NZQA

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KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 3 Chemistry, 2017

91390 Demonstrate understanding of thermochemical principles and the properties of particles and substances

2.00 p.m. Wednesday 15 November 2017
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of thermochemical principles and the properties of particles and substances.	Demonstrate in-depth understanding of thermochemical principles and the properties of particles and substances.	Demonstrate comprehensive understanding of thermochemical principles and the properties of particles and substances.

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 attempt ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L3–CHEMR.

If you need more room for any answer, use the extra space 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.

TOTAL

ASSESSOR'S USE ONLY

QUESTION ONE

(a)   Complete the following table.

Symbol of particle	Electron configuration (use *s, p, d* notation)	Charge	Atomic number
Cl		0	
		+2	20
Mn^{2+}			

(b)   (i)   Define the term electronegativity.

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   (ii)   Explain why the electronegativity of chlorine is greater than that of phosphorus.

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(c) The following graph shows the first ionisation energies of the Group 2 elements from Be to Ba.

First ionisation energies of Group 2 elements
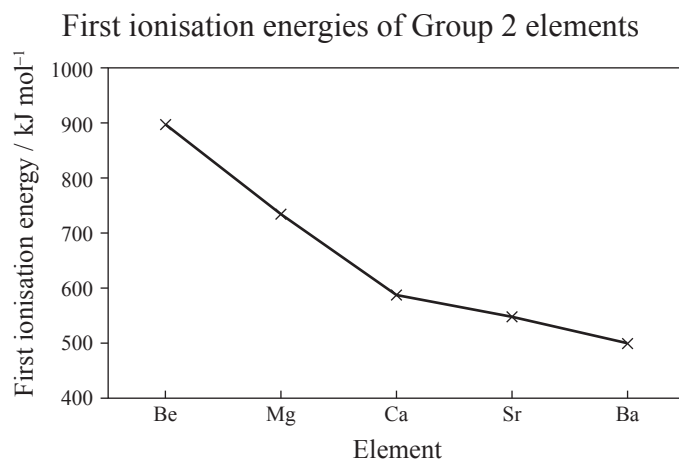
(i) Write an equation to show the first ionisation energy for the element calcium.

(ii) Explain the trend shown of first ionisation energies of the Group 2 elements.

QUESTION TWO

Molecule	Boiling Point / °C	M / g mol^{-1}
Hydrazine, N_2H_4	114	32
Iodomethane, CH_3I	42.4	142
Decane, $C_{10}H_{22}$	174	142

Use the information in the table above to compare and contrast the boiling points of the substances below.

In your answers, you should:

- list the types of intermolecular forces present for each substance

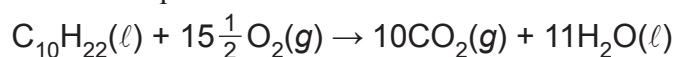- explain the relative strength between the particles involved.

(a) (i) Hydrazine and iodomethane.

(ii) Iodomethane and decane.

(b) Explain why the solubility of hydrazine in water is greater than that of decane in water.

(c) Carbon dioxide and water are formed when decane burns completely in oxygen. The reaction is shown in the equation below.

$$C_{10}H_{22}(\ell) + 15\tfrac{1}{2}O_2(g) \rightarrow 10CO_2(g) + 11H_2O(\ell)$$

Calculate the enthalpy of combustion for decane, given the following data:

$$\Delta_f H^\circ\ (C_{10}H_{22}(\ell)) = -301 \text{ kJ mol}^{-1}$$
$$\Delta_c H^\circ\ (C) \qquad = -393 \text{ kJ mol}^{-1}$$
$$\Delta_c H^\circ\ (H_2) \qquad = -286 \text{ kJ mol}^{-1}$$

(d) The reaction for the complete combustion of hydrazine is shown in the equation below.

$$N_2H_4(\ell) + O_2(g) \rightarrow N_2(g) + 2H_2O(g)$$
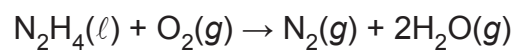
This is an exothermic reaction.

Explain the entropy changes associated with this reaction.

QUESTION THREE

Chlorine, Cl_2, bromine, Br_2, and iodine, I_2, are all halogens.
Bromine is a liquid at room temperature.

(a) (i) In the box below, tick the type(s) of intermolecular attractions in **liquid** bromine.

Intermolecular attraction	Tick (✔)
Temporary dipole-dipole attractions	
Permanent dipole-dipole attractions	
Hydrogen bonding	

(ii) Explain why bromine is a liquid at room temperature, whereas chlorine is a gas.

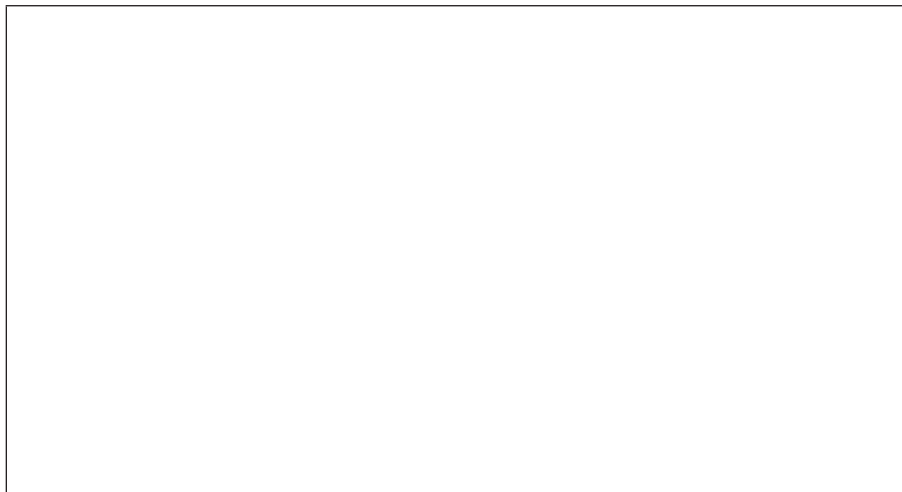(b) (i) Write an equation for the sublimation of iodine in the box below.

(ii) Define the enthalpy of sublimation for iodine.

**Question Three continues
on the following page.**

(iii) Explain why the sublimation of iodine is spontaneous, even though the enthalpy of sublimation is a positive value.

(c)　Iodine forms a linear I_3^- ion.

(i)　Draw the Lewis structure for the I_3^- ion in the box below.

(ii)　Explain why the I_3^- ion has a linear shape.
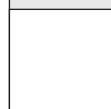
(iii) IF_5 has a square pyramidal shape.

Indicate whether the molecule IF_5 is polar or non-polar.

Circle your choice.   **polar**   **non-polar**

Justify your choice.

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QUESTION NUMBER

Extra paper if required.
Write the question number(s) if applicable.

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