predict ionic and covalent bonding
- use the periodic table to determine whether elements were metal or non-metal
- draw Lewis structures, correctly positioning electrons in orbitals and pairing electrons in molecules, as opposed to drawing triplets of electrons. Candidates were able to **replace** the electron dot pair with a single bonding line
- describe isotopes as atoms with different **numbers** of neutrons as opposed to different neutrons.

Candidates who gained Achievement with Merit or Achievement with Excellence were able to **link** or **refer** the atomic structure and bonding to selected properties, and they were able to **discuss** the selected properties in terms of atomic structure and bonding.

This was demonstrated by the candidates' ability to:
- use labelled diagrams to help with explanations
- write concisely and clearly, without repeating information
- give the relevant fact or description before attempting the explanation
- provide complete and detailed answers.

Chemistry: Describe selected non-metals and their compounds (90173)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
1,317	53.5%	29.2%	9.4%	7.8%

Assessment Report

Candidates who gained Achievement, successfully interpreted what to do from key words used in the standard and the questions. They were able to use their knowledge to **describe** the properties, preparations and reactions of selected non-metals and their compounds.

This was demonstrated in this year's paper by the candidates' ability to:
- describe the Haber and Contact Processes
- describe the process of fractional distillation
- describe the production of chlorine gas using electrolysis of brine
- demonstrate a knowledge of the nitrogen cycle, including names and formulae of specific relevant compounds, as stated in the explanatory notes of the achievement standard
- correctly identify observations for chemical species and their reactions.

Candidates who gained Achievement with Merit or Achievement with Excellence were able to **link** or **refer** the properties, reactions and uses of selected non-metals and their compounds, and they were able to **apply** an understanding of the properties, reactions and uses of selected non-metals and their compounds.

This was demonstrated by the candidates' ability to:
- write balanced equations and use them in explanations and discussions
- provide complete and detailed answers with a logical sequence of ideas
- apply knowledge to a new context. For example, candidates were able to take their knowledge of the use of sulfur dioxide as a preservative and apply it to the context of wine-making.

Chemistry: Describe properties and reactions of metals, acids and bases (90640)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
2,286	31.3%	50.4%	10.1%	8.1%

Assessment Report

Candidates who gained Achievement, successfully interpreted what to do from key words used in the standard and the questions. They were able to use their knowledge to **describe** characteristic properties and reactions of metals, acids and bases.

This was demonstrated in this year's paper by the candidates' ability to:
- describe expected observations for reactions of selected metals, acids and bases
- complete word equations for the reactions of selected metals, acids and bases
- describe the physical and chemical properties of a metal

- use information provided about chemical tests to correctly identify an unknown element or compound
- describe a factor that altered reaction rate
- interpret the shape of the graph provided in terms of rate of reaction and particle collisions
- use upper and lower case letters appropriately in formulae
- distinguish between the strength and the concentration of acids
- give answers in sentences to describe observations and changes, as opposed to one-word answers
- use appropriate chemical terminology such as “low density” rather than “light”.

Candidates who gained Achievement with Merit or Achievement with Excellence were able to **explain** characteristic properties and reactions of metals, acids and bases, and they were able to **apply** an understanding of characteristic properties and reactions of metals, acids and bases.

This was demonstrated by the candidates ability to:
- use balanced equations to further their explanations or discussions
- use correct terminology in describing solutions or compounds. For example copper II ions or Cu^{2+}
- link the shape of the graph to show how the rate of the reaction changes and explain rate in terms of the particle collisions and the particle theory
- discuss the effect of acid and base on metals and indicators.

Candidates who gained Achievement with Excellence also had a clear understanding of the importance of the activity series of metals and were able to use it in discussions. They expressed their understanding clearly, as opposed to writing badly-understood memorised answers.

Chemistry: Describe properties and reactions of carbon and its compounds (90648)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
3.356	42.6%	32.5%	15.4%	9.4%

Assessment Report

Candidates who gained Achievement, successfully interpreted what to do from key words used in the standard and the questions. They were able to use their knowledge to **describe** properties and reactions of carbon and its compounds.

