A-Level Edexcel

CHEMISTRY

UNIT 2(IAL)

2015 — 2019

1 - (CHEM-W 2016-Unit 2(IAL)-Q13) - *Formulae, Equations & amount of substance*

What is the empirical formula of a bromoalkane containing, by mass, 22.0% carbon, 4.6% hydrogen and 73.4% bromine?

(Relative atomic masses: C = 12, H = 1, Br = 80)

☒ **A** C_3H_7Br

☒ **B** C_2H_5Br

☒ **C** C_2H_3Br

☒ **D** CH_3Br

2 - (CHEM-W 2016-Unit 2(IAL)-Q18) - *Formulae, Equations & amount of substance*

Glucose is fermented to produce ethanol.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

What is the atom economy, by mass, for the production of ethanol in this reaction?

(Relative molecular masses: $C_6H_{12}O_6 = 180$, $C_2H_5OH = 46$, $CO_2 = 44$)

☒ **A** 25.6%

☒ **B** 48.9%

☒ **C** 50.0%

☒ **D** 51.1%

3 - (CHEM-S 2018-Unit 2(IAL)-Q16) - *Formulae, Equations & amount of substance*

Compound **X** forms compound **Y** in the reaction shown in the equation.
No knowledge of this reaction is required.

$$\underset{\text{compound } \mathbf{X}}{C_7H_6O_3} + C_2H_4O_2 \rightarrow \underset{\text{compound } \mathbf{Y}}{C_9H_8O_4} + H_2O$$

What mass of compound **X** is required to produce 8.4 g of compound **Y**, if the yield is 40%?

[Molar masses / g mol^{-1}: $C_7H_6O_3 = 138$ $C_9H_8O_4 = 180$]

☒ **A** 3.4 g

☒ **B** 6.4 g

☒ **C** 16.1 g

☒ **D** 21.0 g

4 - (CHEM-S 2018-Unit 2(IAL)-Q18) **-** *Formulae, Equations & amount of substance*

An experiment requires 500 cm^3 of a solution with a **nitrate** ion concentration of 0.100 mol dm^{-3}.

This is prepared by diluting a 0.250 mol dm^{-3} calcium nitrate solution, $Ca(NO_3)_2(aq)$, with water.

What volume of this calcium nitrate solution will be needed?

☒ **A** 50 cm^3

☒ **B** 100 cm^3

☒ **C** 200 cm^3

☒ **D** 400 cm^3

5 - (CHEM-S 2018-Unit 2(IAL)-Q19) - *Formulae, Equations & amount of substance*

A mass of 1.60 g of an anhydrous metal sulfate was dissolved in water.

Addition of excess barium chloride solution resulted in the precipitation of 2.33 g of barium sulfate.

[Molar mass of $BaSO_4$ = 233 g mol^{-1}]

The original substance could be

☒ **A** calcium sulfate.

☒ **B** copper(II) sulfate.

☒ **C** magnesium sulfate.

☒ **D** sodium sulfate.

6 - (CHEM-S 2017-Unit 2(IAL)-Q20) - *Atomic structure & Periodic table*

The first ionisation energy of strontium is less endothermic than that of calcium.

The best explanation for this is that strontium has

☒ **A** more protons.

☒ **B** more protons and neutrons.

☒ **C** 18 and not 8 electrons in its outer shell.

☒ **D** more inner electron shells.

7 - (CHEM-S 2015-Unit 2(IAL)-Q11) - *Bonding & Structure*

Which of the following species has the smallest bond angle?

☒ **A** CO_2

☒ **B** H_2O

☒ **C** SO_3

☒ **D** H_3O^+

8 - (CHEM-S 2015-Unit 2(IAL)-Q12) - *Bonding & Structure*

Which of the following bonds is likely to be the most polar?

☒ **A** H—F

☒ **B** P—O

☒ **C** N—Cl

☒ **D** C—S

9 - (CHEM-W 2015-Unit 2(IAL)-Q14) - *Bonding & Structure*

Diamond, buckminsterfullerene and graphite are all forms of carbon.
A significant difference between buckminsterfullerene and the other two forms is that only buckminsterfullerene

☒ **A** has good electrical conductivity.

☒ **B** has a precise molecular formula.

☒ **C** is tough and rigid.

