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91390



Level 3 Chemistry, 2014

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

2.00 pm Tuesday 11 November 2014 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 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.

TOTAL

(a) Complete the following table.

Symbol	Electron configuration
K	
Cr	
As	

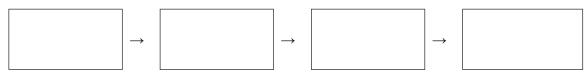
(b)	Explain the difference between the radii of the K atom and the K ⁺ ion.

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(c) The following table shows the electron configurations of four atoms, He, B, N, and Ne. $\,$

Arrange these atoms in order of increasing first ionisation energy by writing the symbol of the appropriate atom in the boxes below.

Atom	He	В	N	Ne
Electron configuration	$1s^2$	$1s^22s^22p^1$	$1s^22s^22p^3$	$1s^22s^22p^6$



lowest ionisation energy

highest ionisation energy

(d)

The	halogens make up Group 17 of the periodic table.	ASSESSOR'S USE ONLY
(i)	The polarity of the HBr molecule is shown below.	
	δ+ δ– H—Br	
	Using this as an example, indicate the polarity of the following bonds by indicating any dipoles present.	
	1. F—Cl 2. At—Cl	
(ii)	Using your knowledge of trends in the periodic table, circle the atom below that has the greater electronegativity value.	
	Br I	
	Justify your answer.	

QUESTION TWO

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(a) The boiling points of ammonia, NH₃, fluorine, F₂, and hydrogen chloride, HCl, are given in the table below.

Complete the table to identify the attractive forces between the molecules in their liquid state.

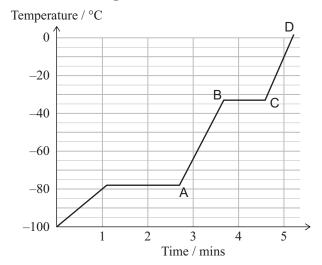
Molecule	Boiling point/°C	Attractive forces
Ammonia, NH ₃	-33	
Fluorine, F ₂	-188	
Hydrogen chloride, HCl	-85	

Discuss the diffe the attractive for					
Then describe wh	r_2 has the r	owest boilin	ig point.		

(c)	An equation for the reaction of ammonia gas with hydrogen chloride gas is: $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$	ASSESSOR'S USE ONLY
	Calculate the standard enthalpy change, $\Delta_r H^\circ$, for this reaction, using the following data.	
	$ \Delta_{\rm f} H^{\circ} ({\rm NH_3}(g)) = -46 \text{ kJ mol}^{-1} $ $ \Delta_{\rm f} H^{\circ} ({\rm HCl}(g)) = -92 \text{ kJ mol}^{-1} $ $ \Delta_{\rm f} H^{\circ} ({\rm NH_4Cl}(s)) = -314 \text{ kJ mol}^{-1} $	

(d) The following graph shows the change in temperature over a five-minute period for a sample of ammonia, where a constant amount of heat was applied per minute.

Heating curve for ammonia



Using the graph above, justify the physical changes occurring to ammonia between points A and D, in terms of the energy of the particles and the intermolecular forces of attraction.		

QUESTION THREE

(a) In New Zealand, fluoride for water treatment is supplied as sodium fluorosilicate, Na_2SiF_6 . One of the ions formed in the solution from sodium fluorosilicate is $SiF_6^{\ 2-}$.

Complete the table below.

	SiF ₆ ²⁻
Lewis diagram	
Name of shape	

(b) Ammonium nitrate is used in 'cold packs' to relieve symptoms of a sports injury. The dissolving of the solid crystals of ammonium nitrate (shown in the equation below) is spontaneous, despite being endothermic.

$$NH_4NO_3(s) \rightarrow NH_4^+(aq) + NO_3^-(aq)$$

Explain why this is so, in terms of the entropy change for the reaction system.

(c) Ammonium nitrate dissociates in an endothermic reaction, as shown in the equation below.

$$NH_4NO_3(s) \rightarrow NH_3(g) + HNO_3(g)$$

Below is a table outlining four statements about changes in entropy that may occur during any reaction.

Tick (\checkmark) to the left of any statement that is correct for the above reaction.

Tick (✓)	Entropy statement
	The entropy of the system increases.
	The entropy of the surroundings increases.
	The entropy of the system decreases.
	The entropy of the surroundings decreases.

Justify your choice(s).					

ASSESSOR'S USE ONLY (d) (i)

(ii)

Compound	kJ mol ⁻¹		
$\Delta_{c}H^{\circ}\left(\mathrm{C}(s)\right)$	-394		
$\Delta_{\mathrm{f}}H^{\circ}(\mathrm{H_{2}O}(\ell))$	-286		
$\Delta_{c}H^{\circ}\left(\mathrm{C}_{2}\mathrm{H}_{5}\mathrm{OH}(\ell)\right)$	-1367		

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lculate the standard enthalpy of formation of liquid ethanol using the information en above.
scuss how the value of the enthalpy change would differ if the ethanol product med was a gas rather than a liquid.
calculation is necessary.

		Extra paper if required.		
QUESTION NUMBER		Write the question number(s) if applicable.	USE ONLY	
NUMBER				
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