A-Level Chemistry (AQA) @ SWA Summer Prep Tasks 2023

In addition to revisiting the GCSE concepts listed on page 2, if you completed Combined Science, you must learn 'Triple' content over the summer. The link for the specification is below.

Where it says 'chemistry only', that is 'triple' content that must be learned before you start in September.

The remainder is combined science content that you should already know. If you don't, then better get revising!

https://filestore.aqa.org.uk/resources/chemistry/specifications/AQA-8462-SP-2016.PDF

GCSE Chemistry Topics

Paper 1

1. Atomic structure and the periodic table
2. Bonding, structure, and the properties of matter
3. Quantitative chemistry
4. Chemical changes
5. Energy changes

Paper 2

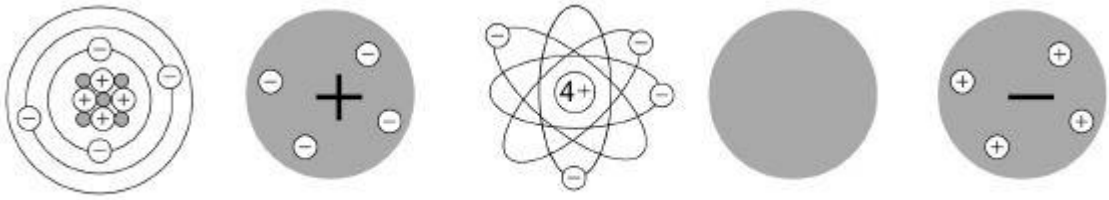
6. The rate and extent of chemical change
7. Organic chemistry
8. Chemical analysis
9. Chemistry of the atmosphere
10. Using resources

GCSE Exam Questions to be completed:

1. Atomic structure and the periodic table

Q1.

The diagram below represents different models of the atom.



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

Tick **one** box.

A		B		C		D		E	

(1)

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

Tick **one** box.

A		B		C		D		E	

(1)

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

Tick **one** box.

A		B		C		D		E	

(1)

(d) Define the mass number of an atom.

_____

_____

(1)

(e) 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**.

Tick **one** box.

< 69.5 ☐

Between 69.5 and 70.0 ☐

Between 70.0 and 70.5 ☐

> 70.5 ☐

(1)

(f) Chadwick's experimental work on the atom led to a better understanding of isotopes.

Explain how his work led to this understanding.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

2. Bonding, structure, and the properties of matter

Q2.

Glass is made from silicon dioxide.

© Velirina/iStock/Thinkstock

(a) Silicon dioxide has a very high melting point.

Other substances are added to silicon dioxide to make glass. Glass melts at a lower temperature than silicon dioxide.

Suggest why.

_____

_____

(1)

(b) Sodium oxide is one of the substances added to silicon dioxide to make glass.

(i) Sodium oxide contains Na^+ ions and O^{2-} ions.

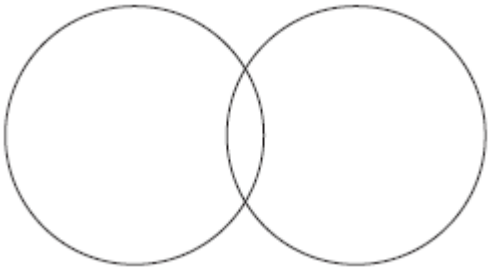
Give the formula of sodium oxide.

_____

(1)

(ii) Sodium oxide is made by heating sodium metal in oxygen gas.

Complete the diagram to show the outer electrons in an oxygen molecule (O_2).



(2)

(c) Glass can be coloured using tiny particles of gold. Gold is a metal.

Describe the structure of a metal.

_____

_____

_____

_____

_____

_____

(3)

(Total 7 marks)

3. Quantitative chemistry

Q3. 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:

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

(a) 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)

(b) Explain why a low pressure is used in **stage 1**.

Give your answer in terms of equilibrium.

_____

_____

_____

(2)

(c) **Stage 2** uses the carbon monoxide produced in **stage 1**.

The carbon monoxide is reacted with more steam to produce carbon dioxide and more hydrogen.

