Year 11 to 12 Bridging

Work A-Level Chemistry

Welcome to A-Level Chemistry!

To help in your transition from GCSE to A-Level we've prepared some bridging work to show you how some of the concepts you will study in sixth form are very similar to those you studied at GCSE, just at a more sophisticated level.

In Year 12 you will have two teachers. With one teacher you will start by studying atomic structure and quantitative chemistry (calculations), and with the other you will look at bonding.

To prepare you, we've put together some A-Level exam questions for which you have studied the necessary content already. Some of them will be extremely challenging, but I promise you have all the knowledge you need. Just think about how to apply it! In your first lesson back with each teacher we will look through them together, so make sure you bring them with you.

We look forward to seeing you in September 😊

Atomic Structure and Quantitative Exam Questions

Q1.

Which atom contains the most neutrons?

A ^{54}Cr ⬭

B ^{55}Mn ⬭

C ^{57}Fe ⬭

D ^{58}Ni ⬭

(Total 1 mark)

Q2.

Which atom has the smallest number of neutrons?

A ^{3}H ⬭

B ^{4}He ⬭

C ^{5}He ⬭

D ^{4}Li ⬭

(Total 1 mark)

Q3.

This question is about sodium fluoride (NaF).

Some toothpastes contain sodium fluoride.
The concentration of sodium fluoride can be expressed in parts per million (ppm).
1 ppm represents a concentration of 1 mg in every 1 kg of toothpaste.

(a) A 1.00 g sample of toothpaste was found to contain 2.88×10^{-5} mol of sodium fluoride.

Calculate the concentration of sodium fluoride, in ppm, for the sample of toothpaste.
Give your answer to 3 significant figures.

Concentration of sodium fluoride _____ ppm

(4)

(b) Sodium fluoride is toxic in high concentrations.
Major health problems can occur if concentrations of sodium fluoride are greater than 3.19×10^{-2} g per kilogram of body mass.

Deduce the maximum mass of sodium fluoride, in mg, that a 75.0 kg person could swallow without reaching the toxic concentration.

Mass of sodium fluoride _____ mg

(1)

(c) The concentration of sodium fluoride in a prescription toothpaste is 2800 ppm.

Use your answer to Question (b) to deduce the mass of toothpaste, in kg, that a 75.0 kg person could swallow without reaching the toxic concentration.

Mass of toothpaste _____ kg

(d) Identify the diagram in the figure below that shows the correct relative sizes of the ions in sodium fluoride.

Justify your answer.

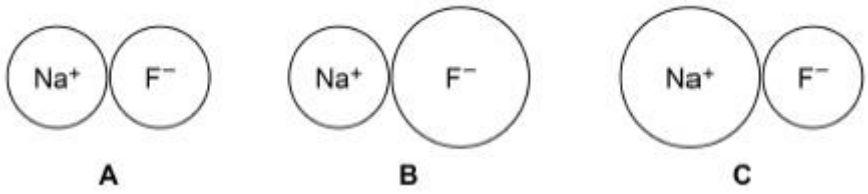


Diagram _____

Justification _____

_____

_____

_____

_____

_____

(3)

Q4.

Which atom has two more protons and two more neutrons than $^{52}_{24}Cr$?

A $^{54}_{26}Cr$ ⬭

B $^{56}_{26}Cr$ ⬭

C $^{54}_{26}Fe$ ⬭

D $^{56}_{26}Fe$ ⬭

(Total 1 mark)

Q5.

Which statement about isotopes of an element is **not** correct?

A They have the same chemical properties. ⬭

B They have the same number of electrons in ions of the same charge. ⬭

C They have the same number of neutrons. ⬭

D They have the same number of protons. ⬭

Q6.

Which atom has one more proton and two more neutrons than $^{31}_{15}P$?

A $^{33}_{16}P$ ⬭

B $^{34}_{16}P$ ⬭

C $^{33}_{16}S$ ⬭

D $^{34}_{16}S$ ⬭

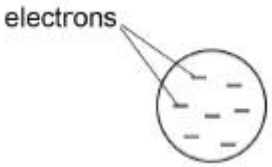
(Total 1 mark)

Q7.

This question is about atomic structure.

