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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 3 Chemistry, 2009

90780 Describe properties of particles and thermochemical principles

Credits: Five
9.30 am Tuesday 17 November 2009

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) Write the electron configuration using *s, p, d* notation for:

Ca^{2+} _____

Br _____

Fe^{2+} _____

(b) Account for the fact that compounds containing Ca^{2+} and Zn^{2+} are not coloured, whereas compounds containing Fe^{2+} are coloured.

_____

_____

_____

_____

(c) Account for the differences in the atomic or ionic properties given below and on the following page.

(i)

Atom	Ionisation energy (kJ mol^{-1})
Ca	596
Br	1146

_____

_____

_____

_____

_____

_____

_____

_____

_____

(ii)

Atom / ion	Radius (pm)
Br	114
Br^-	196
I	133

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QUESTION TWO

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(a) Complete the table below by drawing Lewis diagrams for the two molecules and writing the name that describes the shape of each molecule.

	BrF_3	SF_6
Lewis diagram		
Shape		

(b) Compare the polarities of the two molecules, BrF_3 and SF_6.

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QUESTION THREE

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(a) Calculate the enthalpy change for the reaction below using the bond enthalpy data in the table.

$$CH_3Cl(g) + NH_3(g) \rightarrow CH_3NH_2(g) + HCl(g)$$

Bond	Bond enthalpy (kJ mol^{-1})
C–H	414
C–Cl	339
N–H	391
C–N	286
H–Cl	431

(b) Define the term $\Delta_{vap}H°$.

(c) Justify the similarity in the $\Delta_{vap}H°$ of CH_3Cl and CH_3NH_2.

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	$\Delta_{vap}H°$ (kJ mol^{-1})	Molar mass (g mol^{-1})
CH_3Cl	22	50.5
CH_3NH_2	24	31.0

QUESTION FOUR

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(a) Carbon dioxide and water are formed when hexane burns in oxygen.

$$C_6H_{14}(\ell) + 9½O_2(g) \rightarrow 6CO_2(g) + 7H_2O(\ell) \qquad \Delta_c H° = -4163 \text{ kJ mol}^{-1}$$

Calculate the enthalpy of formation of hexane, $\Delta_f H°(C_6H_{14}, \ell)$.

$\Delta_f H°(CO_2, g) = -393 \text{ kJ mol}^{-1}$

$\Delta_f H°(H_2O, \ell) = -286 \text{ kJ mol}^{-1}$

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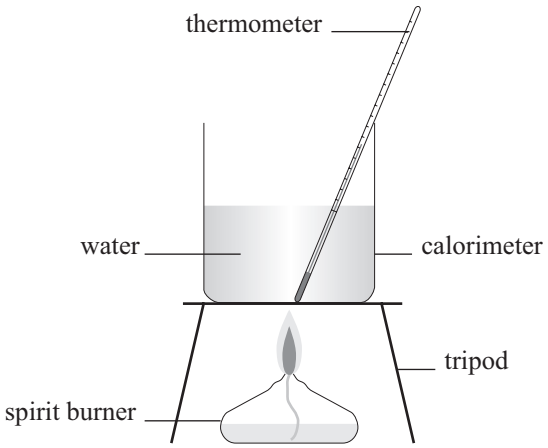
(b) The apparatus below was used to determine the enthalpy of combustion of hexane. When 0.400 g of hexane was burned in the spirit burner, the temperature of 150 g of water was found to increase from 22°C to 39°C.



Calculate the experimental value of $\Delta_c H(C_6H_{14}, \ell)$.

$M(C_6H_{14}) = 86.0 \text{ g mol}^{-1}$

specific heat capacity of water = $4.18 \text{ J g}^{-1} \text{ °C}^{-1}$

(c) Account for the difference between the experimental value and the value given in part (a), AND suggest how this difference could be minimised.

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

Assessor's use only

Question number	