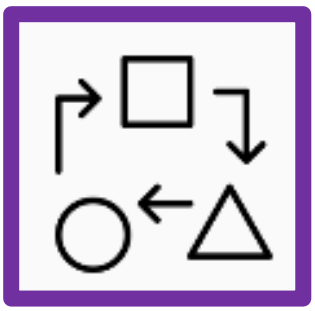
Meadowhead School Summer 2020

GCSE to A-Level Chemistry Transition Work



Instructions

Complete the GCSE questions. This is to help you recap and retrieve vital knowledge you have learned during your GCSE course that provides the foundation for A-Level Chemistry to build upon.

Use your normal GCSE revision resources to help you complete them, but here are some suggestions:

www.tassomai.com

www.senecalearning.com

www.bitesize.com

Youtube - Free Science Lessons

Youtube - Primrose Kitten

Attempt the A-Level Questions. They are accessible to you with the GCSE content you have – you might just need to think outside the box a bit and stretch yourself! This gives insight into the style of questions at A-Level and shows the jump is not that large if you are fully prepped with all of your GCSE knowledge

CGP – 'Head start to Chemistry' and 'Essential Maths Skills' books

MaChemGuy – Prepare for A-Level Chemistry

ASFC Chemistry – Starting A-Level Chemistry

Bring this to your first Chemistry Lesson in Year 12 and give it to your teacher

GCSE to A-Level Chemistry – Transition Work

Atomic Structure

GCSE questions

Q1. This question is about the structure of the atom.

(a) Complete the sentences. Choose answers from the box. Each word may be used once, more than once, or not at all.

electron	**ion**	**neutron**
nucleus	**proton**	

The centre of the atom is the _____ .

The two types of particle in the centre of the atom are the proton and the _____ .

James Chadwick proved the existence of the _____ .

Niels Bohr suggested particles orbit the centre of the atom. This type of particle is the _____ .

The two types of particle with the same mass are the neutron and the _____ . **(5)**

The table below shows information about two isotopes of element **X**.

	Mass number	Percentage (%) abundance
Isotope 1	63	70
Isotope 2	65	30

(b) Calculate the relative atomic mass (A_r) of element **X** using the equation:

$$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope 1} + (\text{mass number} \times \text{percentage}) \text{ of isotope 2}}{100}$$

Use the table above. Give your answer to 1 decimal place.

_____

_____ A_r = _____ **(2)**

(c) Suggest the identity of element **X**. Use the periodic table.

Element **X** is _____ **(1)**

(d) The radius of an atom of element **X** is 1.2×10^{-10} m

The radius of the centre of the atom is $\frac{1}{10000}$ the radius of the atom.

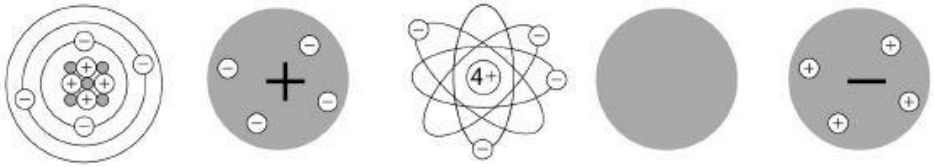
Calculate the radius of the centre of an atom of element **X**. Give your answer in standard form.

_____

_____

_____Radius = _____ m **(2)**

Q2. 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 69.5 and 70.0	
Between 70.0 and 70.5	
> 70.5	

(1)

A-Level question to give a go!

Q1. Which of these correctly shows the numbers of sub-atomic particles in a $^{41}K^{+}$ ion?

	Number of electrons	Number of protons	Number of neutrons	
A	19	19	20	⬭
B	18	20	21	⬭
C	18	19	22	⬭
D	19	18	23	⬭

(Total 1 mark)

Q2. Magnesium exists as three isotopes: ^{24}Mg, ^{25}Mg and ^{26}Mg

(a) In terms of sub-atomic particles, state the difference between the three isotopes of magnesium.

_____

_____ **(1)**

(b) State how, if at all, the chemical properties of these isotopes differ.

Give a reason for your answer.

Chemical properties _____

Reason

_____

_____ **(2)**

Amount of Substance

GCSE questions

Q3. A student investigated the reactions of copper carbonate and copper oxide with dilute hydrochloric acid. In both reactions one of the products is copper chloride.

(a) A student wanted to make 11.0 g of copper chloride.