☒ **D** has some carbon atoms with only three covalent bonds.

10 - (CHEM-W 2016-Unit 2(IAL)-Q1) - *Bonding & Structure*

What are the shapes of the BF_3 and PH_3 molecules?

	BF_3	PH_3
☒ **A**	pyramidal	pyramidal
☒ **B**	pyramidal	trigonal planar
☒ **C**	trigonal planar	pyramidal
☒ **D**	trigonal planar	trigonal planar

11 - (CHEM-W 2016-Unit 2(IAL)-Q2) - *Bonding & Structure*

What are the C—C—C bond angles in diamond and graphite?

	Diamond	Graphite
☒ **A**	109.5°	109.5°
☒ **B**	109.5°	120°
☒ **C**	120°	109.5°
☒ **D**	120°	120°

12 - (CHEM-W 2016-Unit 2(IAL)-Q3) - *Bonding & Structure*

Which describes the polarity of the C—Cl bond and the polarity of the molecule trichloromethane, $CHCl_3$?

	Polarity of C—Cl bond	Polarity of molecule
☒ **A**	non-polar	non-polar
☒ **B**	non-polar	polar
☒ **C**	polar	non-polar
☒ **D**	polar	polar

13 - (CHEM-S 2017-Unit 2(IAL)-Q1) - *Bonding & Structure*

Which is the shortest covalent bond?

☒ **A** H—H

☒ **B** H—N

☒ **C** H—S

☒ **D** H—Br

14 - (CHEM-S 2017-Unit 2(IAL)-Q2) - *Bonding & Structure*

Which compound contains a bond with the **greatest** polarity?

- ☒ **A** Ammonia, NH_3
- ☒ **B** Hydrogen fluoride, HF
- ☒ **C** Methane, CH_4
- ☒ **D** Water, H_2O

15 - (CHEM-S 2017-Unit 2(IAL)-Q3) - *Bonding & Structure*

Which compound has polar bonds but non-polar molecules?

- ☒ **A** Carbon monoxide, CO
- ☒ **B** Hydrogen sulfide, H_2S
- ☒ **C** Phosphorus(III) chloride, PCl_3
- ☒ **D** Tetrafluoromethane, CF_4

16 - (CHEM-S 2017-Unit 2(IAL)-Q23) - *Bonding & Structure, Chemical Equilibria, Organic Nitrogen Compounds: Amines, Amides, Amino Acids & Proteins*

Boron nitride, BN, is a compound first made commercially in the 1940s from boric acid and ammonia, in an atmosphere of nitrogen.

It forms structures analogous to graphite and diamond because it is isoelectronic with these corresponding carbon structures. Boron nitride has also been used to form nanotube structures in a similar way to carbon.

Just as synthetic diamonds are produced from graphite by using high temperatures and high pressures, the diamond-like cubic boron nitride can also be made from heating the graphite-like hexagonal boron nitride under high pressure.

Boron nitride forms ceramic materials with very high thermal and chemical stability and, a wide range of uses. For example, they are stable in air up to 1000 °C, which is an advantage over similar graphite materials. The hexagonal form of boron nitride is a very effective lubricant and is also used in cosmetics. However, it is an electrical insulator, in contrast to graphite, which is a good electrical conductor.

(a) (i) Write the equation for the formation of boron nitride from boric acid, H_3BO_3, and ammonia.

State symbols are not required.

(1)

(ii) Suggest why this reaction is carried out in an atmosphere of nitrogen.

(1)

.....