This was demonstrated in this year’s paper by the candidates’ ability to:
- describe properties and reactions of carbon and its compounds
- draw and name organic molecules using appropriate IUPAC nomenclature
- describe the structure, physical properties and uses of allotropes of carbon, including C-60
- describe the solubility of carbon dioxide and the acidic nature of this solution
- use upper and lower case letters appropriately in formulae and write subscripts correctly with small numbers written below the line.

Candidates who gained Achievement with Merit or Achievement with Excellence were able to **link** properties and reactions of carbon and its compounds, and they were able to **apply** an understanding of properties and reactions of carbon and its compounds.

This was demonstrated by the candidates’ ability to:
- link their knowledge to the contexts presented in the examination paper
- write balanced chemical equations from information provided in questions
- demonstrate an understanding of the difference between and significance of inter-molecular and intra-molecular forces
- draw on significant and relevant chemical knowledge when discussing, comparing, or explaining
- write clear and concise answers.

Assessment Schedule

Chemistry: Describe chemical reactions (90171)

Evidence Statement

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a) 1(b) 1(c) 1(d)	O T O P	3 correct		
2(a) 2(b) 2(c)	calcium sulfate lead chloride zinc carbonate	2 correct		
3(a) 3(b) 3(c)	magnesium sulfate copper oxide + water magnesium oxide	3 chemical names correct		
4(a) 4(b) 4(c)	$CaCl_2$ (*aq*) + **Na_2SO_4 (*aq*)** → $CaSO_4$ (*s*) + **2**NaCl (*aq*) $Cu(NO_3)_2$ (*aq*) + **2**NaOH (*aq*) → **$Cu(OH)_2$ (*s*)** + **2$NaNO_3$ (*aq*)** Cl_2 *(g)* + **2**KI (*aq*) → **I_2 (*aq*)** + **2KCl (*aq*)**	Three of the species (elements and compounds) in **bold** are correctly identified by their correct formulae.	Two correctly balanced equations. States not required.	

5(a)(i) 5(a)(ii)	The **green** solid turns **black**/brown. **Limewater turns milky.** $CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$	Three observations from question five are correct.		
5(b)(i) 5(b)(ii)	A **red brown /orange precipitate** would form. The **orange** solution becomes **colourless.** $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$ or $FeCl_3(aq) + 3NaOH(aq) \rightarrow Fe(OH)_3(s) + 3NaCl(aq)$	The formulae for **either** the reactants **OR** the products are correct for 2 equations.	Equations are correctly balanced for two experiments. Accept two balanced half equations **OR** the balanced ionic or molecular equation for Experiment 3 (states are not required.)	
5(c)(i) 5(c)(ii)	The **solution turns blue**. A **grey solid forms** / **black coating forms.** (Pink-brown) **metal disappears**. **Heat given off.** Blue colour is due to copper ions/Cu^{2+}. Grey solid is silver metal / Ag metal. Cu is oxidised because it loses electrons / increases its valency. Ag^+ is reduced because it gains electrons / decreases its valency. $Cu(s) \rightarrow Cu^{2+}(aq) + 2e$ $Ag^+(aq) + e^- \rightarrow Ag(s)$ **OR** $Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+} + 2Ag(s)$ **OR** $Cu(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$		Links both observations to the correct species name or symbol **OR** correctly explains either oxidation or reduction.	Shows understanding of both oxidation and reduction processes, correctly using specific names or symbols.
6(a) 6(b)	$63.6 + 16 = 79.6$ g mol^{-1} $63.6 + (14.0 + 3 \times 16.0) \times 2$ $= 187.6$ g mol^{-1}	Both calculations are correct (ignore units).		
7	63.6 g Cu is produced from 79.6 g CuO 18.0 g Cu is produced from: $79.6 \times \frac{18.0}{63.6} = 22.5$ g CuO 22.5 g of copper II oxide will be reduced.	Evidence of correct method. (Further evidence of the ability to calculate relative molecular masses if not achieved in question 6.) Do not penalise for follow-on error if incorrect rounding in 6(a).	Evidence of correct method and calculation is correct. (1 error allowed eg no unit/ calculator error/ rounding to 2dp instead of 3sf.)	

