A-Level Chemistry
Summer Introductory Material

Name: _____

Previous School: _____

GCSE Chemistry/Science Grade: _____

A-Level Chemistry Summer Introductory Material

The material below has been selected to show what you might be doing in your A Level Chemistry lessons at the start of the course. Some of it is familiar and some of it will be new to you. The calculations mirror the type of calculations you would have done at GCSE. The other topics have a link to some useful videos that might help you. Have a go and bring it in when we start. Don't worry if you cannot do it all but give it your best.

If you want to do some reading about general chemistry I would recommend The Disappearing Spoon – Sam Kean or Periodic Tales by Hugh Aldersley-Williams. They are still in print and are cracking reads (excuse the organic chemistry reference).

Amount of Substance – Calculations

These are questions in the A Level Course that have been covered in the GCSE Chemistry course. Please review your notes and have a go at these multichoice questions.

Balancing Equations

1.

The unbalanced equation for the reaction of copper with concentrated nitric acid is shown below.

.....Cu + ...HNO_3 → .....$Cu(NO_3)_2$ + ...NO_2 + ...H_2O

What is the number of moles of HNO_3 that react with 1 mole of Cu?

A 2
B 3
C 4
D 6

Your answer ☐ **[1]**

Mass Calaculation from Moles

2. Zinc reacts with aqueous silver nitrate, as shown in the equation:

$Zn(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Zn(NO_3)_2(aq)$

0.10 g of zinc is added to 15 cm^3 of 0.25 mol dm^{-3} aqueous silver nitrate.

What is the mass of silver metal that would be formed?

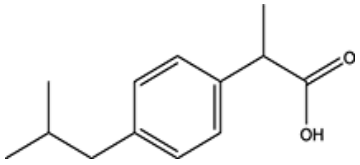
A 0.16 g
B 0.20 g
C 0.33 g
D 0.40 g

Your answer ☐ **[1]**

Using milligrams(mg) in moles

3. Ibuprofen is a medicine used to relieve pain.

The structure of ibuprofen is shown below.



A standard tablet contains 200 mg of ibuprofen.

What is the amount, in moles, of ibuprofen in a standard tablet?

A. 9.62×10^{-4}
B. 9.71×10^{-4}
C. 9.62×10^{-1}
D. 9.71×10^{-1}

Your answer ☐

[1]

Using Avogadro's number 6.022 x 10^{23} /mol to find the number of particles

4. How many oxygen atoms are in 120.2 g of SiO_2?

A 3.01×10^{23}
B 1.20×10^{24}
C 2.41×10^{24}
D 3.61×10^{24}

Your answer ☐ **[1]**

Concentration calculations

5. 15.00 cm^3 of 18.0 mol dm^{-3} concentrated hydrochloric acid is diluted with water to prepare 250 cm^3 of dilute hydrochloric acid.

What is the concentration, in mol dm^{-3}, of the dilute hydrochloric acid?

A 0.0675
B 0.270
C 0.300
D 1.08

Your answer ☐ **[1]**

Concentration calculations

6. A student mixes 100 cm^3 of 0.200 mol dm^{-3} NaCl(aq) with 100 cm^3 of 0.200 mol dm^{-3} Na_2CO_3(aq).

What is the total concentration of Na^+ ions in the mixture formed?

A. 0.100 mol dm^{-3}
B. 0.200 mol dm^{-3}
C. 0.300 mol dm^{-3}
D. 0.400 mol dm^{-3}

Your answer ☐

[1]

Calculating volume of gas using 24dm^3/mol

7. Magnesium nitrate, $Mg(NO_3)_2$, decomposes when heated:

$Mg(NO_3)_2(s) \rightarrow MgO(s) + 2NO_2(g) + ½O_2(g)$

0.00250 mol of $Mg(NO_3)_2$ is decomposed.

What is the volume of gas produced, measured at RTP?

A 30 cm^3
B 60 cm^3
C 120 cm^3
D 150 cm^3

Your answer ☐ **[1]**

Using ratios of gas volumes

8. Complete combustion of 40 cm^3 of a gaseous hydrocarbon **X** requires 240 cm^3 of oxygen. 160 cm^3 of carbon dioxide forms. All gas volumes are at room temperature and pressure.

What is the formula of **X**?

