

## C3 Structure & Bonding Homework task 1

### Q1.

This question is about hydrocarbons.

Methane is a hydrocarbon.

The formula of methane is CH<sub>4</sub>

(a) Name the **two** elements in methane.

1 \_\_\_\_\_

2 \_\_\_\_\_

(2)

(b) Complete the diagram below to show the structure of a methane (CH<sub>4</sub>) molecule.



(1)

(c) What is the type of bonding in methane?

Tick (✓) **one** box.

Covalent

Ionic

Metallic

(1)

(d) Calculate the percentage by mass of element C in a CH<sub>4</sub> molecule.

Relative atomic mass (*A<sub>r</sub>*): C = 12

Relative formula mass (*M<sub>r</sub>*): CH<sub>4</sub> = 16

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Percentage of C = \_\_\_\_\_ %

(2)

Cracking breaks down hydrocarbons into smaller molecules.

(e) Name **one** method of cracking.

\_\_\_\_\_

(1)

$C_{13}H_{28}$  is a hydrocarbon.

(f)  $C_{13}H_{28}$  is cracked to produce  $C_8H_{18}$  and another product.

Complete the equation for the reaction.



(1)

(g)  $C_8H_{18}$  and  $C_{13}H_{28}$  are both alkanes.

$C_8H_{18}$  is a smaller molecule than  $C_{13}H_{28}$

Give **one** use of alkanes that have small molecules.

\_\_\_\_\_  
\_\_\_\_\_

(1)

(h) Cracking also produces alkenes.

Ethene is an alkene.

What is the formula of ethene?

Tick (✓) **one** box.

$C_2H_4$         $C_2H_6$         $C_3H_6$         $C_3H_8$

(1)

(i) Complete the sentence.

Ethene molecules join together to form a long-chain molecule called

\_\_\_\_\_ .

(1)

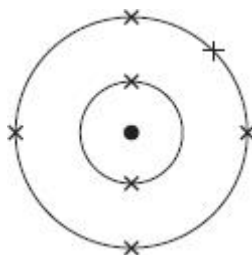
(Total 11 marks)

**Q2.**

This question is about structure and bonding.

- (a) **Figure 1** represents the electronic structure of an atom of an element.

**Figure 1**



Name the element in **Figure 1**.

Give **one** reason for your answer.

Use the periodic table.

Element \_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_

(2)

Sodium reacts with fluorine to produce sodium fluoride.

Sodium fluoride is an ionic compound.

- (b) An atom of sodium and an atom of fluorine react to form a sodium ion and a fluoride ion.

Complete the dot and cross diagram for the sodium ion and the fluoride ion.

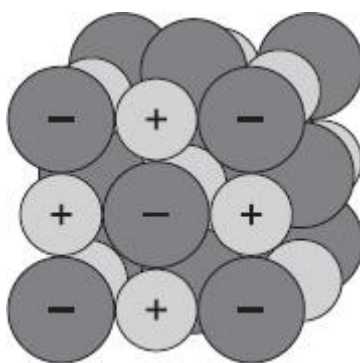
Show the charges on the ions.



(2)

(c) **Figure 2** represents the structure of sodium fluoride.

**Figure 2**



Describe how sodium ions and fluoride ions are held together in sodium fluoride.

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(3)

(d) What is a property of sodium fluoride?

Tick (✓) **one** box.

Conducts electricity when solid

High melting point

Low boiling point

(1)

(Total 8 marks)

## HIGHER TIER QUESTIONS

### Q3.

Carbon can exist in a number of different structures.

- (a) The first fullerene to be discovered was Buckminsterfullerene.

What is the formula of Buckminsterfullerene?

Tick (✓) **one** box.

C40

C50

C60

C70

(1)

- (b) Graphite is a form of carbon.

Explain why graphite conducts electricity.

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(2)

Steel is an alloy of iron and carbon.

- (c) Explain why steel is harder than iron.

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(3)

(d) Iron is alloyed with carbon and other metals to make stainless steel.

A stainless steel fork contains 71.92% iron.

The table below shows the mass of each element in the fork.

Element	Iron	Carbon	Chromium	Nickel
Mass of element in g	X	0.05	10.44	5.80

Calculate the mass of iron (X) in the fork.

