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91164



Level 2 Chemistry, 2014

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

2.00 pm Tuesday 11 November 2014 Credits: Five

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

QUESTION ONE

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(a) Draw the Lewis structure (electron dot diagram) for each of the following molecules.

Molecule	HCN	$\mathrm{CH_2Br_2}$	AsH ₃
Lewis structure			

(b) The Lewis structure for a molecule containing atoms of boron, oxygen, and hydrogen, is shown below.

(i) The following table describes the shapes around two of the atoms in the molecule above.

Complete the table with the approximate bond angles x and y.

Central atom	Shape formed by bonds around the central atom	Approximate bond angle
В	trigonal planar	x =
0	bent	<i>y</i> =

(ii) The bond angles x and y in the molecule above are different.

Elaborate on why the bond angles are different.

In your answer you should include:

- factors which determine the shape around the:
 - $\bf B$ atom for bond angle $\bf x$
 - O atom for bond angle y
- reference to the arrangement of electrons around the **B** and **O** atoms.

Molecules can be d	described as being polar or no	on-polar.
he following diag		ares for two molecules, SO_2 and CO_2 .
	$\ddot{O} = \ddot{S} - \ddot{O}$:	O = C = O
Firele the term that	t describes the polarity of ea	ch of the molecules.
SO_2	Polar	Non-polar
CO_2	Polar	Non-polar
or each molecule,	, justify your choice.	
		There is more space for your
		answer to this question on the following page.

(d)	Hydrogen gas.	$H_{2}(g)$	reacts with	oxvgen gas.	$O_{2}(g)$	as shown l	ov the	following	equation

$$H_2(g) + \frac{1}{2}O_2(g) \to H_2O(g)$$
 $\Delta_r H^0 = -242 \text{ kJ mol}^{-1}$

Given the average bond enthalpies in the table below, calculate the average bond enthalpy of the ${\bf O}-{\bf H}$ bond in ${\bf H}_2{\bf O}$.

Bond	Average bond enthalpy / kJ mol ⁻¹
Н-Н	436
O=O	498

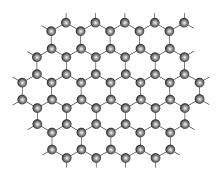
QUESTION TWO

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

Solid	Type of substance	Type of particle	Attractive forces between particles
Mg(s) (magnesium)			
I ₂ (s) (iodine)			

(b) Graphene is a new 2-dimensional material made of carbon atoms. Graphene can be described as a 'one-atom-thick' layer of graphite. A diagram of graphene and two of its properties is shown below.



Properties of graphene:

Melting point: very high

Electrical conductivity: excellent

Use your knowledge of structure and bonding to explain the two properties of graphene given above.			

(c) Solid Mg and $\rm I_2$ were tested for three physical properties. The table below shows the results of the tests.

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	Physical property			
Substance tested	Ductile	Soluble in cyclohexane (non-polar solvent)	Conducts electricity	
Mg	yes	no	yes	
I_2	no	yes	no	

Use your knowledge of structure and bonding to explain the results of the tests.		

QUESTION THREE

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(i)	When solid sodium hydroxide is added to water, the temperature increases. Circle the term that best describes this reaction.				
	Exothermic	Endothermic			
	Give a reason for your cho	pice.			
(ii)	The freezing of water to fo	orm ice can be represented by the following equation.			
. ,	$H_2O(\ell) \to H_2O(s)$				
	Circle the term that best describes this reaction.				
	Exothermic	Endothermic			
	Explain your choice.				
	your knowledge of structure ride in water.	e and bonding to explain the dissolving process of sodium			
Supp	oort your answer with an ani	notated (labelled) diagram.			

Methanol and ethanol can both be used as fuels. Their combustion reactions can be represented by the following equations:	ASSE
Methanol combustion: $2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$ $\Delta_r H^o = -1450 \text{ kJ mol}^{-1}$ Ethanol combustion: $\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$ $\Delta_r H^o = -1370 \text{ kJ mol}^{-1}$	
Justify which fuel, methanol or ethanol, will produce more heat energy when 345 g of each fuel is combusted in excess oxygen.	
$M(CH_3OH) = 32.0 \text{ g mol}^{-1}$	
$M(C_2H_5OH) = 46.0 \text{ g mol}^{-1}$	

		Extra paper if required.	
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