A. C_4H_8
B. C_4H_{10}
C. C_6H_{12}
D. C_6H_{14}

Your answer ☐

[1]

Empirical formula

9. A hydrocarbon contains 85.71% carbon by mass.

What is the empirical formula of the hydrocarbon?

A CH
B CH_2
C CH_4
D C_2H_4

Your answer ☐ **[1]**

Empirical formula

10. A sample of a compound **M** contains 1.46 g of carbon, 0.482 g of hydrogen and 1.69 g of nitrogen.

What is the empirical formula of **M**?

A. CH_2N
B. C_4HN_4
C. CH_4N
D. C_2H_4N

Your answer ☐

[1]

Atom Economy

11. Hydrogen can be prepared industrially by the reaction of methane with steam. The equation is shown below.

$CH_4(g) + 2H_2O(g) \rightarrow 4H_2(g) + CO_2(g)$

What is the atom economy of hydrogen for this process?

A 3.8%
B 4.3%
C 15.4%
D 17.4%

Your answer ☐ **[1]**

Percentage yield

12. A student reacts 4.50 g of $C_6H_5NH_2$ with excess CH_3COCl in the reaction below.

$C_6H_5NH_2 + CH_3COCl \rightarrow C_6H_5NHCOCH_3 + HCl$

$M_r = 93.0$ $M_r = 135.0$

The reaction produces 3.25 g of $C_6H_5NHCOCH_3$.

What is the percentage yield of $C_6H_5NHCOCH_3$?

A 49.8
B 68.9
C 72.2
D 95.4

Your answer ☐ **[1]**

Electron Configuration

Electron Configuration at A Level is more complicated than at GCSE. Watch the videos linked below, summarise the info and have a go with the questions below. Don't worry if you don't get it as we will cover them in your lessons.

A Level Chemistry Revision "Electron Configuration"
https://www.youtube.com/watch?v=9ogq50CBgCg

A Level Chemistry Revision "Electron Configuration 2"
https://www.youtube.com/watch?v=LxtMp4v8FNQ

A Level Chemistry Revision "Periodic Trends in Electron Configuration"

https://www.youtube.com/watch?v=7zIE54-YvLk

13. How many p-orbitals are occupied by electrons in a sulfur atom?

A 2
B 4
C 6
D 10

Your answer ☐ **[1]**

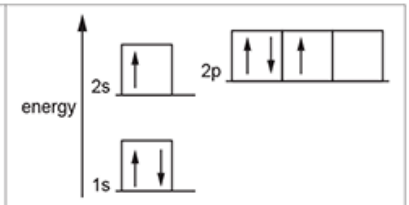
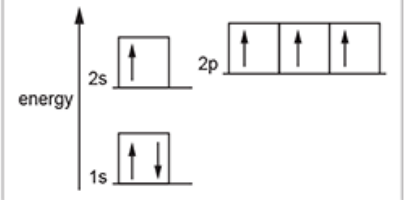
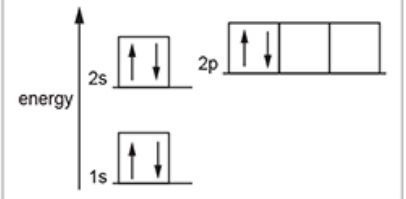
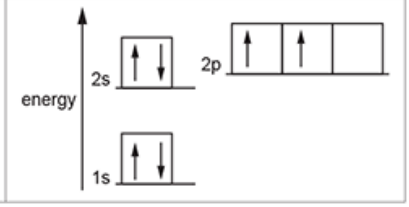
14. Which element has atoms with the largest number of unpaired p-electrons?

A aluminium
B oxygen
C chlorine
D phosphorus

Your answer ☐ **[1]**

15. In the diagrams below, each box represents an orbital and each electron is shown as an arrow.

Which diagram shows the correct arrangement of electrons in an atom of carbon?

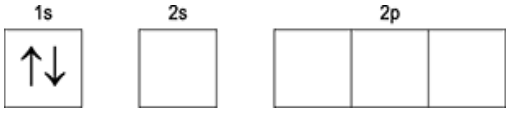
A	
B	
C	
D	

Your answer ☐ **[1]**

16. This question is about electron structure and ions.

Electrons occupy orbitals within an atom. The diagram below shows an incomplete 'electrons in boxes' representation for the filling of orbitals in an oxygen atom.

Complete the diagram.



