YEAR 12 – BRIDGING UNITS

A-LEVEL CHEMISTRY

ST HILDA'S COLLEGE

The 6th Form
@ St Hilda's

BRIDGING UNITS

Name:

Anything is POSSIBLE

A-level chemistry is one for the hardest subjects to study but is very rewarding and enjoyable. You need to be hardworking, organised, enthusiastic and resilient to succeed. Have you got what is takes?

In 2023 the average % for a grade 7 in Chemistry (Trilogy/Chemistry) was 55%. Which means you can still get confused. At A-level we need to assume that you are confident with the GCSE topics in this booklet as they will be the starting point for your A-level studies.

Trilogy Chemistry does not contain a lot of Organic chemistry and most of the separates content has been included.

When you are choosing your A-level subjects is it ideal to study at least two science subjects. Good subjects to combine with Chemistry are: Biology, Physics, Maths, Psychology.

At the time of printing, your A-level teachers for 2024 – 2026 will be Dr Meredith and Mr Goodrum.

We are looking forward to seeing you in September.

Dr Meredith & Mr Goodrum

Contents & instructions

This work is to ensure you have a good understanding of certain topics as they are essential to success at A-level and are the starting point of a number of topics. The information pages have been mostly taken from chemreivse.org

Most of the information needed to complete the questions are in this booklet. If the information you need is not in this booklet it is assumed that you would know it. If in doubt look it up!

Section 1 - Atomic Structure

Section 2 - Quantitative Chemistry

Chemistry calculations. Some quantitative questions will be included in other sections.

Section 3 - Bonding

Section 1 Atomic Structure

Chemrevise.org link

https://chemrevise.org/wp-content/uploads/2023/10/4.1-atomic-structure-and-periodic-table.pdf

Free science lessons links

Alpha scattering experiment -

https://www.youtube.com/watch?v=qAlpNXO_FRE

The Nuclear model -

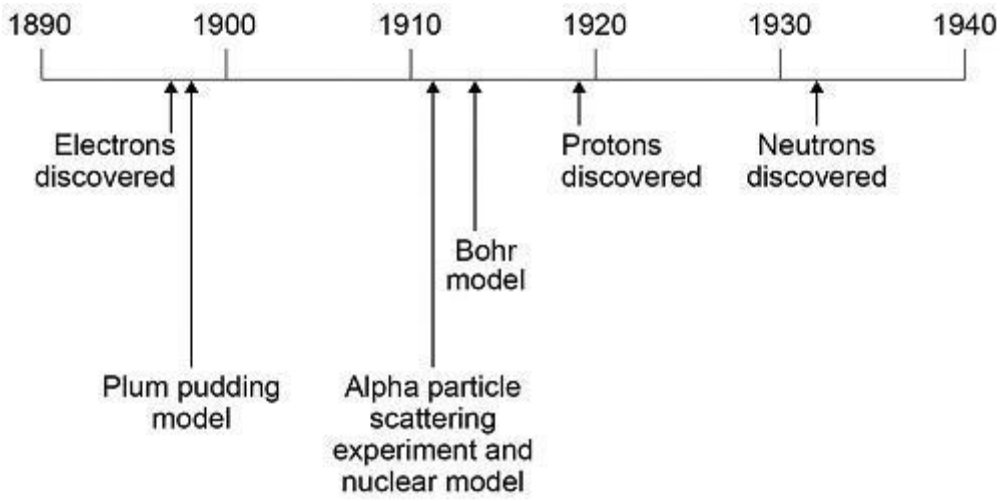
https://www.youtube.com/watch?v=cI2Shr8nns8

Atomic number and mass number -

https://www.youtube.com/watch?v=nyvVjJf7RAU

Atomic structure questions

Q1. This question is about the development of scientific theories. The diagram below shows a timeline of some important steps in the development of the model of the atom.



(a) The plum pudding model did not have a nucleus. Describe **three** other differences between the nuclear model of the atom and the plum pudding model.

1 _____

_____

_____

2 _____

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3 _____

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(3)

(b) Niels Bohr adapted the nuclear model. Describe the change that Bohr made to the nuclear model.

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(2) (Total 5 marks)

Q2. This question is about atomic structure.

(a) Atoms contain subatomic particles. The table below shows properties of two subatomic particles. Complete the table.

Name of particle	Relative mass	Relative charge
neutron		
		+1

(2)

An element **X** has two isotopes. The isotopes have different mass numbers.

(b) Define mass number.

_____

_____

(1)

(c) Why is the mass number different in the two isotopes?