The equation for the reaction in **stage 2** is:

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$$

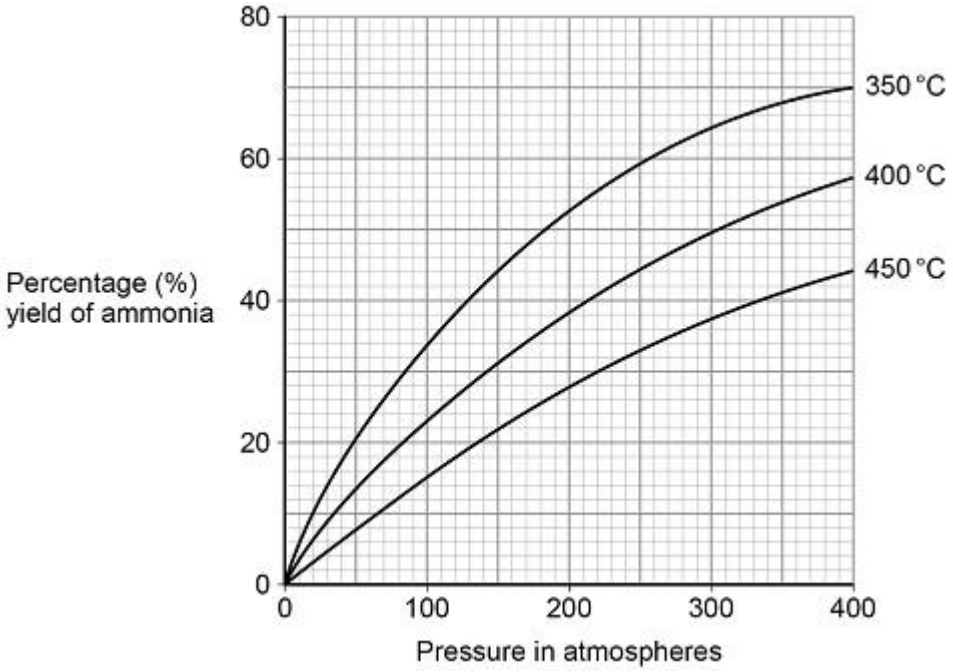
What is the effect of increasing the pressure on the equilibrium yield of hydrogen in **stage 2**?

_____

_____

(1)

The graph below shows the percentage yield of ammonia produced at different temperatures and pressures in the Haber process.



A temperature of 450 °C and a pressure of 200 atmospheres are used in the Haber process.

(d) A student suggested that a temperature of 350 °C and a pressure of 285 atmospheres could be used instead of those used in the Haber process.

Determine how many times greater the percentage yield of ammonia obtained would be.

Use the graph.

_____

_____

_____

_____

Percentage yield = _____ times greater

(3)

(e) A pressure of 285 atmospheres is **not** used in the Haber process instead of 200 atmospheres.

Give **one** reason why.

_____

_____

(1)

(f) How does the graph above show that the forward reaction in the Haber process is exothermic?

_____

_____

(1)

(g) World production of ammonia is now about 30 times greater than it was in 1950.

Suggest why the demand for ammonia has increased.

_____

_____

_____

_____

(2)

(Total 12 marks)

4. Chemical changes

Q4. This question is about electrolysis.

Aluminium is produced by electrolysing a molten mixture of aluminium oxide and cryolite.

(a) Explain why a mixture is used as the electrolyte instead of using only aluminium oxide.

_____

_____

_____

_____

(2)

(b) What happens at the negative electrode during the production of aluminium?

Tick (✓) **one** box.

Aluminium atoms gain electrons. ☐

Aluminium atoms lose electrons. ☐

Aluminium ions gain electrons. ☐

Aluminium ions lose electrons. ☐

(1)

(c) Oxygen is produced at the positive electrode.

Complete the balanced half-equation for the process at the positive electrode.

$\rightarrow \quad O_2 \quad +$

(2)

(d) Explain why the positive electrode must be continually replaced.

_____

_____

_____

(3)

(e) The overall equation for the electrolysis of aluminium oxide is:

$$2\ Al_2O_3 \rightarrow 4\ Al + 3\ O_2$$

Calculate the mass of oxygen produced when 2000 kg of aluminium oxide is completely electrolysed.

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

Mass of oxygen = _____ kg

(4)

Sodium metal and chlorine gas are produced by the electrolysis of molten sodium chloride.

(f) Explain why sodium chloride solution **cannot** be used as the electrolyte to produce sodium metal.