[1]

17. Electron configurations for atoms of different elements are shown below.

Which electron configuration represents the element with the largest first ionisation energy?

A $1s^2 2s^2$

B $1s^2 2s^2 2p^4$

C $1s^2 2s^2 2p^6$

D $1s^2 2s^2 2p^6 3s2$

Your answer ☐

[1]

18. What is the electron configuration for an Mg^{2+} ion?

A. $1s^2 2s^2$
B. $1s^2 2s^2 2p^6$
C. $1s^2 2s^2 2p^6 3s^2$
D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$

Your answer ☐

Intermolecular forces

Intermolecular forces at A Level is more complicated than at GCSE. Watch the videos linked below, summarise the info and have a go with the questions below. Once again, don't worry if you don't get it as we will cover them in your lessons.

A Level Chemistry Revision "Intermolecular Forces".
https://www.youtube.com/watch?v=a95E-XBm4Fk

19. Which compound has the highest boiling point?

A ethanol
B heptane
C sodium chloride
D water

Your answer ☐ **[1]**

20. This question is about the first 36 elements in the periodic table:

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr

From these 36 elements **only**, write the symbol for the element(s) that fit each description.

The **three** elements that, when in a molecule, can form hydrogen bonds with other suitable molecules.

..... **[1]**

Shapes of Molecules

Shapes of molecules is a new topic relating to simple covalent molecules. Watch the videos linked below, summarise the info and have a go with the questions below. Don't worry if you don't get it as we will cover them in your lessons.

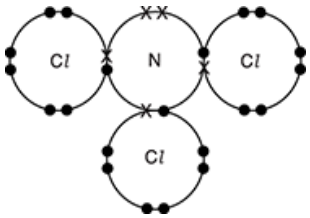
A Level Chemistry Revision "Shapes of Molecules".

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

A Level Chemistry Revision "Effect of Lone Pairs on the Shape of Molecules". - YouTube

https://www.youtube.com/watch?v=q3L8xARUFZM

21. A '*dot-and-cross*' diagram for nitrogen trichloride, NCl_3, is shown below.



Which row shows the correct shape and bond angle in a molecule of NCl_3?

	Name of shape	Bond angle
A	Pyramidal	104.5°
B	Pyramidal	107°
C	Tetrahedral	107°
D	Trigonal planar	120°

Your answer

[1]

22. Predict the shape and bond angle in a molecule that has 2 bonding pairs and 2 lone pairs around a central atom.

A. linear, 180°
B. non-linear, 104.5°
C. tetrahedral, 109.5°
D. trigonal planar, 120°

Your answer ☐

[1]

23. The diagram shows the bonds present in a molecule of $COCl_2$.

What is the shape of a molecule of $COCl_2$?

A. non-linear
B. pyramidal
C. tetrahedral
D. trigonal planar

Your answer ☐

[1]

24. A chemist determines some properties of two substances, **C** and **D**.

The results are shown in the table.

	C	**D**
Melting point / ˚C	660	801
Electrical conductivity when solid	Yes	No
Electrical conductivity when molten	Yes	Yes
Solubility in water	No	Yes

Which row correctly identifies the bonding and structure in **C** and **D**?

	C	**D**
A	giant ionic	giant metallic
B	giant ionic	giant ionic
C	giant metallic	giant metallic
D	giant metallic	giant ionic

Your answer ☐

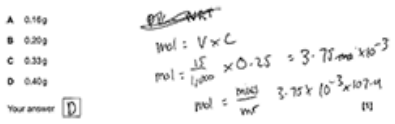
[1]

25. Which p-block element contains atoms with one unpaired electron?

A Al
B Si
C P
D S

Your answer ☐ **[1]**

Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			**C**	1 (AO1.2)	**ALLOW** 4 **<u>Examiner's Comments</u>** Candidates found this question difficult, with the nitric acid N atoms being split between two products, $Cu(NO_3)_2$ and NO_2. B proved to be the biggest distractor from the correct response of C, probably the result of miscounting the N atoms.
			Total	**1**	
2			**C**	1 (AO 2.2)	**<u>Examiner's Comments</u>** Candidates found this question very difficult with less than half successfully choosing option C. Many candidates chose option D, as shown in Exemplar 1. Exemplar 1  This candidate's working is clear and would have been correct had $AgNO_3$ have been the limiting factor. Calculating the moles of Zn shows that this is the limiting factor, producing 0.33 g of Ag for option C.
			Total	**1**	
3			B	1	

