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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 3 Chemistry, 2010

90780 Describe properties of particles and thermochemical principles

Credits: Five
9.30 am Monday 22 November 2010

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 periodic table is provided on the Resource Sheet L3–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 2–10 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 properties of particles and thermochemical principles. ☐	Explain and apply properties of particles and thermochemical principles. ☐	Discuss properties of particles and thermochemical principles. ☐
Overall Level of Performance ☐		

You are advised to spend 45 minutes answering the questions in this booklet.

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QUESTION ONE

(a) Complete the following table.

Symbol	Electron configuration
Ca	
Cr	
Mn^{2+}	

(b) Explain why calcium has only one oxidation state, other than zero, while manganese has several different oxidation states.

(c) Match the atoms and ions in the table below to the radii given.

99 pm 137 pm 197 pm

Ca	Ca^{2+}	Mn

Justify your answer.

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QUESTION TWO

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(a) Complete the table by:

(i) drawing Lewis diagrams for the two molecules

(ii) drawing the shape of each molecule

(iii) giving the name of the shape of each molecule.

Molecule	SF_4	XeF_4
Lewis diagram		
Diagram of shape		
Name of shape		

(b) Discuss the fact that although both SF_4 and XeF_4 have four bonds around the central atom, the molecules have different shapes and polarities.

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QUESTION THREE

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(a) (i) Write the equation for which the enthalpy change is the enthalpy of formation, $\Delta_f H°$, for zinc oxide.

(ii) Zinc oxide is formed when zinc sulfide is heated in air.

$$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$$

Calculate the enthalpy change, $\Delta_r H°$, for this reaction, using the following data.

$\Delta_f H°$ (ZnS(s)) = –200 kJ mol^{-1}

$\Delta_f H°$ (ZnO(s)) = –348 kJ mol^{-1}

$\Delta_f H°$ ($SO_2(g)$) = –297 kJ mol^{-1}

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(b) The equation for the combustion of ethanol is:

$$CH_3CH_2OH(g) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g) \quad \Delta_r H^\circ = -1379 \text{ kJ mol}^{-1}$$

Calculate the bond enthalpy for the O–H bond using the enthalpy of the reaction above and the bond enthalpy data in the table.

Bond	Bond enthalpy / kJ mol^{-1}
C–H	+ 412
C–O	+ 360
O=O	+ 496
C–C	+ 348
C=O	+ 743

QUESTION FOUR

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(a) (i) Write the equation for which the enthalpy change is the enthalpy of fusion, $\Delta_{fus}H°$, for zinc sulfide.

(ii) Give a reason why $\Delta_{fus}H°$ is always greater than zero.

(b) Ethanol (CH_3CH_2OH) and propane ($CH_3CH_2CH_3$) have similar molar masses but ethanol is a liquid at room temperature, while propane is a gas.

Identify the types of intermolecular forces for each of these substances and explain why ethanol has a higher boiling point than propane.

(c) Account for the difference in the boiling points of the two substances in the table below by comparing **all the intermolecular forces**.

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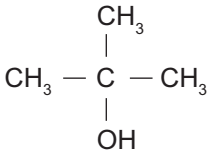
Name	Structure	Boiling Point / °C
butan-1-ol	$CH_3CH_2CH_2CH_2OH$	117.7
2-methylpropan-2-ol		82.6

Extra paper for continuation of answers if required.
Clearly number the question.

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Question number	

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