(2)

(g) Calculate the volume of 150 kg of chlorine gas at room temperature and pressure.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3

Relative formula mass (M_r): Cl_2 = 71

Volume = _____ dm^3

(2)

(Total 16 marks)

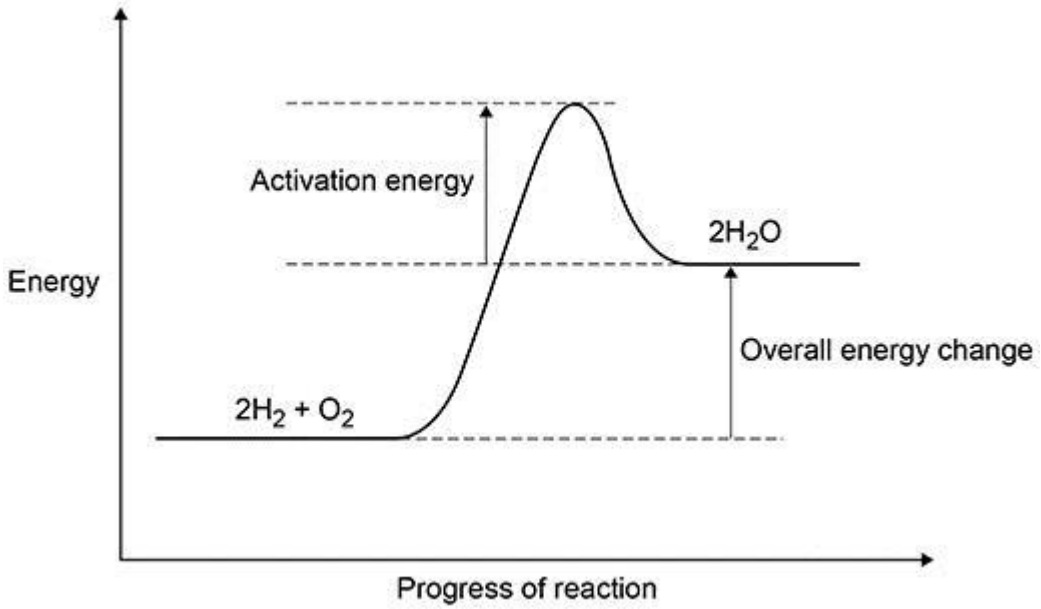
5. Energy changes

Q5. The reaction between hydrogen and oxygen releases energy.

(a) A student drew a reaction profile for the reaction between hydrogen and oxygen.

Figure 1 shows the student's reaction profile.

Figure 1



The student made **two** errors when drawing the reaction profile.

Describe the **two** errors.

1 _____

_____

2 _____

_____

(2)

(b) The reaction between hydrogen and oxygen in a hydrogen fuel cell is used to produce electricity.

Hydrogen fuel cells and rechargeable cells are used to power some cars.

Give **two** advantages of using hydrogen fuel cells instead of using rechargeable cells to power cars.

1 _____

2 _____

(2)

(c) Reactions occur at the positive electrode and at the negative electrode in a hydrogen fuel cell.

Write a half equation for **one** of these reactions.

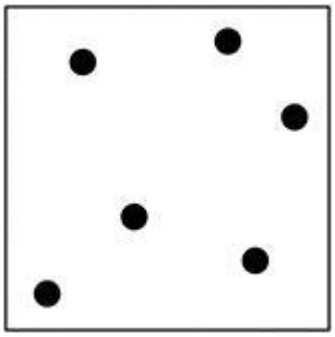
_____

(1)

(d) The three states of matter can be represented by a simple particle model.

Figure 2 shows a simple particle model for hydrogen gas.

Figure 2



Give **two** limitations of this simple particle model for hydrogen gas.

1 _____

_____

2 _____

_____

(2)

(e) The hydrogen gas needed to power a car for 400 km would occupy a large volume.

Suggest **one** way that this volume can be reduced.

_____

_____

(1)

(f) The energy needed for a car powered by a hydrogen fuel cell to travel 100 km is 58 megajoules (MJ).

The energy released when 1 mole of hydrogen gas reacts with oxygen is 290 kJ

The volume of 1 mole of a gas at room temperature and pressure is 24 dm^3

Calculate the volume of hydrogen gas at room temperature and pressure needed for the car to travel 100 km

Volume of hydrogen gas = _____ dm^3

(4)

(Total 12 marks)

6. The rate and extent of chemical change

Q6. This question is about carboxylic acids.

Carboxylic acids belong to a homologous series.

The table below shows information about the first three carboxylic acids in this homologous series.

Name	**Formula**	**pH of a 0.01 mol/dm^3 solution**
Methanoic acid		2.91
Ethanoic acid	CH_3COOH	3.39
	CH_3CH_2COOH	3.44

(a) Complete the table above.

(2)

(b) Ethanoic acid ionises in water.

The equation for the reaction is:

$$CH_3COOH(aq) \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$$

Explain how the equation shows that ethanoic acid is a weak acid.

