EXEMPLAR

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For Supervisor's use only

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Chemistry, 2007

90171 Describe chemical reactions

Credits: Four
9.30 am Monday 19 November 2007

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

A metal activity series, solubility rules, a table of ions and a periodic table are provided in Resource Booklet L1–CHEMR.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

For Assessor's use only	Achievement Criteria				
Achievement		**Achievement with Merit**		**Achievement with Excellence**	
Describe chemical reactions.	✓	Interpret information about chemical reactions.	✓	Apply understanding of chemical reactions.	–
Overall Level of Performance	**M**				

Has calculations only to **E** level, not explanations. Not an **E** level student.

You are advised to spend 40 minutes answering the questions in this booklet.

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QUESTION ONE: PRECIPITATION

The following pairs of solutions are mixed. Use the solubility rules in your Resource Booklet to identify if a **precipitate** is formed.

(a) Write the **name of the precipitate**. If none is formed, write **no precipitate.**

	Solutions that are mixed	Name of the Precipitate, OR No Precipitate
(i)	Silver nitrate + calcium chloride	Silver Chloride or $AgCl$
(ii)	Potassium sulfate + iron(II) nitrate	none
(iii)	Calcium nitrate + sodium sulfate	Calcium Sulfate or $CaSO_4$

A

(b) Write a balanced equation for the formation of ONE precipitate identified in Question One (a) above. Spectator ions may be omitted from ionic equations.

$Ca(NO_3)_{2(aq)} + Na_2SO_{4(aq)} \rightarrow CaSO_{4(s)} + 2NaNO_{3(aq)}$

M

QUESTION TWO: EQUATIONS

(a) Complete the following word equations.

(i) magnesium + oxygen $\xrightarrow{\text{heat}}$ magnesium oxide

(ii) calcium carbonate $\xrightarrow{\text{heat}}$ calcium oxide + carbon dioxide

(iii) lead nitrate + potassium chloride $\longrightarrow$ lead chloride + potassium nitrate

A

(b) Complete and balance the following equations.

Charge removed. Need just one equation correct to get **M**.

(i) $2I^-(aq) + Cl_2(aq) \longrightarrow 2Cl^- + I_2$

(ii) $Zn(s) + 2AgNO_3(aq) \longrightarrow Zn(NO_3)_{2(aq)} + 2Ag(s)$

M

QUESTION THREE: OBSERVING CHEMICAL REACTIONS

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A small amount of zinc hydroxide is heated in a test tube over a Bunsen burner. The following reaction occurs.

$$Zn(OH)_2(s) \xrightarrow{\text{heat}} ZnO(s) + H_2O(g)$$

(a) State what **type** of reaction is occurring. Thermal decomposition

A

(b) Fully describe the **observations** that would be expected if this reaction was carried out in a school laboratory. Remember to **link** your observations to the substances involved.

The students would notice steam rising from the beaker as a product of the reaction would be water however due to the heat it would evaporate and rise as a gas. A solid would form at the bottom of the beaker, this solid would be Zinc Oxide or ZO. When Zinc Hydroxide is heated it thermally decomposes into Zinc Oxide and Water.

N

Only one correct observation. Need two for A, with no incorrect observation.

QUESTION FOUR: MOLAR MASSES

Calculate the relative molar masses of the following compounds. Use the relative atomic masses provided in the periodic table in the Resource Booklet.

(a) ZnO

ZnO = 65.4 + 16

ZnO = 81.4 g mol^{-1}

(b) $CuSO_4$

$CuSO_4$ = 63.6 + 32.1 + (16 x 4)

$CuSO_4$ = 159.7 g mol^{-1}

(c) $Pb(NO_3)_2$

$Pb(NO_3)_2$ = 207 + (14 x 2) + (16 x 6)

