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SUPERVISOR'S USE ONLY

91164



Level 2 Chemistry, 2016

91164 Demonstrate understanding of bonding, structure, properties and energy changes

9.30 a.m. Monday 21 November 2016 Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of bonding, structure, properties and energy	Demonstrate in-depth understanding of bonding, structure, properties and	Demonstrate comprehensive understanding of bonding, structure,
changes.	energy changes.	properties and energy changes.

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 L2–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 2–10 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

QUESTION ONE

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Instant cold packs are useful for treating sports injuries on the field. They contain salts such as ammonium nitrate, NH₄NO₃. When the packs are activated, the salt dissolves in water, causing the temperature to decrease.

Circle the term that best describes the dissolving process.

endothermic

exothermic

Give a reason for your choice.

(b) The equation for hydrating anhydrous copper sulfate is as follows:

$$\text{CuSO}_4(s) + 5\text{H}_2\text{O}(\ell) \rightarrow \text{CuSO}_4.5\text{H}_2\text{O}(s)$$
 $\Delta_r H^\circ = -78.2 \text{ kJ mol}^{-1}$

$$\Delta_r H^{\circ} = -78.2 \text{ kJ mol}^{-1}$$

Circle the term that best describes this reaction.

endothermic

exothermic

Give a reason for your choice.

- Pentane, C_5H_{12} , is a liquid at room temperature. It evaporates at 36.1°C in an endothermic (c) process.
 - Explain why the evaporation of pentane is an endothermic process. (i)

ASSESSOR'S USE ONLY Draw, including labels, the energy diagram for the combustion of pentane, $C_5H_{12}(\ell)$. (ii) Pentane combustion: $C_5H_{12}(\ell) + 8O_2(g) \rightarrow 5CO_2(g) + 6H_2O(\ell)$ $\Delta_{..}H^{\circ} = -3509 \text{ kJ mol}^{-1}$ Include in your diagram the reactants, products, and change in enthalpy. Reaction proceeds (iii) Hexane, C₆H₁₄, like pentane, will combust (burn) in sufficient oxygen to produce carbon dioxide gas and water. Hexane combustion: $2C_6H_{14}(\ell) + 19O_2(g) \rightarrow 12CO_2(g) + 14H_2O(\ell)$ $\Delta_r H^o = -8316 \text{ kJ mol}^{-1}$ Justify which alkane – pentane or hexane – will produce more heat energy when 125 g of each fuel is combusted in sufficient oxygen. $M(C_5H_{12}) = 72.0 \text{ g mol}^{-1}$ $M(C_6H_{14}) = 86.0 \text{ g mol}^{-1}$

QUESTION TWO

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(a) Complete the table below by stating the type of substance, the type of particle, and the attractive forces between the particles in the solid for each substance.

Substance	Type of substance	Type of particle	Attractive forces between particles
$\operatorname{ZnCl}_2(s)$ (zinc chloride)			
C(s) (graphite)			
$CO_2(s)$ (carbon dioxide/dry ice)			

conduct electricity	when some, but wi	ii conduct when	monen.	
Justify this stateme	ent in terms of the p	particles, structur	re, and bonding for	or both substances

Tou may include a diagram or diagrams in your answer.	ustify these statements in terms of	of the particles, structure, and bonding of these substances.
Space for diagrams	, c	
Space for diagrams		
	Space for diagrams	

QUESTION THREE

(ii)

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(a) (i) Draw the Lewis structure (electron dot diagram) for each of the following molecules, and name their shapes.

Molecule	H ₂ O	CS ₂	PH ₃
Lewis structure			
Name of shape			
Approximate bond angle around the central atom	109.5°	180°	109.5°

Compare and contrast the shapes and bond angles of $\mathrm{H_2O}$, $\mathrm{CS_2}$ and $\mathrm{PH_3}$.		

Molecule	H-N-H H	H-B-H H
	Ammonia	Borane
Polarity of molecule	polar	non-polar

Ammonia, NH ₃ , is polar, and borane, BH ₃ , is non-polar.		
Justify this statement.		

(c) Calculate the enthalpy change, $\Delta_r H^\circ$, for the reaction of but-1-ene gas, $C_4 H_8(g)$, with hydrogen gas, $H_2(g)$, to form butane gas, $C_4 H_{10}(g)$.

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Use the average bond enthalpies given in the table below.

Bond	Average bond enthalpy / kJ mol ⁻¹
C=C	614
C-C	346
С-Н	414
Н-Н	436

Show your working and include appropriate units in your answer.			

		Extra paper if required.	
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