<table>
<tr>
<td>8</td>
<td colspan="2">2×84.0 g $NaHCO_3$ produces 44 g CO_2
12.6 g $NaHCO_3$ produces $44 \times \frac{12.6}{168}$
= 3.30 g CO_2
3.30 g of carbon dioxide will be produced.</td>
<td>Evidence of correct method.
(Further evidence of the ability to calculate relative molecular masses if not achieved in question 6.)</td>
<td>Evidence of correct use of ratio (2:1) in method and calculation is correct.
(1 error allowed eg no unit/ calculator error.)</td>
<td>Calculation is correct.</td>
</tr>
<tr>
<td>9(a)</td>
<td>P
$\frac{43.7}{31.0} = 1.41$
$\frac{1.41}{1.41} = 1.0$
1 P
2 P</td>
<td>O
$\frac{56.3}{16.0} = 3.52$
$\frac{3.52}{1.41} = 2.50$
2.5 O
5 O
Empirical formula = P_2O_5</td>
<td rowspan="3">Evidence of correct method
such as
P
$\frac{43.7}{31.0} = 1.41$
AND
O
$\frac{56.3}{16.0} = 3.52$
OR
Evidence of correct method
such as
(P) 284 x 43.7 = 124.1
AND
(O) 284 x 56.3 = 159.9</td>
<td rowspan="3">Empirical formula is correct (at least to the stage of the ratio P : O = 1 : 2.5

Evidence of correct method, and calculation is correct.
(1 error allowed)</td>
<td rowspan="3">Molecular formula calculation is correct.</td>
</tr>
<tr>
<td>9(b)</td>
<td colspan="2">M_r (P_2O_5) = (31.0 × 2) + (16.0 × 5)
= 142
284/142 = 2
Molecular formula = 2 × emp. formula
= P_4O_{10}</td>
</tr>
<tr>
<td>OR
9(a) & (b)</td>
<td colspan="2">(P) 284 x 0.437 = 124.1
$\frac{124.1}{31} = 4.003$
(O) 284 x 0.563 = 159.9
$\frac{159.9}{16} = 9.993$
Ratio of P: O = 4: 10
Molecular formula = P_4O_{10}</td>
</tr>
</table>

Judgement Statement

Achievement

Total of **SIX** opportunities answered at Achievement (or higher)

6 × A

Merit

Total of **SIX** opportunities answered with **FOUR** at Merit level and TWO at Achievement level.

4 × M + 2 × A

Excellence

Total of **SIX** opportunities answered with **TWO** at Excellence level and TWO at Merit level and TWO at Achievement level.

2 × E + 2 × M + 2 × A

Assessment Schedule

Chemistry: Describe atomic structure and bonding (90172)

Evidence Statement

<table>
<tr><th>Question</th><th>Evidence</th><th>Evidence contributing to Achievement</th><th>Evidence contributing to Achievement with Merit</th><th>Evidence contributing to Achievement with Excellence</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><td>Atomic no.</td><td>p</td><td>e</td><td>n</td><td>symbol</td></tr>
<tr><td>8</td><td></td><td>8</td><td></td><td>^{17}O</td></tr>
<tr><td>8</td><td></td><td>10</td><td></td><td>$^{17}O^{2-}$</td></tr>
<tr><td></td><td>11</td><td>11</td><td>12</td><td></td></tr>
<tr><td>47</td><td></td><td>46</td><td>61</td><td></td></tr>
</table>
</td><td>2 rows correct