$Pb(NO_3)_2$ = 331 g mol^{-1}

A

QUESTION FIVE: CALCULATING MASS

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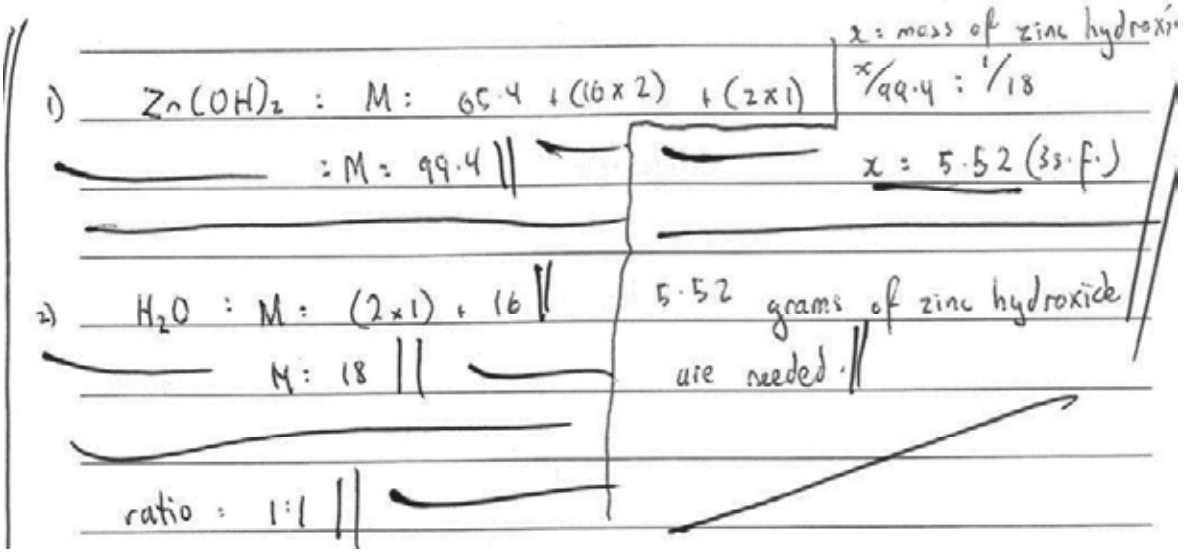
(a) Calculate the mass of zinc hydroxide that must be heated to produce 1.00 gram of water. Use the equation below. Show all of your working clearly.

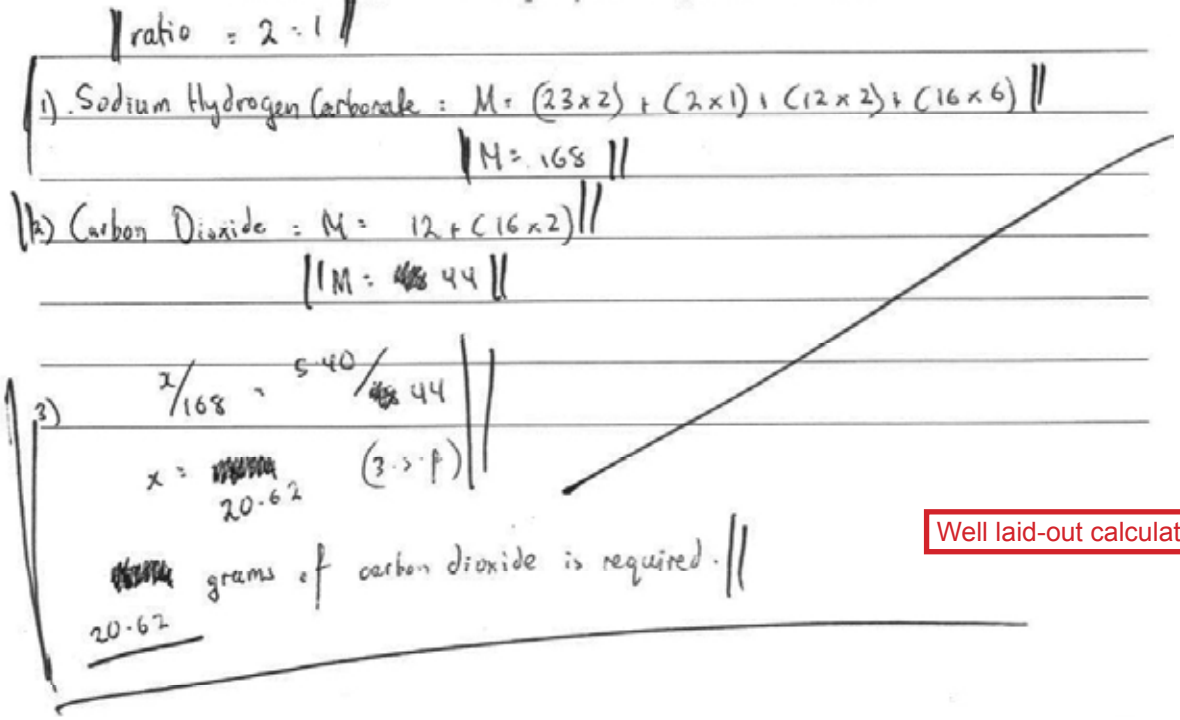
$$Zn(OH)_2(s) \longrightarrow ZnO(s) + H_2O(g)$$