In the nineteenth century JJ Thomson discovered the electron. He suggested that negative electrons were found throughout an atom like 'plums in a pudding of positive charge'.

The diagram shows an atom of element **R** using the 'plum pudding' model.
An atom of **R** contains seven electrons.



(a) State **two** differences between the 'plum pudding' model and the model of atomic structure used today.

1. _____

_____

2. _____

_____

(2)

(b) Deduce the full electron configuration of an atom of element **R**.

_____

(1)

(c) Identify **R** and deduce the formula of the compound formed when **R** reacts with the Group 2 metal in the same period as **R**.

_____

(1)

Q8.

This question is about atomic structure.

(a) Define the mass number of an atom.

_____

_____

(1)

(b) Complete the table below to show the numbers of neutrons and electrons in the species shown.

	Number of protons	**Number of neutrons**	**Number of electrons**
^{46}Ti	22		
^{49}Ti^{2+}	22		

(2)

(c) A sample of titanium contains four isotopes, ^{46}Ti, ^{47}Ti, ^{48}Ti and ^{49}Ti
This sample has a relative atomic mass of 47.8
In this sample the ratio of abundance of isotopes ^{46}Ti, ^{47}Ti and ^{49}Ti is 2:2:1

Calculate the percentage abundance of ^{46}Ti in this sample.

Abundance of ^{46}Ti _____ %

(3)

Q9.

This question is about the isotopes of chromium.

(a) Give the meaning of the term relative atomic mass.

_____

_____

_____

_____

(2)

(b) A sample of chromium containing the isotopes ^{50}Cr, ^{52}Cr and ^{53}Cr has a relative atomic mass of 52.1

The sample contains 86.1% of the ^{52}Cr isotope.

Calculate the percentage abundance of each of the other two isotopes.

Abundance of ^{50}Cr _____ % Abundance of ^{53}Cr _____ %

(4)

(c) State, in terms of the numbers of fundamental particles, **one** similarity and **one** difference between atoms of ^{50}Cr and ^{53}Cr

Similarity

_____

_____

Difference

_____

_____

(2)

Q10.

Which row shows the number of each fundamental particle in one $^{25}Mg^{2+}$ ion?

	protons	neutrons	electrons	
A	12	12	10	⬭
B	14	11	12	⬭
C	12	13	10	⬭
D	12	13	12	⬭

(Total 1 mark)

Q11.

This question is about the elements in Group 2.

(a) Describe the structure and bonding in magnesium.

_____

_____

_____

_____

(2)

(b) State the trend in the atomic radius of the elements down Group 2 from Mg to Ba

Give a reason for this trend.

Trend _____

Reason _____

_____

_____

(2)

(e) A sample of strontium is made up of only three isotopes: ^{86}Sr, ^{87}Sr and ^{88}Sr
This sample contains 83.00% by mass of ^{88}Sr
This sample of strontium has $A_r = 87.73$

Calculate the percentage abundance of each of the other two isotopes in this sample.

% abundance ^{87}Sr = _____

% abundance ^{86}Sr = _____

(4)

(f) $Mg(OH)_2$ is used as an antacid to treat indigestion.
A student does an experiment to determine the percentage by mass of $Mg(OH)_2$ in an indigestion tablet.

40.0 cm^3 of 0.200 mol dm^{-3} HCl (an excess) is added to 0.200 g of a powdered tablet.
The mixture is swirled thoroughly.
All of the $Mg(OH)_2$ reacts with HCl as shown.

$$Mg(OH)_2 + 2\ HCl \rightarrow MgCl_2 + 2\ H_2O$$

The amount of HCl remaining after this reaction is determined by titration with 0.100 mol dm^{-3} NaOH

29.25 cm^3 of 0.100 mol dm^{-3} NaOH are needed.

Calculate the percentage by mass of $Mg(OH)_2$ in the indigestion tablet.

Percentage by mass _____

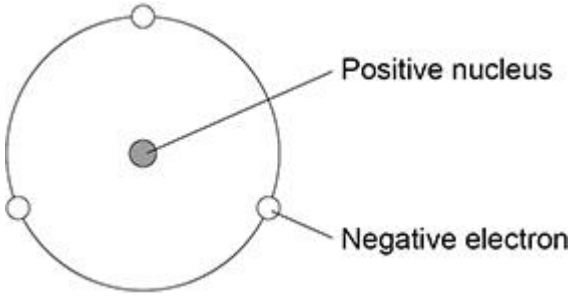
(6)

(Total 19 marks)

Q12.