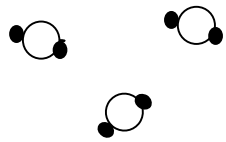
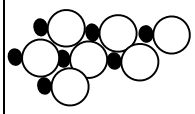
Note: 2 answer options for the first row.</td><td></td><td></td></tr>
<tr><td>1(b)(i)</td><td>fluorine atom</td><td>2,7</td><td rowspan="4">3 correct</td><td rowspan="4"></td><td rowspan="4"></td></tr>
<tr><td>1(b)(ii)</td><td>aluminium atom</td><td>2,8,3</td></tr>
<tr><td>1(b)(iii)</td><td>oxide ion</td><td>2,8</td></tr>
<tr><td>1(b)(iv)</td><td>lithium ion</td><td>2</td></tr>
<tr><td>1(c)</td><td>Describes similarities of Mg and Ca in terms of atomic structure.
Elements in Group 2 have 2 valence electrons (electron arrangements Mg 2, 8, 2 and Ca 2, 8, 8, 2.)
They react by losing 2 electrons to form ions with a (+2) positive charge.</td><td>One common property relating to valence electrons, eg
Group 2 /
2 valence electrons /
2 outer shell electrons /
form 2^+ ions /
lose 2 electrons to form ions.</td><td>Elements have similar chemical properties :
Group 2 /
2 valence electrons /
2 outer shell electrons :
form 2^+ ions /
lose 2 electrons to form ions.</td><td></td></tr>
<tr><td>1(d)</td><td>Isotopes of the same element have different numbers of neutrons. ^{39}K has 20n, ^{40}K has 21n and ^{41}K has 22n per atom.
Relative atomic mass of 39.1 represents the relative natural occurrence of the common isotopes. ^{39}K is much more abundant than ^{40}K, or ^{41}K.</td><td>Isotopes have different numbers of neutrons.</td><td>Links mass to number of neutrons in each isotope /
Recognises the greater abundance of ^{39}K.</td><td>Links mass to number of neutrons in each isotope :
Recognises greater abundance of ^{39}K.</td></tr>
<tr><td>2(a)(i)

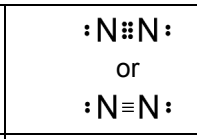
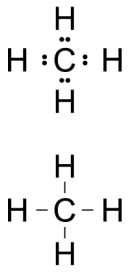
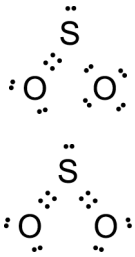
2(a)(ii)

2(a)(iii)</td><td>Covalent: two Cl atoms with 7 e in valence shell share 1e from each atom/ a pair of electrons : to fill outer shell.
Ionic: Li atom donates 1 electron to Cl to form Li^+. Cl atom accepts one electron from Li to form Cl^- with a full valence shell.
Covalent: S needs 2 electrons to fill outer shell. Cl needs 1 electron to fill outer shell. Two chlorine atoms can share a pair of electrons with an S atom.</td><td>Li Cl bonding correct :

Cl_2 bonding correct /
SCl_2 bonding correct.</td><td>Achievement + Explanation for two compounds.

Correct Number of valence electrons :
Shared (Cl_2, SCl_2) /transferred (LiCl).</td><td></td></tr>
</table>

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(b)	Formulae are NaCl and $MgCl_2$ Ratios are 1Na : 1Cl; 1Mg : 2Cl; Na is in Group 1, so ion is Na^+ Mg is in Group 2, so ion is Mg^{2+} ratio/ formula **:** of compound results in overall neutral charge / ions with full /stable valence shell.	For Na and Mg state the correct **:** Formulae with Cl / Ratios with Cl / ion symbols / Groups.	Explanation links formulae / ratios **:** Groups / ions charges / number of electrons transferred **:** Full/stable **:** valence/outer shells/ Overall neutral charge.	
3	Oxygen is a discrete molecule with only weak intermolecular attractions. Hence it has a very low melting point / **needs very little energy** to separate molecules. MgO is an ionic compound with strong ionic bonds. The MP is high because it takes **much more** (heat) **energy** to melt the solid.	Bonding /particles for O_2 **and** MgO ie O_2 molecular/ covalent **:** MgO ionic bonding/ ions.	Achievement + For **either** O_2 **or** MgO the link explained. Bonding/particles **:** energy to melt solid**/** strength of intermolecular attractions / ionic bond.	For O_2 **and** MgO discuss Bonding/particles **:** strength of attractive forces **:** energy to melt.
4(a)	Carbon dioxide  Sodium chloride 	Use symbols given **:** wide spacing CO_2 **:** close packing NaCl.	Use symbols given **:** wide spacing CO_2 **:** close packing NaCl with alternating ions shown in two dimensions/ layers.	
4(b)	CO_2 in both solid and liquid states has discrete molecules with **no free charge** so they cannot conduct a current. NaCl in solid has + and – ions (Na^+ and Cl^- ions) strongly held in place in the crystal (lattice). They cannot move to conduct a current. When melted the ions are free to move to conduct a current.	Bonding / particles **and** charge for ONE compound. CO_2 molecules **:** no charge **/** NaCl ionic **:** charged particles / ions (electrons negates).	**Two** of three links. Liquid NaCl conducts: mobile ions ('electrons' negates) Solid NaCl does not conduct **:** no mobile ions CO_2 does not conduct **:** no **free** ions /electrons/ charged particles in any state.	For both compounds in both states Particle **:** Charge **:** State **:** Energy / Movement of particles