M

(b) Calculate the mass of sodium hydrogen carbonate, $NaHCO_3$, required to form 5.40 grams of carbon dioxide, CO_2, when heated. Show all of your working clearly.

$$2NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$



Well laid-out calculations

E

QUESTION SIX: CHEMICAL REACTIONS

Assessor's use only

Part A

A colourless solution of barium nitrate is added to a pale green solution of iron(II) sulfate in a beaker. A reaction occurs.

(a) Describe the observations that would be expected for this reaction.

a white precipitate would form. [redacted] The green colour of the solution would fade

N

Need two observations

(b) State what type of reaction is occurring. precipitation reaction.

A

(c) Discuss the chemistry of this reaction. Your discussion should refer to the observations you made in part (a). Include a balanced equation in your answer. Spectator ions may be omitted.

The white precipitate that formed would be barium sulfate, since the two substances swap partners the two products would be Iron (Fe^{2}) Nitrate $(NO_3)_2$ and Barium Sulfate ($BaSO_4$), Iron Nitrate is soluble however Barium Sulfate is not so it would form a precipitate

Charges are missing on ionic equation, but molecular equation is correct.

$\Rightarrow Ba(NO_3)_{2(aq)} + FeSO_{4(aq)} \rightarrow BaSO_{4(s)} + Fe(NO_3)_{2(aq)}$

or $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

The green colour of the solution would fade due to the fact that the Iron Sulfate combination that results in the green colour would be split up.

A

Identifies $FeSO_4$ as giving green colour but not Fe^{2+}. This is given in question.

Part B

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A strip of magnesium ribbon is heated over a Bunsen burner. It burns with a bright white light and forms a white ash.

Discuss the chemistry of this reaction in terms of oxidation and reduction. Write the appropriate half equations and overall balanced equation in your answer.

The magnesium ribbon is oxidised and it therefore loses 2 electrons, it originally had 2 electrons in its valence shell but these are lost in order for it to become an ion. Magnesium is the reductant.

$Mg \rightarrow Mg^{2+} + 2e$

Their is also oxygen in this reaction, the oxygen is reduced so it gains the 2 electrons magnesium has lost, it originally had 6 electrons in its valence shell but since it has gained the 2 electrons magnesium has dropped it has completed its valence shell and become a stable ion. Oxygen is the oxidant.

$O + 2e \rightarrow O^{2-}$

Since one reacant gains electrons and another loses them there is an oxidation-reduction redox reaction, Magnesium is oxidised and Oxygen is reduced because magnesium has lost 2 electrons and has drawn oxygen, Oxygen has gained 2 electrons and been reduced and been oxidised

$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$

Explanations are correct; half equations are incorrect.

M

QUESTION SEVEN: MOLECULAR FORMULA

A compound was analysed and found to contain:

- 20.2% phosphorus
- 10.4% oxygen and
- 69.4% chlorine.

It has a relative molar mass of 153.5.

All rounded to three significant figures

Determine the molecular formula of this substance. Show all of your working clearly.

Empirical Formula :

	P	O	Cl
1)	$20.2/31.0$	$10.4/16$	$69.4/35.5$
2)	$0.652/0.65$	$0.65/0.65$	$1.95/0.65$
3)	1	1	3

Empirical Formula : $P_1O_1Cl_3$

Molecular Formula :

	P	O	Cl
153.5	(31×1)	(16×1)	(35.5×3)
	$= 31$	$= 16$	$= 106.5$

$= 31 + 16 + 106.5$

$= 153.5$

$= \frac{153.5}{153.5}$

$= 1$

So $P_{(1\times1)}O_{(1\times1)}Cl_{(3\times1)}$

Molecular Formula is $P_1O_1Cl_3$ or $PbOCl_3$

Calculation is correct and final answer correct, but rewritten with a silly mistake in it. This candidate clearly knows what they are doing, so **E**.

E