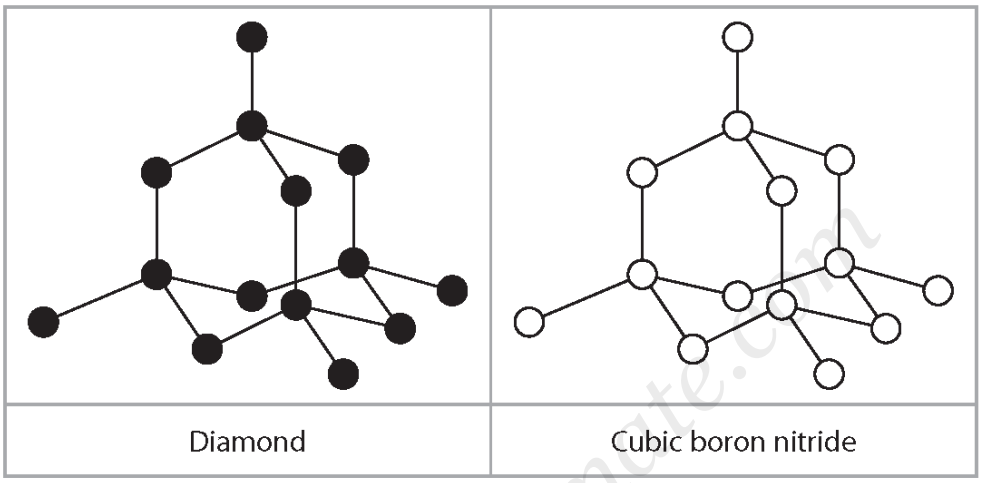
.....

(b) The structure of the cubic boron nitride corresponds to the diamond structure. The boron and nitrogen atoms alternate throughout the structure.

(i) In the left hand box, the diagram shows a section of the diamond structure, where each black circle represents a carbon atom.

In the right hand box label all the nitrogen and boron atoms in the diagram of cubic boron nitride.

(1)



Diamond	Cubic boron nitride

(ii) State the bond angle and shape around the carbon atoms in diamond and fully justify your answer.

(4)

Bond angle ..... Shape .....

Justification .....

.....

.....

(c) The equilibrium between graphite and diamond is

$$C(\text{graphite}) \rightleftharpoons C(\text{diamond}) \qquad \Delta H = +1.9\,\text{kJ mol}^{-1}$$

The density of graphite is $2.27\,\text{g cm}^{-3}$ and the density of diamond is $3.51\,\text{g cm}^{-3}$.

*(i) Suggest why a very high temperature and high pressure are needed to convert graphite to diamond.

(4)

(ii) The use of a catalyst in the conversion of graphite to diamond has been reported. Describe how the addition of a catalyst can lower the temperature required for a reaction.

(3)

(d) Diamond and graphite are stable in air up to approximately 800 °C. Identify **one** of the products if diamond or graphite is heated in air above this temperature.

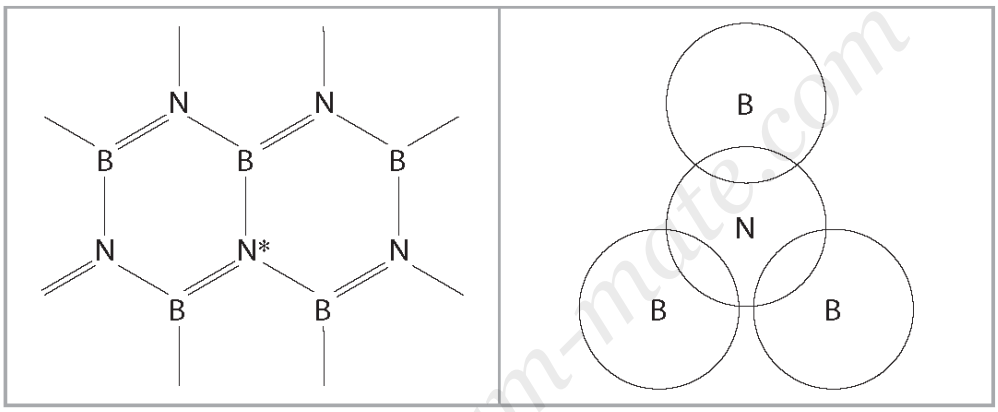
(1)

.....

(e) The structure of hexagonal boron nitride corresponds to that of graphite.

(i) The simplified diagram in the left hand box shows the bonding in hexagonal boron nitride.
In the right hand box, complete the dot and cross diagram showing only the electrons around the nitrogen atom which is labelled with an asterisk (*).
Use (×) for the nitrogen electrons and (•) for the boron electrons.

(1)



*(ii) Describe how each carbon atom is bonded in the graphite structure and hence explain why graphite is a good conductor of electricity. Suggest why hexagonal boron nitride is an electrical insulator.

(3)

(iii) Graphite and the hexagonal boron nitride are both used as lubricants because of the weak intermolecular forces between the layers of hexagonal rings. Identify these intermolecular forces and describe how they arise.

(3)