Question	Evidence		Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
5			2 diagrams correct	At least 3 diagrams correct.	
	Or 	or  S-central atom: total electrons = 18			

Judgement Statement

Achievement

Total of **FIVE** opportunities answered at Achievement (or higher)

5 × A

Merit

Total of SIX opportunities answered with **FIVE** at Merit level and **ONE** at Achievement level.

5 × M +1 × A

Excellence

Total of SIX opportunities answered with **TWO** at Excellence level and **THREE** at Merit level and **ONE** at Achievement level.

2 × E + 3 × M + 1 × A

Assessment Schedule

Chemistry: Describe selected non-metals and their compounds (90173)

Evidence Statement

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a)	Process A: **nitrogen fixation / oxidation** where lightning converts **nitrogen (N_2)** into nitrogen oxides ($NO/NO_2/N_xO_Y$) which dissolve in rain / water to give **nitrates** / NO_3^- in the soil. Nodules on legumes contain the catalyst for this process. Process B: plants **decay** and the proteins are converted into **ammonium compounds** such as ammonium nitrate / NH_4NO_3. Also accept: A: fixation via lightning and B: fixation via bacteria in legumes root nodules.	Explanations may be incomplete but correct species given for process A or B. One process thoroughly and minor points of 2nd. Conversion from N_2 to NO_3^- generalised description. Emphasis on chemistry of cycle.	Explanations show clearly that the correct chemical species and conversions in both processes are understood. Lightning path emphasised; legumes not a direct path. Emphasis on different compounds being processed.	
1(b)(i) 1(b)(ii)	Haber process Fe / iron/(Os/U older catalysts).	Both correct.		
1(c)(i)	Ammonia is less dense/lighter than air			
1(c)(ii)	$2NH_4Cl(s) + Ca(OH)_2(s) \rightarrow CaCl_2(s) + 2NH_3(g) + 2H_2O(l)$	The formulae for **either** the reactants or the products are correct.	The formulae for **both** the reactants and the products are correct but equation is not balanced.	The equation is correctly balanced. (States are not required). E1
2(a)	To **remove solid particles** from the air.	Achievement only.		
2(b)	Air is compressed so that when it is allowed to expand, the temperature decreases until some of the **gases liquefy**. The process is continued until the temperature is below the Boiling Point of nitrogen (< –196°C). (Ne and He are still gases.)		Links expansion/cooling effect/temperature decrease/repetition to getting temperature low enough.	
2(c)	All gases are in **the liquid state except neon and helium**. The **temperature is raised (to –196°C)** and **all the nitrogen gas boils off** and is collected before the temperature increases to –186°C where argon is collected.	Neon and helium are gaseous (ignore CO_2).	Correct explanation of the collection of nitrogen (**including the boiling point**).	

Question	Evidence		Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(a)	Greenish-yellow **and** gas		Both colour and state correct.		
3(b)	$Cl_2(g) + H_2O(l) \rightarrow HCl(aq) + HOCl(aq)$ or correct ionic equation may use equilibrium arrow.		The formulae for **either** the reactants **or** the products are correct.	The formulae for **both** the reactants **and** the products are correct.	Both equations are correctly balanced. (States are not required.) E1
3(c)	$2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$		One error in equation, ie. electrons on left or charge left off chloride ion.	Equation all correct. Merit only.	
3(d)	**How it works**	**Why needed**	Any one of the statements in the 4 cells is correct.	One of the rows in the evidence table is correct (links how and why).	
	Lets Na^+ ions through but not OH^-.	So concentration of NaOH occurs (on RHS)/solution NaOH forms.			
	Keeps gases H_2 and Cl_2 apart. Must name gases.	So they cannot react / combine together (not mixed).			
4(a)	• Yellow powder melts to a red liquid that burns with a blue flame. • A choking gas forms. • A white vapour is seen. • Turns black from yellow.		One correct observation noted.		
4(b)	It must be done in a **fume cupboard**/ hood because SO_2 is a **poisonous/irritant** gas.		Answer includes both points in bold. Emphasis on isolation of reaction.		
4(c)	**Properties** of SO_2 Disinfectant or preservative OR kills bacteria/mould/fungi OR destroys enzymes. Denatures proteins on bacteria coat. **Added first** to ensure other microorganisms do not cause undesirable reactions/produce chemicals that might interfere with fermentation. **If not added** juice/wine may discolour / smell bad / not ferment / taste bad / because other reactions could occur instead of or as well as fermentation.		ONE correct property.	Links reason for adding SO_2, to a stated property.	Answer includes a relevant prediction and shows understanding of consequences of not adding it. Must not include incorrect chemistry ie absorbs O_2. E2

