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NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 3 Chemistry, 2007

90780 Describe properties of particles and thermochemical principles

Credits: Five
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 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 2–11 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) Write the electron configuration using *s, p, d* notation for:

K _____

P^{3-} _____

Zn^{2+} _____

(b) Explain in terms of electron configuration why zinc sulfate, $ZnSO_4$, forms a colourless solution, whereas copper sulfate, $CuSO_4$, forms a blue solution.

(c) Explain the difference between the radii of the following species.

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(i) K atom and K^+ ion

(ii) P atom and P^{3-} ion

(d) Account for the differences in electronegativity values for nitrogen, potassium and arsenic.

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Element	Electronegativity
Nitrogen, N	3.04
Potassium, K	0.82
Arsenic, As	2.18

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QUESTION TWO

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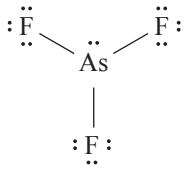
(a) Complete the table below by drawing Lewis diagrams for BrF_3 and BrF_5, and naming their shape.

		BrF_3	BrF_5
(i)	Lewis diagram		
(ii)	Shape		

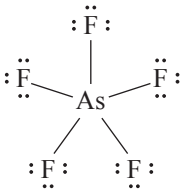
(b) Discuss the polarities of AsF_3 and AsF_5 molecules. Your discussion should include:

- justification for the molecular shape and
- relative electronegativies of the atoms within the molecule.

The Lewis structures for each molecule are shown below.



Arsenic trifluoride, AsF_3



Arsenic pentafluoride, AsF_5

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QUESTION THREE

(a) The boiling points of HF, F_2 and HCl are given below.

Molecule	Boiling point (°C)
Hydrogen fluoride, HF	19.5
Fluorine, F_2	−188.1
Hydrogen chloride, HCl	−85.1

Discuss the different boiling points of hydrogen fluoride, fluorine and hydrogen chloride in terms of the relative strengths of the intermolecular forces between the particles involved.

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(b) Write the equation for the reaction that has an enthalpy change given by $\Delta_f H°$(HCl, *g*).

(c) (i) Calculate $\Delta_f H°$ (HCl, *g*) using the following bond enthalpies

Bond	Bond enthalpy / kJ mol^{-1}
H–H	436
Cl–Cl	242
H–Cl	431

(ii) $\Delta_f H°$ (HBr, *g*) is –36.2 kJ mol^{-1}.

Calculate the heat produced by the formation of 50.0 g of HBr(*g*) from its elements in their standard states.

QUESTION FOUR

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Calculate the heat of combustion of ethyne, $\Delta_c H^\circ C_2H_2(g)$, from the following data:

$$2C(s) + H_2(g) \rightarrow C_2H_2(g) \qquad \Delta_r H^\circ = 229 \text{ kJ mol}^{-1}$$

$$\Delta_c H^\circ (H_2, g) = -285 \text{ kJ mol}^{-1}$$

$$\Delta_c H^\circ (C, s) = -393 \text{ kJ mol}^{-1}$$

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

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