_____

_____

(1)

(d) The model of the atom changed as new evidence was discovered. The plum pudding model suggested that the atom was a ball of positive charge with electrons embedded in it. Evidence from the alpha particle scattering experiment led to a change in the model of the atom from the plum pudding model. Explain how.

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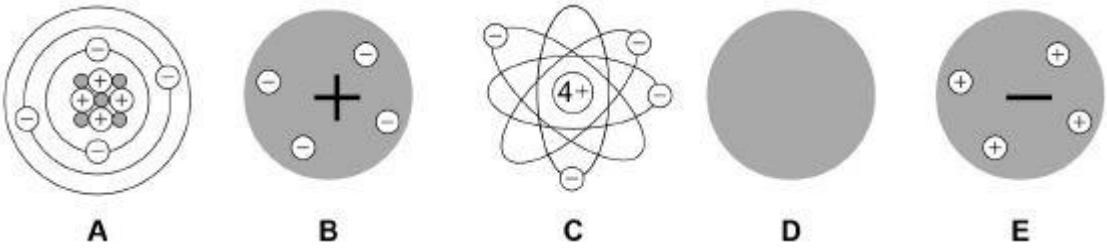
(4)

(Total 8 marks)

Q3.

The diagram below represents different models of the atom.



(a) Which diagram shows the plum pudding model of the atom? _____ **(1)**

(b) Which diagram shows the model of the atom developed from the alpha particle scattering experiment? _____ **(1)**

(c) Which diagram shows the model of the atom resulting from Bohr's work? ____**(1)**

(d) Element **X** has two isotopes. Their mass numbers are 69 and 71

The percentage abundance of each isotope is:

- 60% of ^{69}**X**
- 40% of ^{71}**X**

Estimate the relative atomic mass of element **X**. Choose on of the options.

<69.6

Between 69.5 and 70.0

Between 70.0 and 70.5

>70.5

(1)

(e) Chadwick's experimental work on the atom led to a better understanding of isotopes. Explain how his work led to this understanding.

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(3)

(Total 7 marks)

Section 1 total = /20

Section 2 Quantitative Chemistry

Balancing

https://www.youtube.com/watch?v=vxCyzR6uETs

Calculating moles
https://www.youtube.com/watch?v=Md4BQL91U6w

Calculating mass of a number of moles
https://www.youtube.com/watch?v=kMak1TQ3YgU

Avogadro's Constant 1
https://www.youtube.com/watch?v=3y8YDlNeuRk

Reacting Masses 1
https://www.youtube.com/watch?v=TV6n5MFH6IU

Reacting Masses 2
https://www.youtube.com/watch?v=5zOpoeN0dV0

Concentration of solutions
https://www.youtube.com/watch?v=3G3KQIyoZDI

Atom Economy
https://www.youtube.com/watch?v=h1-Vj6eh-mM

Section 2 Quantitative Questions

1) a) How many moles in 33.0 kg of ammonium sulfate $(NH_4)_2SO_4$. .....

..... (2)

b) What is the mass of 0.040 moles of oxygen, O_2? .....

..... (2)

2) a) What maximum mass of methanol that can be made when 12 g of hydrogen reacts with an excess of carbon monoxide? $CO + 2H_2 \rightarrow CH_3OH$

.....

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..... (3)

b) In a reaction, 60 g of methanol was formed from 12 g of hydrogen. Calculate the percentage yield.

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..... (2)

3) Calculate the percentage atom economy to make iron from iron(III) oxide by reaction with carbon monoxide. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

.....

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..... (3)

Q4 is reacting masses with the final stage being volume of gas.

4) What volume of hydrogen gas is formed, measured at room temperature and pressure, when 0.65 g of zinc reacts with sulfuric acid? $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

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..... (3)

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Q5 is using the ratio to work out the volume of gas.

5) What volume of carbon dioxide gas is formed when 100 cm^3 of propane gas burns (both gases are at room temperature and pressure)? $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ (2)

.....

6 Lead reacts with chlorine to form lead(II) chloride. When 6.21 g of lead reacts with 2.84 g of chlorine, which is the limiting reagent and what mass of lead(II) chloride is formed?

$Pb + Cl_2 \rightarrow PbCl_2$

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..... (5)

7 Calculate the number of moles in the following solutions.

a) 100 cm^3 of 0.20 mol/dm^3 HNO_3 .....

.....

b) 25 cm^3 of 1.50 mol/dm^3 KOH .....

.....

c) 50 cm^3 of 0.10 mol/dm^3 H_2SO_4 ..... (6)

.....

8 Calculate the concentration of the following solutions in g/dm^3.

a) 0.100 mol/dm^3 NaOH .....

.....

b) 0.250 mol/dm^3 CH_3COOH .....