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
5	UV radiation splits oxygen molecules into 2 (reactive) oxygen atoms. $O_2(g) \xrightarrow[UV]{} 2O(g)$ The O atoms then react with oxygen molecules to form ozone. $O(g) + O_2(g) \rightarrow O_3(g)$ **OR** $3O_2(g) \rightarrow 2O_3(g)$ UV is absorbed in the first reaction, so the making of ozone in the upper atmosphere absorbs some of the dangerous UV radiation from the sun. The Earth is therefore shielded from its damaging rays. **OR** When ozone absorbs radiation, some molecules dissociate. $O_3(g) \rightarrow O_2(g) + O(g)$ This reaction also absorbs radiation. **OR** When ozone reacts with chlorine atoms (from CFCs), the amount of ozone decreases, reducing the amount of UV that the ozone layer can absorb. The Cl is a catalyst as it is not used up. $O_3 + Cl \rightarrow O_2 + ClO$ (all in gas state) $ClO + O \rightarrow Cl + O_2$ OR overall $O_3 + O \rightarrow 2O_2$ (one Cl atom can destroy 100 000 ozone molecules)	Describes why the ozone layer is important to people and the environment. **OR** describes the effect of reduced ozone in the upper atmosphere on people and the environment. **OR** describes how human activities can damage the ozone layer.	Links at least two aspects in some detail. Descriptive. Equations, if used, do not have to be balanced but chemical species must be relevant.	Discusses at least two linked aspects in detail. Must include chemistry of formation or decomposition by chlorine free radicle; either as equations or written out. E2

Judgement Statement

Achievement

Total of **NINE** opportunities answered at Achievement (or higher)

9A

Merit

Total of ELEVEN opportunities answered with **FIVE** at Merit level and SIX at Achievement level.

5 × M + 6 × A

Excellence

Total of TWELVE opportunities answered with **TWO** at Excellence level (with one E1 and one E2) and THREE at Merit level and SEVEN at Achievement level

1 × E1 + 1 × E2 + 3 × M + 7 × A

Assessment Schedule

Chemistry: Describe properties and reactions of metals, acids and bases (90640)

Evidence Statement

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a) 1(b)(i) 1(b)(ii)	Bubbles of gas / effervescence / the solid disappears (or dissolves) / fizzing / temperature goes down The splint / flame would go out / stop burning / be extinguished The gas would burn OR there is a pop /squeak / explosion (ie sound is described)	**Two** of the three observations in Question 1(a) and 1(b) are correct.		
1(c)(i) 1(c)(ii)	sodium sulfate + water + carbon dioxide zinc sulfate + hydrogen	Both **word** equations are correct.		
2(a) 2(b)	$2Li + 2H_2O \rightarrow 2LiOH + H_2$ $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$	Correct formulae for products in ONE equation. $LiOH + H_2$ $Mg(OH)_2 + H_2$ / $MgO + H_2$	Correct reactants and products for **both** hydroxide producing reactions (unbalanced) **OR** One correctly balanced equation **OR** accept $Mg + H_2O \rightarrow MgO + H_2$	Both equations are balanced with correct **hydroxide** products for each metal.