This question is about atomic structure.

(a) The figure below is a model proposed by Rutherford to show the structure of an atom.



State **two** features of the current model that are not shown in the Rutherford model.

Feature 1 of the current model _____

_____

Feature 2 of the current model _____

_____

_____

(2)

(b) A sample of tin is analysed in a time of flight mass spectrometer. The sample is ionised by electron impact to form 1+ ions.

The table below shows data about the four peaks in this spectrum.

m/z	Percentage abundance
112	22.41
114	11.78
117	34.97
120	To be determined

Calculate the relative atomic mass of tin in this sample. Give your answer to 1 decimal place.

Relative atomic mass _____

(4)

Q13.

Rhenium has an atomic number of 75

(a) Define the term relative atomic mass.

_____

_____

_____

(2)

(b) The relative atomic mass of a sample of rhenium is 186.3

The table below shows information about the two isotopes of rhenium in this sample.

Relative isotopic mass	Relative abundance
185	10
To be calculated	17

Calculate the relative isotopic mass of the other rhenium isotope. Show your working.

Relative isotopic mass _____

(2)

(c) State why the isotopes of rhenium have the same chemical properties.

_____

_____

(1)

Bonding Questions

Q1.

This question is about magnesium and its compounds.

(b) Describe the bonding in magnesium.

_____

_____

_____

_____

(2)

(c) Explain, in terms of structure and bonding, why magnesium chloride has a high melting point.

_____

_____

_____

_____

_____

_____

(3)

Q2.

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)

Q3.

(a) Nickel is a metal with a high melting point.

(i) State the block in the Periodic Table that contains nickel.

_____

(1)

(ii) Explain, in terms of its structure and bonding, why nickel has a high melting point.

_____

_____

_____

_____

_____

(2)

(iii) Draw a labelled diagram to show the arrangement of particles in a crystal of nickel.
In your answer, include at least six particles of each type.

(2)

(iv) Explain why nickel is ductile (can be stretched into wires).

_____

_____

_____

(1)

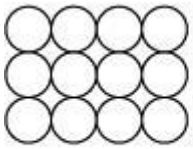
(ii) Balance the following equation to show how anhydrous nickel(II) chloride can be obtained from the hydrated salt using $SOCl_2$

.....$NiCl_2.6H_2O(s)$ + ... $SOCl_2(g)$ ⟶ .....$NiCl_2(s)$ + ...$SO_2(g)$ + ...$HCl(g)$

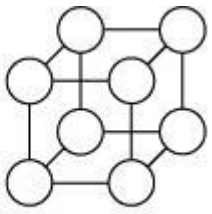
Q4.

At room temperature, both sodium metal and sodium chloride are crystalline solids which contain ions.

(a) On the diagrams for sodium metal and sodium chloride below, mark the charge for each ion.



Sodium metal



Sodium chloride

(2)

(b) (i) Explain how the ions are held together in solid sodium metal.

_____

_____

(ii) Explain how the ions are held together in solid sodium chloride.

_____

_____

(iii) The melting point of sodium chloride is much higher than that of sodium metal. What can be deduced from this information?

_____

_____

(3)

(c) Compare the electrical conductivity of solid sodium metal with that of solid sodium chloride. Explain your answer.

Comparison

_____

_____

Explanation

_____

_____

_____

(3)

(d) Explain why sodium metal is malleable (can be hammered into shape).

_____

_____

(1)

(e) Sodium chlorate(V), $NaClO_3$, contains 21.6% by mass of sodium, 33.3% by mass of chlorine and 45.1% by mass of oxygen.

(i) Use the above data to show that the empirical formula of sodium chlorate(V) is $NaClO_3$

_____

_____

_____

_____

_____

(ii) Sodium chlorate(V) may be prepared by passing chlorine into hot aqueous sodium hydroxide. Balance the equation for this reaction below.

..... Cl_2 + ... NaOH → ..... NaCl + $NaClO_3$ + $3H_2O$

(3)

Q5.