.....

c) 1.50 mol/dm^3 HNO_3 ..... (6)

.....

9 0.20 moles of NaOH is dissolved in 250 cm^3 of water.

a) Calculate the concentration in mol/dm^3. .....

b) Calculate the concentration in g/dm^3. ..... (4)

.....

10 5.0 g of KNO_3 is dissolved in 100 cm^3 of water.

a) Calculate the concentration in g/dm^3. .....

b) Calculate the concentration in mol/dm^3. .....

..... (4)

Q11. Copper is extracted from metal ores. Chalcopyrite is a metal ore containing a compound with the formula $CuFeS_2$

(a) $CuFeS_2$ reacts with oxygen to produce copper(II) sulfate and iron(II) sulfate. Complete the equation for this reaction. You should balance the equation.

$$CuFeS_2 + \_\_\_\_\_ \rightarrow CuSO_4 + FeSO_4$$

(2)

(b) Calculate the percentage by mass of copper in $CuFeS_2$

Relative atomic masses (A_r): S = 32 Fe = 56 Cu = 63.5

Percentage by mass = _____ %

(3)

(Total 5 marks)

Q12. This question is about salts. Iron chloride is produced by heating iron in chlorine gas. The equation for the reaction is:

$$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$$

Calculate the volume of chlorine needed to react with 14 g of iron. You should calculate:

- the number of moles of iron used
- the number of moles of chlorine that react with 14 g of iron
- the volume of chlorine needed.

Relative atomic mass (A_r): Fe = 56 The volume of 1 mole of gas = 24 dm^3

Volume of chlorine = _____ dm^3

(3)(Total 3 marks)

Q13. This question is about citric acid ($C_6H_8O_7$). Citric acid is a solid.

A student investigated the temperature change during the reaction between citric acid and sodium hydrogencarbonate solution.

The student made 250 cm^3 of a solution of citric acid of concentration 0.0500 mol/dm^3

Calculate the mass of citric acid ($C_6H_8O_7$) required.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

Mass = _____ g

(3)

(Total 3 marks)

Q14. This question is about reversible reactions and equilibrium. Hydrogen is used to produce ammonia in the Haber process. The hydrogen is made in two stages.

Stage 1 is the reaction of methane and steam to produce carbon monoxide and hydrogen. The equation for the reaction is:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3\,H_2(g)$$

Calculate the atom economy for the formation of hydrogen in **stage 1**.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

Atom economy = _____%

(2)

(Total 2 marks)

Q15. This question is about displacement reactions. A mixture contains 1.00 kg of aluminium and 3.00 kg of iron oxide. The equation for the reaction is:

$$2\ Al + Fe_2O_3 \rightarrow 2\ Fe + Al_2O_3$$

Show that aluminium is the limiting reactant.

Relative atomic masses (A_r): O = 16 Al = 27 Fe = 56

(4) (Total 4 marks)

Q16. This question is about titanium dioxide (TiO_2). Titanium is extracted from titanium dioxide in a two-stage process. The equation for the first stage in the process is:

$TiO_2 + 2\ Cl_2 + 2\ C \rightarrow TiCl_4 + 2\ CO$

Calculate the volume of chlorine gas needed to react completely with 100 kg of titanium dioxide. Relative atomic masses (A_r): O = 16 Ti = 48

The volume of one mole of gas = 24 dm^3

Volume = _____ dm^3 **(6) (Total 8 marks)**

Total = / 67

Section 3 Bonding

A link to chemrevise.org

https://chemrevise.org/wp-content/uploads/2023/10/4.2-bonding-and-structure.pdf

Link of free science lessons

https://www.freesciencelessons.co.uk/gcse-chemistry-paper-1/structure-and-bonding/

Q1. Work out the ionic formula for the following substances. Write the ions first and then the formula

a) Sodium oxide = Na^+ O^{2-} = Na_2O

b) Calcium fluoride

c) Iron(II) oxide

d) Iron(III) oxide

e) Zinc nitrate

f) Aluminium sulfate

g) Iron(III) carbonate

h) Ammonium sulfate

i) Barium hydroxide (16 marks)

Q2. This question is about different forms of carbon.

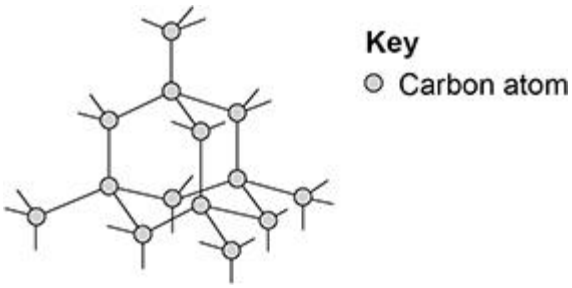


Figure 1 represents the structure of diamond.