Question	Evidence		Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(c)	Window frames for houses.	unreactive (with air or water) / has protective oxide layer (must be linked to reactivity) / doesn't corrode / malleable / can be anodised(and coloured)	Three **different** properties relevant to the TWO uses are stated.		
	Overhead electrical power cables.	conducts electricity / ductile / lightweight or low density (**NOT** *light*) / unreactive (with air or water) / has protective oxide layer (must be linked to reactivity) / doesn't corrode			
3(a) 3(b) (i) 3(b) (ii)	**Compound X** is copper oxide / CuO **Element Y** is iron / Fe Reason(s): copper oxide reacts to form copper sulfate solution **:** this is blue **OR** copper oxide reacts to form Cu^{2+} ions **:** these are blue in solution **OR** copper oxide would not burn **:** it has already reacted with O_2 / is already oxidised. Reason(s): iron reacts to form Fe^{2+} ions / $FeSO_4$ / iron(II) sulfate **:** are/is pale green in solution **OR** the (colourless) gas formed would be hydrogen **OR** the Fe would burn to form iron oxide / FeO. (**NOT** iron(III) oxide)		One solid identified.	One solid identified with reason(s) linking the observation(s) and the product(s) formed. **OR** Both solids identified.	BOTH solids correctly identified and answer shows clear reasoning with ONE observation for each solid explained in terms of the products, which are also identified.

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
4(a)	At the start the **rate of reaction is greatest / reaction is fastest** **OR** there are **more (named) reactant particles / acid is most concentrated AND marble chip largest / has largest SA** and therefore more collisions can occur between them.	**Two** of the statements in bold from (a) – (c) are correctly stated or implied.	Both explanations 4(a) and 4(b) correctly link rate to the reactants.	
4(b)	The **reaction has stopped / no more gas is produced :** there are no reactant particles left to collide / one reactant is used up.			
4(c)	EITHER **increase in concentration of the acid** (**NOT** *strength)* OR **increase in surface area of the solid / limestone / calcium carbonate** **(NOT catalyst).**			
4(d)	The particles will • **be moving faster** • **have more energy** • this means they will **collide more frequently** / often / more in a given time than before/more in the same time) with each other • the **collisions** will be **more effective / successful.**		Any of the 3 bold points	All of the 4 bullet points
5(a)	TEST ONE OBSERVATIONS Sodium hydroxide: (paper) turns/goes etc blue/purple. Hydrochloric acid: (paper) turns red / red-orange (*NOT orange or orange-yellow*) TEST TWO OBSERVATIONS Sodium hydroxide: no reaction. Hydrochloric acid: **2** of bubbles of gas / metal disappears / tube contents get hot	Correct observations for **both** solutions in **ONE** test.		

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
5(b)	NaOH is a base / alkali which cause Universal Indicator paper to go blue / purple. Bases do not react with Mg. HCl is an acid containing H^+ / H_3O^+ ions which causes UI paper to go red / red-orange. Hydrogen gas and magnesium chloride is produced.		Links observations to acid/base character in both tests. Eg NaOH is base/alkali and turns UI blue/purple HCl is acid – turns UI red. (Bases don't react with metals) AND Mg reacts with acids to make hydrogen.	Shows understanding that • there are H^+ / H_3O^+ (ions) in acid • H^+ / H_3O^+ / acid reacts with Mg/metal • products are magnesium chloride / metal salt / salt **:** hydrogen (gas) • Base / OH^- does not react with Mg / (most) metals

NOTES (in brackets) not needed.

Judgement Statement

Achievement

Total of **FOUR** opportunities answered at Achievement (or higher)

4 × A

Merit

Total of SEVEN opportunities answered with **THREE** at Merit level and FOUR at Achievement level.

3 × M + 4 × A

Excellence

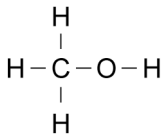
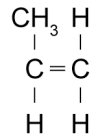
Total of SEVEN opportunities answered with **TWO** at Excellence level and FIVE at Achievement level.

2 × E + 5 × A

Assessment Schedule

Chemistry: Describe properties and reactions of carbon and its compounds (90648)

Evidence Statement

Question	Evidence		Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1	 **OR** CH_3OH		Three answers correct. Structural formulae must be either full or condensed (not molecular formulae).		
	 **OR** CH_3CHCH_2				
		hexane			
		ethanoic acid			
2(a)	CO_2 is **less soluble** in warm water than in cold water.		Correct statement.		
2(b)	$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O$		Correct formulae of either products or reactants.	Correct formulae for both products and reactants (may be unbalanced).	Correct balanced equation. E1
2(c)	Carbon dioxide is heavier/ more dense than air.		Correct		
2(d)(i)	Test: Place **wet blue** litmus paper at top of jar.		Correct		
2(d)(ii) 2(d)(iii)	Observation: it goes pink / red. Reason: It is soluble in water and forms an acidic solution.		Goes pink and CO_2 is acidic.	Both achieved points plus CO_2 soluble.	
2(e)	Carbon monoxide / CO		Correct name of gas **OR** correct formula.		