The equation for the reaction is:

$$CuCO_3 + 2HCl \rightarrow CuCl_2 + H_2O + CO_2$$

Relative atomic masses, A_r: H = 1; C = 12; O = 16; Cl = 35.5; Cu = 63.5

Calculate the mass of copper carbonate the student should react with dilute hydrochloric acid to make 11.0 g of copper chloride.

_____

_____

_____Mass of copper carbonate = _____ g **(4)**

(b) The percentage yield of copper chloride was 79.1 %. Calculate the mass of copper chloride the student actually produced.

_____

_____Actual mass of copper chloride produced = _____ g **(2)**

(c) Look at the equations for the two reactions:

Reaction 1 $CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$

Reaction 2 $CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$

Reactive formula masses: CuO = 79.5; HCl = 36.5; $CuCl_2$ = 134.5; H_2O = 18

The percentage atom economy for a reaction is calculated using:

$$\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equation}} \times 100$$

Calculate the percentage atom economy for Reaction 2.

_____

_____

_____Percentage atom economy = _____ % **(3)**

(d) The atom economy for Reaction 1 is 68.45 %. Compare the atom economies of the two reactions for making copper chloride. Give a reason for the difference.

_____**(1)**

A-Level question to give a go!

Q3. Ethanol can be made from glucose by fermentation.

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

In an experiment, 268 g of ethanol (M_r = 46.0) were made from 1.44 kg of glucose (M_r = 180.0).
What is the percentage yield?

A 18.6% ⬭

B 36.4% ⬭

C 51.1% ⬭

D 72.8% ⬭

(Total 1 mark)

Q4. A gas cylinder contains 5.0 kg of propane.
How many propane molecules are in the cylinder?
The Avogadro constant, $L = 6.022 \times 10^{23}$ mol^{-1}

A 6.8×10^{22} ⬭

B 7.2×10^{22} ⬭

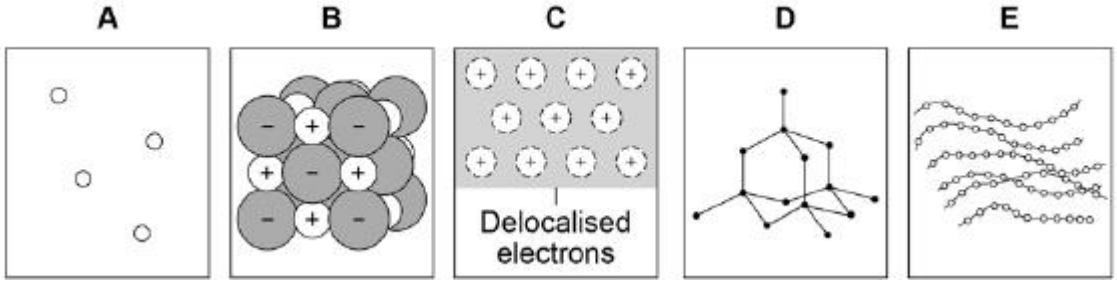
C 6.8×10^{25} ⬭

D 7.2×10^{25} ⬭

(Total 1 mark)

GCSE questions

Q4. **Figure 1** shows the structure of five substances.



(a) Which diagram shows a gas? Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(b) Which diagram shows the structure of diamond? Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(c) Which diagram shows a metallic structure? Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(d) Which diagram shows a polymer? Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

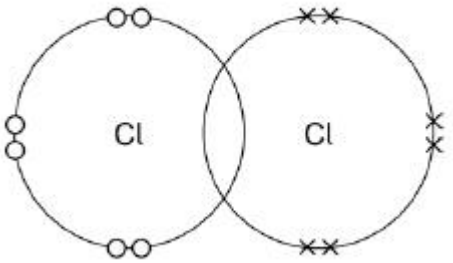
(e) A chlorine atom has 7 electrons in the outer shell.

Two chlorine atoms covalently bond to form a chlorine molecule, Cl_2

Figure 2 is a dot and cross diagram showing the outer shells and some electrons in a chlorine molecule.

Complete the dot and cross diagram. Show only the electrons in the outer shell.

Figure 2



(1)

(f) What is the reason for chlorine's low boiling point? Tick (✓) **one** box.