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X = \_\_\_\_\_ g

(4)

(Total 10 marks)

#### Q4.

This question is about halogens.

Bromine reacts with sodium to produce sodium bromide.

(a) Describe the structure of and bonding in sodium bromide.

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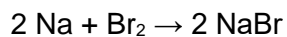
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(2)

(b) The equation for the reaction is:



1 g of bromine reacts with sodium.

Calculate the number of bromine molecules in 1 g of bromine.

1 mole of bromine contains  $6.02 \times 10^{23}$  bromine molecules.

Relative formula mass ( $M_r$ ) of bromine = 160

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Number of bromine molecules = \_\_\_\_\_

(3)

(c) The table below shows the boiling points of some halogens.

Halogen	Boiling point in °C
Bromine	60
Chlorine	-34
Fluorine	-188

Explain the trend in the boiling points of the halogens.

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(4)

(Total 9 marks)

## Mark schemes

### Q1.

(a) hydrogen

*in any order*  
*ignore H*

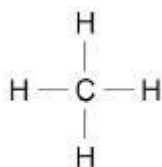
1

carbon

*ignore C*

1

(b)



1

(c) covalent

1

(d)  $\frac{12}{16} \times 100$

1

= 75 (%)

1

(e) any **one** from:

- catalytic (cracking)
- steam (cracking)

1

(f)  $\text{C}_{13}\text{H}_{28} \rightarrow \text{C}_8\text{H}_{18} + \text{C}_5\text{H}_{10}$

1

(g) fuels

1

(h)  $\text{C}_2\text{H}_4$

1

(i) poly(ethene)

*allow polythene*  
*allow (a) polymer*

1

[11]

### Q2.

(a) (element)  
nitrogen

*allow N*



(reason)

any **one** from:

*MP2 dependent on MP1 being awarded*

- has an atomic number of 7
- has 7 electrons

*allow has an electronic structure of 2,5*

- has 7 protons

1

- (b) • 8 electrons on F **and** none on Na

1

- Na<sup>+</sup> **and** F<sup>-</sup>

an answer of:



can be awarded **2** marks

*allow any combination of dots, crosses, circles or e<sup>(-)</sup> for electrons*

1

- (c) (strong) electrostatic forces

1

of attraction

1

(between) oppositely charged ions

1

- (d) high melting point

1

[8]

### Q3.

- (a) C<sub>60</sub>

1

- (b) (graphite has) delocalised electrons

1

(so the delocalised electrons) carry electrical charge through the structure

*allow (so the delocalised electrons) move through the structure*

1

- (c) carbon atoms have different sizes to iron atoms / ions

1

(so carbon atoms) distort the layers of iron atoms / ions

1

(therefore) the layers cannot slide

1

(d) (percentage and mass of other elements)

$$28.08 (\%) = 16.29 (\text{g})$$

1

$$(\text{mass of fork}) = \frac{16.29}{28.08} \times 100 (\text{g})$$

1

$$= 58.01 (\text{g})$$

1

$$(\text{mass of iron}) = \frac{71.92}{100} \times 58.01$$

71.92

*allow (mass of fork – mass of other elements) = 41.72 (g)*

*allow 41.7 (g)*

*allow correct use of incorrect calculation of mass and / or percentages*

1

[10]

#### Q4.

(a) giant structure of ions

1

with strong electrostatic forces of attraction

*if no other mark awarded allow 1 mark for ionic bonding*

1

(b) (moles bromine =  $\frac{1}{160}$ )  
0.00625

1

(molecules of bromine =)  
 $0.00625 \times 6.02 \times 10^{23}$

*allow correct use of an incorrectly calculated value for moles of bromine*

1

(molecules of bromine =)  
 $3.76 \times 10^{21}$  (molecules)

*allow  $3.7625 \times 10^{21}$  (molecules)*

1

*allow converse*

(c) boiling point decreases up the group

*allow boiling point decreases down the table*

1

(because) the relative formula / molecular mass decreases

**or**

(because) the size of the molecule decreases

1

(so) the intermolecular forces decrease (in strength)

*allow (so) the forces between molecules  
decrease (in strength)*

1

(so) less energy is needed to overcome the intermolecular forces

*allow (so) less energy is needed to separate the  
molecules*

*do **not** accept a reference to breaking bonds  
unless specifically between molecules*

1

[9]