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(f)	When the amount of oxygen decreases the graphite is then burning in a limited supply of air / incomplete combustion occurs.	Incomplete combustion OR low level of oxygen.	Incomplete combustion due to low level of oxygen OR Explains why O_2 level decreases and therefore CO produced.	Incomplete combustion due to low level of oxygen. Low oxygen due to excess amount of carbon/graphite relative to total oxygen in the jar.
2(g)	$2C + O_2 \rightarrow 2CO$	Correct species.	Balanced equation.	
3(a)	There are 60 C atoms in a molecule	Correct		
3(b)(i) 3(b)(ii)	There are weak bonds between the layers of carbon atoms **:** the layers slide over each other. The carbon atoms are held in a giant covalent lattice by strong covalent bonds.	Describes one structure correctly or describes strength of bonds in one allotrope.	Links property to strength of bonds for both graphite and diamond.	
3(c)	Melting point lower than both of the others because only weak forces between molecules. Not as hard as others, or greasy/powdery, as the molecules separate easily. Non-conductor because no free electrons.	Predicts one property.	Predicts one correct property, with supporting reason.	Answer links structure to at least two properties with supporting reasons. E2

Question	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
4(a)	$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$	Correct formulae of all reactants **OR** all products **OR** a word equation.	Correct formulae of all reactants and all products.	Correctly balanced equation – states not required. E1
4(b)	• Ethanol adds less CO_2 to the atmosphere than the same amount of propane, but more of the ethanol would have to be burned to produce the same amount of energy – the extra CO_2 could increase the problems caused by the greenhouse effect eg global warming, ice cap melting, sea levels rising, droughts etc. • ethanol cleaner burning, refer to soot, link to particulate health problems. • propane more likely to undergo incomplete combustion releasing CO, a poisonous gas that can attach to hemoglobin. • since propane is a gas the filling of cylinders with gas under pressure is more dangerous and in the case of an accident propane could be more likely to cause an explosive combustion reaction. • ethanol spills can be diluted with water but propane is insoluble in water. • the social implications of having ethanol available at retail outlets in large quantities could be huge as it is the only alcohol that can be consumed by humans. Note: economics not a valid point of comparison here.	At least two correct and relevant. Eg propane produces more energy, **OR** Ethanol produces less pollutants.	Elaboration beyond the facts in the table. Links made to further chemical knowledge. Eg production of carbon dioxide leads to environmental problems such as acid rain and the greenhouse effect.	Elaboration across all three areas: – environment – energy – safety. Involves comparisons and links to further chemical knowledge. E2
5	Crude oil consists of a mixture of hydrocarbons with very different B.Pts due to the differences in sizes of their molecules. The oil is heated and the hot gases pass up a tower that has baffles inside it. The smaller, lighter molecules with low B.Pts are collected at the top of the tower as the gas fraction. This has molecules with 1-4 C atoms per molecule. Other fractions with higher B.Pts collect lower down the tower with the heaviest ones collected as tar/residue at the bottom.	Crude oil is a mixture of hydrocarbons with different sizes/B.Pts.	Description of heating and breaking up into fractions. Explanation in terms of differences in boiling points.	Full discussion of the process including linking size/B.Pt of molecules to their collection points in the column.

Note: in all tasks, states will be included in any given equation but students at this level will not be expected to write them.

Judgement Statement

Achievement

Total of **EIGHT** opportunities answered at Achievement level (or higher)

8 × A

Merit

Total of EIGHT opportunities answered with **FIVE** at Merit level and THREE at Achievement level.

5 × M + 3 × A

Excellence

Total of EIGHT opportunities answered with **THREE** at Excellence level (including at least one E1 and one E2),), TWO at Merit level and THREE at Achievement level.

3 × E + 2 × M + 3 × A