There are several types of crystal structure and bonding shown by elements and compounds.

(a) (i) Name the type of bonding in the element sodium.

_____

(1)

(ii) Use your knowledge of structure and bonding to draw a diagram that shows how the particles are arranged in a crystal of sodium.
You should identify the particles and show a minimum of six particles in a two-dimensional diagram.

(2)

(b) Sodium reacts with chlorine to form sodium chloride.

(i) Name the type of bonding in sodium chloride.

_____

(1)

(ii) Explain why the melting point of sodium chloride is high.

_____

_____

_____

_____

(2)

(c) The table below shows the melting points of some sodium halides.

	NaCl	NaBr	NaI
Melting point /K	1074	1020	920

Suggest why the melting point of sodium iodide is lower than the melting point of sodium bromide.

_____

_____

(1)

Q6.

This question is about some Period 3 elements and their oxides.

(b) Explain why magnesium has a higher melting point than sodium.

_____

_____

_____

_____

(2)

(c) State the structure of, and bonding in, silicon dioxide.
Other than a high melting point, give **two** physical properties of silicon dioxide that are characteristic of its structure and bonding.

Structure

_____

Bonding

_____

Physical property 1

_____

Physical property 2

_____

(4)

(d) Give the formula of the species in a sample of solid phosphorus(V) oxide.
State the structure of, and describe fully the bonding in, this oxide.

Formula

_____

Structure

_____

Bonding

_____

_____

_____

_____

(4)

Q7.

Which statement about inorganic ionic compounds is **always** correct?

A They dissolve in water to give neutral solutions. ⬭

B They release energy when they melt. ⬭

C They contain metal cations. ⬭

D They form giant structures. ⬭

(Total 1 mark)

Q8.

(a) (i) Define the term *relative atomic mass* (A_r) of an element.

_____

_____

_____

_____

(2)

(ii) A sample of the metal silver has the relative atomic mass of 107.9 and exists as two isotopes. In this sample, 54.0% of the silver atoms are one isotope with a relative mass of 107.1

Calculate the relative mass of the other silver isotope.

State why the isotopes of silver have identical chemical properties.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) State the type of bonding involved in silver.

Draw a diagram to show how the particles are arranged in a silver lattice and show the charges on the particles.

(3)

(d) Silver reacts with fluorine to form silver fluoride (AgF).

Silver fluoride has a high melting point and has a structure similar to that of sodium chloride.

State the type of bonding involved in silver fluoride.

Draw a diagram to show how the particles are arranged in a silver fluoride lattice and show the charges on the particles.

Explain why the melting point of silver fluoride is high.

_____

_____

_____

_____

(5)

Q9.

Which substance has significant electron delocalisation?

A graphite ⬭

B iodine ⬭

C sodium chloride ⬭

D tetrachloromethane ⬭

(Total 1 mark)

Q10.

Some airbags in cars contain sodium azide (NaN_3).

(a) Sodium azide is made by reacting dinitrogen monoxide gas with sodium amide ($NaNH_2$) as shown by the equation.

$$2NaNH_2 + N_2O \longrightarrow NaN_3 + NaOH + NH_3$$

Calculate the mass of sodium amide needed to obtain 550 g of sodium azide, assuming there is a 95.0% yield of sodium azide. Give your answer to 3 significant figures.

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(d) Sodium azide has a high melting point.

Predict the type of bonding in a crystal of sodium azide.
Suggest why its melting point is high.

Type of bonding

_____

Reason for high melting point

_____

_____

_____

_____

_____

(3)

(iii) Which is the correct formula of magnesium azide?

Tick (✓) **one** box.

Mg_3N ☐

MgN ☐

MgN_6 ☐

Mg_3N_2 ☐

(1)

Q11.

What happens when water is vaporised?

A Covalent bonds break within molecules. ⬭

B Intermolecular forces are overcome. ⬭

C The enthalpy of the molecules decreases. ⬭

D The disorder of the molecules decreases. ⬭

(Total 1 mark)

Q12.

Which is **not** responsible for conducting electricity?

A The sodium ions in molten sodium chloride ⬭

B The electrons between layers of carbon atoms in graphite ⬭

C The bonding electrons in a metal ⬭

D The lone pair electrons in liquid water molecules ⬭