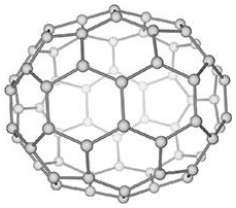
(a) Describe the structure and bonding of diamond.

(3)

(b) Explain why diamond has a very high melting point.

(3)

Figure 2 represents the molecule C_{70}



(c) What is the name of this type of molecule? Choose one option from:

Fullerene Graphene Nanotube polymer

(1)

(d) Molecules such as C_{70} can be used in medicine to move drugs around the body. Suggest **one** reason why the C_{70} molecule is suitable for this use.

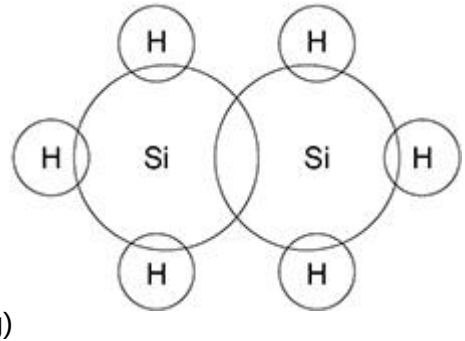
(1)

(e) Calculate the number of C_{70} molecules that can be made from one mole of carbon atoms. The Avogadro constant = 6.02×10^{23} per mole

Number of molecules = _____

(3) (Total 10 marks)

Q3. Si_2H_6 is a covalent compound of silicon and hydrogen.



(a) Complete the figure below to show the outer shell electrons in a molecule of Si_2H_6 **(1)**

(b) Si_2H_6 reacts with oxygen. The equation for the reaction is: $2\ Si_2H_6(g) + 7\ O_2(g) \rightarrow 4\ SiO_2(s) + 6\ H_2O(g)$

30 cm^3 of Si_2H_6 is reacted with 150 cm^3 (an excess) of oxygen. Calculate the total volume of gases present after the reaction. All volumes of gases are measured at the same temperature and pressure.

(Oxygen is in excess. Use the volume of Si_2H_6 to calculate the volume of O_2 reacted and the volume of gas in the products. Then work out which gases have been used in the reaction and which are present at the end of the experiment.)

Volume of gases = _____ cm^3

(4) (Total 5 marks)

Q4. Sodium reacts with oxygen to produce the ionic compound sodium oxide. Oxygen is a Group 6 element.

(a) Draw a dot and cross diagram to show what happens when atoms of sodium and oxygen react to produce sodium oxide.

(4)

(b) Explain why sodium oxide has a high melting point.

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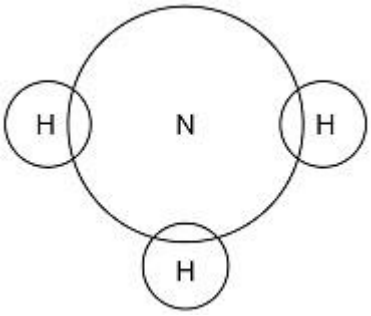
(3)
(Total 7 marks)

Q5. This question is about ammonia, NH_3

(a) Complete the dot and cross diagram for the ammonia molecule shown in **Figure 1**. Show only the electrons in the outer shell of each atom.

Figure 1



(2)

(b) Give **one** limitation of using a dot and cross diagram to represent an ammonia molecule.

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_____

(1)

(c) Explain why ammonia has a low boiling point.

You should refer to structure and bonding in your answer.

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(3)

(Total 6 marks)

Q6. This question is about structure and bonding. Graphite and fullerenes are forms of carbon. Graphite is soft and is a good conductor of electricity.

a) Explain why graphite has these properties. Answer in terms of structure and bonding.

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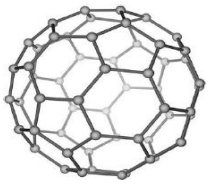
(4)

(b) **Figure 1** shows a model of a Buckminsterfullerene molecule. A lubricant is a substance that allows materials to move over each other easily. Suggest why Buckminsterfullerene is a good lubricant. Use **Figure 1**.

Figure 1



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_____

_____**(2)**

(Total 6 marks)

Q7. This question is about uses of metals in electrical wires. Electrical wires can be made from: aluminium, copper, silver.

(a) Describe how metals conduct electricity.

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(3)

(b) Electrical wires ar

e usually made of pure metals and **not** alloys. This is because pure metals are better electrical conductors. Suggest why alloys do **not** conduct electricity as well as pure metals. Answer in terms of structure and bonding.

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_____

(2) (Total 5 marks)

Total = / 55