(2)

(c) A student adds a solution of ethanoic acid to zinc carbonate in an open flask on a balance.

Explain what happens to the mass of the flask and its contents during the reaction.

(3)

(d) The student compares the rates of the reaction of zinc carbonate with:

- 0.01 mol/dm^3 methanoic acid
- 0.01 mol/dm^3 ethanoic acid.

The rate of the reaction with methanoic acid is greater than the rate of the reaction with ethanoic acid.

Explain why.

You should refer to ions in your answer.

Use the table above.

(3)

Ethanoic acid reacts with ethanol to produce an ester.

(e) Give the name of the ester produced when ethanoic acid reacts with ethanol.

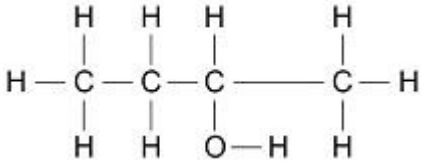
(1)

(f) Hexanedioic acid and ethanediol join together to produce a polyester.

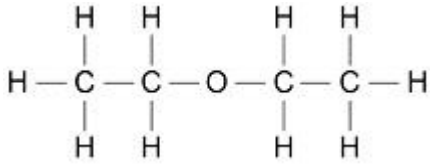
Ethanoic acid and ethanol join together in the same way to produce an ester.

Which is the displayed structural formula of the ester produced when ethanoic acid reacts with ethanol?

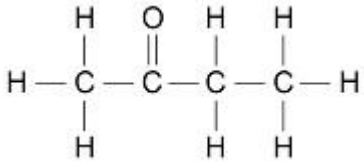
Tick (✓) **one** box.



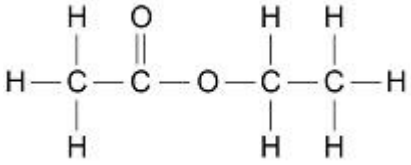
☐



☐



☐



☐

(1)

(Total 12 marks)

7. Organic chemistry

Q7. This question is about polymers.

(a) Name the monomer used to form poly(chloroethene).

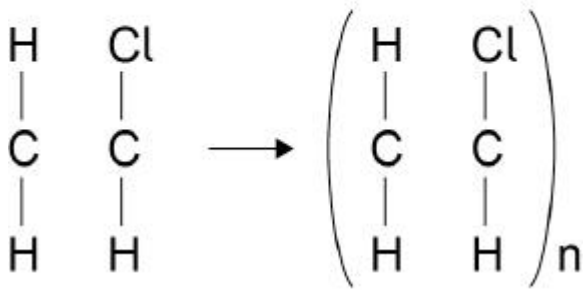
_____

(1)

(b) **Figure 1** shows the equation for the formation of poly(chloroethene).

Complete **Figure 1**.

Figure 1



(3)

(c) Poly(chloroethene) is the only product.

What type of polymer is poly(chloroethene)?

_____

(1)

Ethanediol reacts with butanedioic acid to produce a polyester and a small molecule.

(d) **Figure 2** shows the structural formula of ethanediol.

Figure 2

$HO–CH_2–CH_2–OH$

Name the functional group present in ethanediol.

_____

(1)

(e) **Figure 3** shows the structural formula of butanedioic acid.

Figure 3

$HOOC–CH_2–CH_2–COOH$

Which formula represents the carboxylic acid functional group?

Tick (✔) **one** box.

$–CH_2–$ ☐

$–CH_2–CH_2–$ ☐

$–CH_2–COOH$ ☐

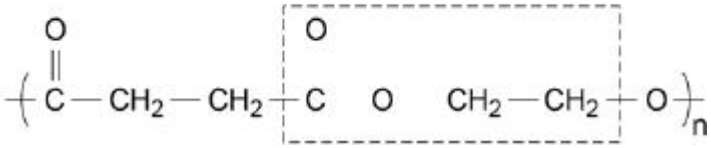
$–COOH$ ☐

(1)

(f) **Figure 4** shows part of the structure of the polyester.

Complete the box in **Figure 4**.

Figure 4



(2)

(g) Name the small molecule produced when ethanediol reacts with butanedioic acid.

_____

(1)

Starch, proteins and DNA are naturally occurring polymers.

(h) Name the monomers from which starch and proteins are produced.

Starch _____

Proteins _____

(2)

(i) Describe the structure of DNA.

_____

(2)

(Total 14 marks)

8. Chemical analysis

Q8. A large amount of aluminium sulfate was accidentally added to the drinking water supply at a water treatment works.

(a) Describe a test to show that the drinking water contained aluminium ions.