Strong covalent bonds ☐

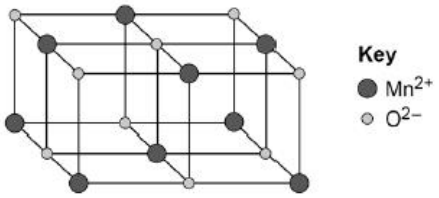
Strong forces between molecules ☐

Weak covalent bonds ☐

Weak forces between molecules ☐

(1)

Figure 3 represents the structure of manganese oxide. Manganese oxide is an ionic compound.



(g) Determine the empirical formula of manganese oxide. Use **Figure 3**.

_____

_____Empirical formula = _____ **(1)**

(h) Why does manganese oxide conduct electricity as a liquid? Tick (✓) **one** box.

Atoms move around in the liquid ☐

Electrons move around in the liquid ☐

Ions move around in the liquid ☐

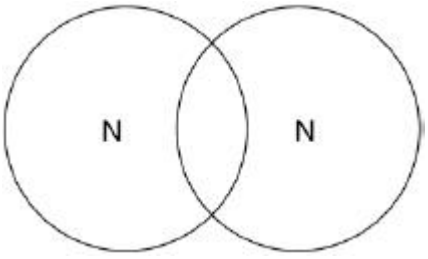
Molecules move around in the liquid ☐

(1)

Q5. This question is about structure and bonding.

(a) Complete the dot and cross diagram to show the covalent bonding in a nitrogen molecule, N_2

Show only the electrons in the outer shell.



(2)

(b) Explain why nitrogen is a gas at room temperature. Answer in terms of nitrogen's structure.

_____

_____

_____

_____**(3)**

(c) Graphite and fullerenes are forms of carbon. Graphite is soft and is a good conductor of electricity.

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

(4)

A-Level question to give a go!

Q5. Which is the correct crystal structure for the substance named?

	Substance	Structure	
A	Iodine	Simple molecular	⬭
B	Diamond	Ionic	⬭
C	Sodium chloride	Giant covalent	⬭
D	Graphite	Metallic	⬭

(Total 1 mark)

Q6. What is the formula of calcium nitrate(V)?

A $CaNO_3$ ⬭

B $Ca(NO_3)_2$ ⬭

C Ca_2NO_2 ⬭

D $Ca(NO_2)_2$ ⬭

(Total 1 mark)

Q7. The table shows some data about the elements bromine and magnesium.

Element	Melting point / K	Boiling point / K
Bromine	266	332
Magnesium	923	1383

In terms of structure and bonding explain why the boiling point of bromine is different from that of magnesium. Suggest why magnesium is a liquid over a much greater temperature range compared to bromine.

(Total 5 marks)

Energetics

GCSE questions

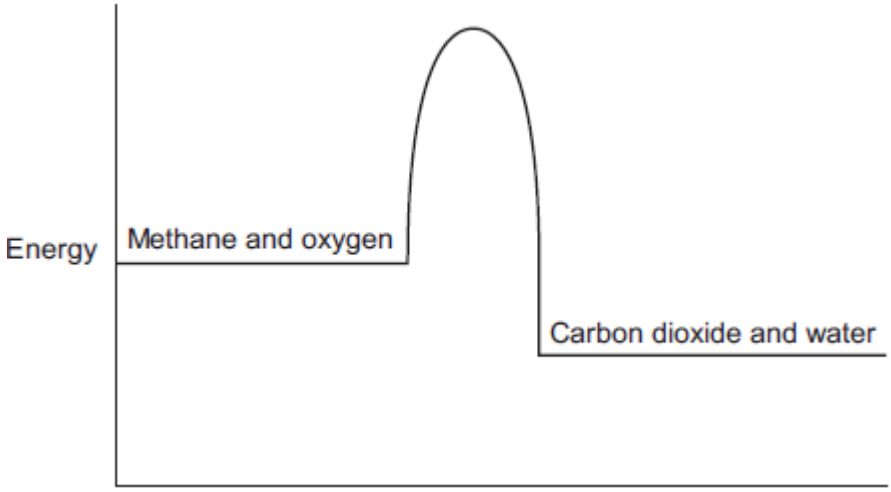
Q6. Methane (CH_4) is used as a fuel.

(a) Methane burns in oxygen.

(i) The diagram below shows the energy level diagram for the complete combustion of methane.

Draw and label arrows on the diagram to show:

- the activation energy
- the enthalpy change, *ΔH*.