			Total	**1**	
4			**C**	1 (AO 2.6)	**Examiner's Comments** Candidates found this question more demanding than Questions 1–6 with only about half the candidates correctly choosing option C. Most candidates showed working on their scripts with B being the common distractor, the result of working out the moles of SiO_2 as 120.2/60.1 = 2, and then multiplying the Avogadro Constant by 2, rather than first doubling 2 to take into account the two O atoms in SiO_2.
			Total	**1**	
5			**D**	1 (AO 2.4)	**Examiner's Comments** Most higher attaining candidates chose the correct option of D. From candidate annotations, most calculated the moles of HCl as 0.27 mol. This directly gave the common distractor of B, the result of not taking into account the volume of 250 cm^3. Successful candidates multiplied 0.27 by 4 (or divided by 0.250) to get the correct response of 1.08 mol dm^{-3} (D).
			Total	**1**	
6			C	1	
			Total	**1**	
7			**D**	1 (AO 2.6)	**Examiner's Comments** Candidates found this question demanding. It showed very good discrimination between abilities with most able candidates choosing the

					correct option D. Option C was chosen by many, the result of working out the moles of $NO_2(g)$ without adding the moles of O_2. Care is needed when reading the question which asked for 'volume of gas', rather than 'volume of $NO_2(g)$. Despite the question stating the volume has been measured at RTP, some candidates chose to use the Ideal Gas Equation instead of the simplified molar volume of 24 dm^3 mol^{-1} at RTP. This approach could still lead to success but would have wasted significant time.
			Total	**1**	
8			A	1	
			Total	**1**	
9			**B**	1 (AO 1.2)	**<u>Examiner's Comments</u>** Most candidates are well drilled in the calculation of an empirical formula from percentage compositions and most selected the correct response of B. Option D proved to the main distractor, presumably due to confusion between the terms empirical and molecular formula.
			Total	**1**	
10			C	1	
			Total	**1**	
11			**C**	1 (AO 1.2)	**<u>Examiner's Comments</u>** Most candidates selected the correct response of C but some chose D, the result of dividing 8 (for $4H_2$) by 44 (for

					CO_2) instead of dividing by their sum (8 + 44 = 52). Overall, candidates showed a good understanding of the term 'atom economy'.
			Total	**1**	
12			**A**	1 (AO 2.4)	
			Total	**1**	
13			**C**	1 (AO 1.1)	**ALLOW 6** **<u>Examiner's Comments</u>** Candidates found this question more difficult than Questions 1–3. The question discriminated well. Most candidates showed the electron configuration in their working. A and D were the main distractors. Rather than the number of p-**orbitals** occupied, option A (2) is the number of p sub-shells (2p and 3p) and D (10) is the total number of p electrons (6 + 4). The errors may be the result of candidates not understanding the meaning of orbital and sub-shell or perhaps not reading the question closely enough. Underlining 'p-orbitals' may have helped candidates.
			Total	**1**	
14			**D**	1 AO1.2	
			Total	**1**	
15			D	1 (AO 1.1)	

			Total	**1**	
16				1	**ALLOW** unpaired electrons in last two boxes pointing down.
			Total	**1**	
17			C	1	**Examiner's Comments** Many candidates did not take into account the trend across periods, with A being a common incorrect answer.
			Total	**1**	
18			B	1	
			Total	**1**	
19			**C**	1 AO1.2	
			Total	**1**	
20			**ALLOW upper case when it is obvious, e.g. ALLOW CR for Cr, AS for As** **ALLOW names for elements** **THREE** from: **N O F H** ✓	1 (AO 1.1)	**DO NOT ALLOW ANY OTHER ELEMENTS (CON)** **Examiner's Comments** Most candidates selected N, O and F, with other responses choosing other elements seemingly at random.
			Total	**1**	
21			B	1	**Examiner's Comments** Generally scored well.
			Total	**1**	
22			B	1	
			Total	**1**	
23			D	1	
			Total	**1**	

24			D	1	
			Total	**1**	
25			**A**	1 (AO2.1)	**Examiner's Comments** Most candidates chose the correct response of A: Al. The best approach seen on many scripts was to write out the electron configuration beside the options and to count off the paired electrons.
			Total	**1**	