Give the result of the test.

Test _____

_____

Result _____

_____

_____

_____

(3)

(b) Describe a test to show that the drinking water contained sulfate ions.

Give the result of the test.

Test _____

_____

Result _____

_____

(2)

(c) Plan an investigation to find the total mass of dissolved solids in a 100 cm^3 sample of the drinking water.

Your investigation should produce valid results.

(4)

(Total 9 marks)

9. Chemistry of the atmosphere

Q9. This question is about combustion of fuels.

(a) Some central heating boilers use wood as a fuel.

Suggest **two** reasons why wood is more sustainable than natural gas as a fuel for central heating boilers.

1 _____

_____

2 _____

_____

(2)

Natural gas is mainly methane.

When methane burns it can produce both carbon monoxide and carbon dioxide.

(b) Explain the process by which carbon monoxide can be produced when methane is burned.

_____

_____

_____

_____

(2)

(c) Balance the equation for the combustion of methane to produce carbon monoxide.

_____ $CH_4(g)$ + _____ $O_2(g)$ → _____ $CO(g)$ + _____ $H_2O(l)$

(1)

(d) Propane burns to form carbon dioxide and water.

The equation for the reaction is:

$$C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(l)$$

3.60 dm^3 carbon dioxide is produced when a sample of propane is burned in 7.25 dm^3 oxygen.

Calculate the volume of unreacted oxygen.

Give your answer in cm^3

Volume of unreacted oxygen = _____ cm^3

(4)

(Total 9 marks)

10. Using resources

Q10. Fertilisers are used to improve agricultural productivity.

(a) Ammonium nitrate is used in fertilisers.

Name the **two** compounds used to manufacture ammonium nitrate.

_____

_____

(1)

(b) A fertiliser contains the following information on the label:

NPK value = 14 : 11 : 11

Explain why this information is useful to farmers.

_____

_____

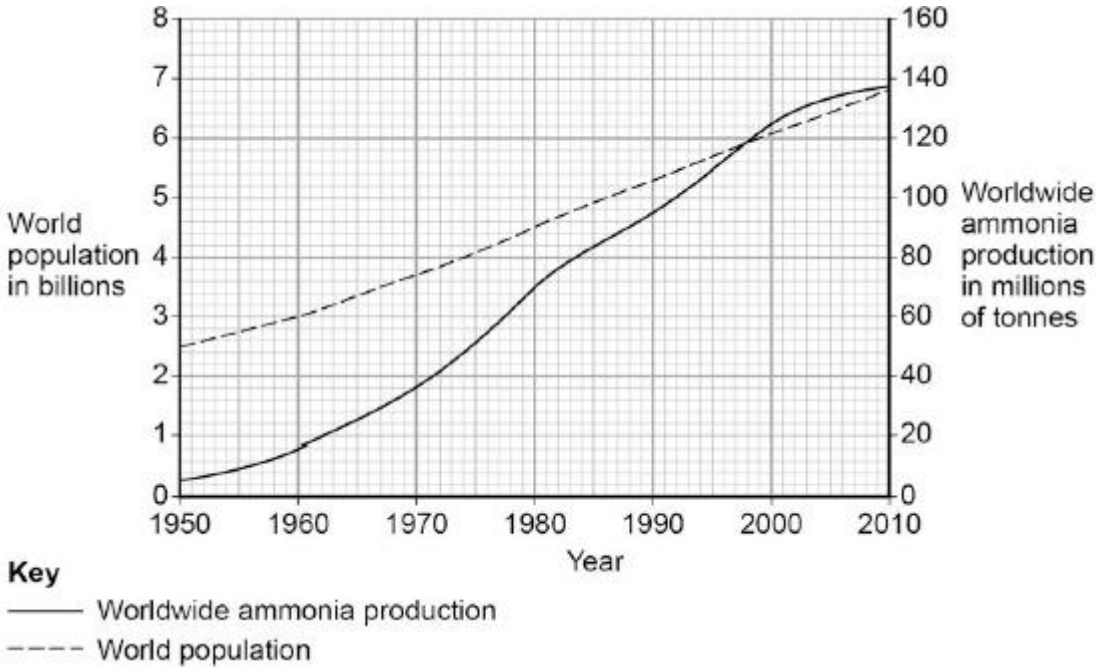
_____

_____

_____

(2)

(c) The figure below shows worldwide ammonia production and world population from 1950 to 2010.



Use the figure above and your knowledge to explain the relationship between ammonia production and world population.

(3)

(Total 6 marks)