(2)

(ii) Complete and balance the symbol equation for the complete combustion of methane.

CH_4 + _____ ⟶ CO_2 + _____ **(2)**

(ii) Explain why, in terms of the energy involved in bond breaking and bond making, the combustion of methane is exothermic.

(3)

(b) Methane reacts with chlorine in the presence of sunlight. The equation for this reaction is:

Some bond dissociation energies are given in the table.

Bond	Bond dissociation energy in kJ per mole
C−H	413
C−Cl	327
Cl−Cl	243
H−Cl	432

(i) Show that the enthalpy change, *ΔH*, for this reaction is −103 kJ per mole.

_____

_____

_____

_____ **(3)**

(ii) Methane also reacts with bromine in the presence of sunlight.

This reaction is less exothermic than the reaction between methane and chlorine.

The enthalpy change, *ΔH*, is −45 kJ per mole.

What is a possible reason for this? Tick (✓) **one** box.

CH_3Br has a lower boiling point than CH_3Cl ☐

The C−Br bond is weaker than the C−Cl bond. ☐

The H−Cl bond is weaker than the H−Br bond. ☐

Chlorine is more reactive than bromine. ☐

(1)

A-Level question to give a go!

Q8. Calculate the enthalpy change, in kJ, for this dissociation of mole of propan-1-ol.

$$C_3H_7OH(g) \longrightarrow 3C(g) + 8H(g) + O(g)$$

	C—H	C—C	C—O	O—H
Mean bond dissociation enthalpy / kJ mol^{-1}	412	348	360	463

A −4751 ⬭

B −4403 ⬭

C +4403 ⬭

D +4751 ⬭

(Total 1 mark)

Q9. Hydrogen is produced by the reaction of methane with steam. The reaction mixture reaches a state of dynamic equilibrium.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H = +206 \text{ kJ mol}^{-1}$$

Some enthalpy data is given in the table.

Bond	C–H	O–H	H–H	C≡H
Bond enthalpy / kJ mol^{-1}	413	463	436	To be calculated

Use the information in the table and the stated enthalpy change to calculate the missing bond enthalpy.

A 234 ⬭

B 1064 ⬭

C 1476 ⬭

D 1936 ⬭

(Total 1 mark)

Kinetics

GCSE questions

Q7. When sodium thiosulfate solution reacts with dilute hydrochloric acid, the solution becomes cloudy.

The equation for the reaction is:

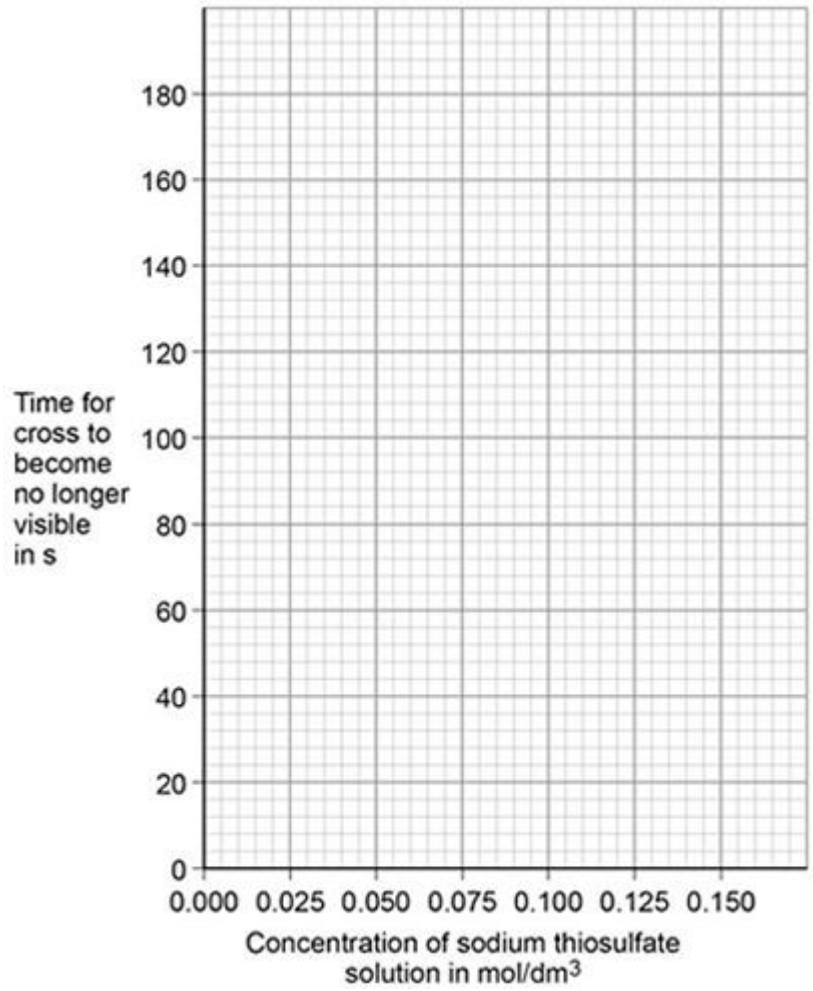
$$Na_2S_2O_3(aq) + 2\,HCl(aq) \longrightarrow 2\,NaCl(aq) + SO_2(g) + H_2O(l) + S(s)$$

Some students used this reaction to investigate the effect of concentration on rate of reaction. The table shows the students' results.

Concentration of sodium thiosulfate solution in mol / dm^3	**Time for cross to become no longer visible in s**
0.020	170
0.040	90
0.060	82

0.080	42
0.100	34
0.120	30
0.140	28

(a) Plot the data from the table above on the graph below. Draw a line of best fit.



(3)

The students repeated the investigation two more times. They obtained similar results each time.

(b) The students analysed their results to give a conclusion and an explanation for their investigation.

Conclusion: 'The higher the concentration, the lower the rate of reaction.'

Explanation: 'At higher concentrations, the particles have more energy, so they are moving faster. Therefore the collisions are more energetic.'

The students are not correct.
Give a **correct** conclusion **and** explanation for the results of the investigation.

Conclusion _____

_____

Explanation _____

_____

_____

_____ **(3)**

(c) A solution containing 0.18 g of sodium thiosulfate reacts with dilute hydrochloric acid in 2 minutes.

Calculate the mean rate of reaction in g / s. Give your answer in standard form.

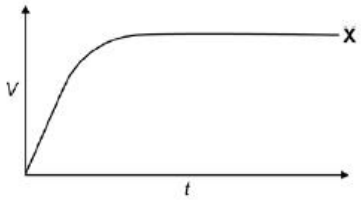
_____

_____

_____Mean rate of reaction = _____ g / s **(3)**

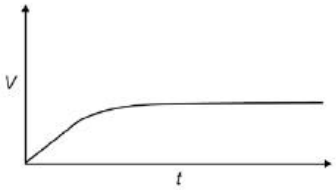
A-Level question to give a go!

Q10. Line **X** in the diagram represents the volume (V) of gas formed with time (t) in a reaction between an excess of magnesium and aqueous sulfuric acid.

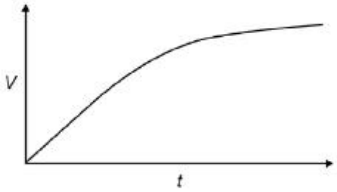


Which line represents the volume of hydrogen formed, at the same temperature and pressure, when the concentration of sulfuric acid has been halved?

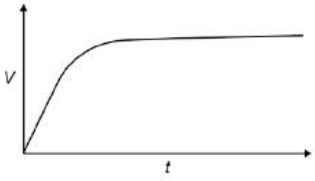
A



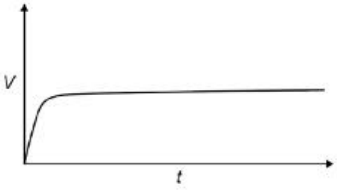
B



C



D



(Total 1 mark)

Q11. The gas-phase reaction between hydrogen and chlorine is very slow at room temperature.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

(a) Define the term *activation energy*.

_____

_____ **(2)**

(b) Give **one** reason why the reaction between hydrogen and chlorine is very slow at room temperature.

_____

_____ **(1)**

(c) Explain why an increase in pressure, at constant temperature, increases the rate of reaction between hydrogen and chlorine.

_____

_____ **(2)**

(d) Explain why a small increase in temperature can lead to a large increase in the rate of reaction between hydrogen and chlorine.

_____

_____ **(2)**

(e) Give the meaning of the term *catalyst*.

_____

_____ **(1)**

(f) Suggest **one** reason why a solid catalyst for a gas-phase reaction is often in the form of a powder.

_____ **(1)**