A-level Chemistry Summer Homework: Transition activities

The following activities cover some of the key skills from GCSE science that are relevant at A-level. They include the vocabulary used when working scientifically, and some maths and writing skills.

You must complete these activities before you start A-level chemistry in September and have them ready to hand to your new teacher in your first lesson.

The activities are **not a test**. Try the activities first and see what you remember, and then use textbooks or other resources to answer the questions. **Don't** just go to Google for the answers! Actively engaging with your notes and resources from GCSE will make this learning experience *more* worthwhile. You will have a solid head-start to A-level chemistry, because you will be able to retrieve the knowledge and skills if the work has come from you!

Using maths skills

Throughout A-level Chemistry you will need to be able to use maths skills you developed in GCSE Chemistry and GCSE maths, such as using standard form, rounding correctly and quoting your answer to an appropriate number of significant figures.

Activity 1 Using maths skills

1. Write the following numbers in standard form:

   a. 4000

   c. 16 001

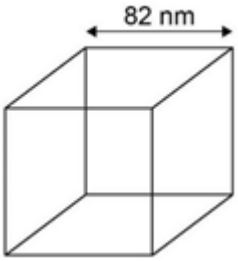
   b. 1 000 000

   d. 12.45

2. Zinc oxide can be produced as nanoparticles.
   A nanoparticle of zinc oxide is a cube of side 82nm.

   1nm = 10^{-9} m

   Calculate the surface area of a nanoparticle of zinc oxide. Give your answer in standard form.



3. Express the following numbers to 3 significant figures:
   a. 57 658
   c. 0.001000

   b. 0.045346
   d. 2.03988×10^{-4}

4. Make the bracketed symbol after each equation the subject of the equation, e.g. in question (a), write the equation in the form: $\lambda =$

   (a) $c = f\lambda$ (λ)

   (b) $c = \frac{n}{V}$ (V)

   (c) $q = m\,c\,\Delta T$ (ΔT)

   (d) $n = c \times \frac{V}{1000}$ (V)

   (e) $n = c \times \frac{V}{1000}$ (c)

   (f) $E = hf$ (h)

   (g) $\Delta G = \Delta H - T\Delta S$ (ΔS)

Using the periodic table

During A-level Chemistry you will need to become familiar with the periodic table of the elements and be able to use information from the table to answer questions.
Here is a copy of the periodic table that you will be given to use in your exams.

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
(1)	(2)											(13)	(14)	(15)	(16)	(17)	(18)
								1.0 H hydrogen 1				10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	4.0 He helium 2
6.9 Li lithium 3	9.0 Be beryllium 4											27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12											69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	96.0 Mo molybdenum 42	[97] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La * lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	[286] Nh nihonium 113	[289] Fl flerovium 114	[289] Mc moscovium 115	[293] Lv livermorium 116	[294] Ts tennessine 117	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac † actinium 89	[267] Rf rutherfordium 104	[270] Db dubnium 105	[269] Sg seaborgium 106	[270] Bh bohrium 107	[270] Hs hassium 108	[278] Mt meitnerium 109	[281] Ds darmstadtium 110	[281] Rg roentgenium 111	[285] Cn copernicium 112	[289] Fl flerovium 114	[289] Mc moscovium 115	[293] Lv livermorium 116	[294] Ts tennessine 117	[294] Og oganesson 118

Key

relative atomic mass
symbol
name
atomic (proton) number

* 58 – 71 Lanthanides	140.1 Ce cerium 58	140.9 Pr praseodymium 59	144.2 Nd neodymium 60	[145] Pm promethium 61	150.4 Sm samarium 62	152.0 Eu europium 63	157.3 Gd gadolinium 64	158.9 Tb terbium 65	162.5 Dy dysprosium 66	164.9 Ho holmium 67	167.3 Er erbium 68	168.9 Tm thulium 69	173.0 Yb ytterbium 70	175.0 Lu lutetium 71
† 90 – 103 Actinides	232.0 Th thorium 90	231.0 Pa protactinium 91	238.0 U uranium 92	[237] Np neptunium 93	[244] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[247] Bk berkelium 97	[251] Cf californium 98	[252] Es einsteinium 99	[257] Fm fermium 100	[258] Md mendelevium 101	[259] No nobelium 102	[262] Lr lawrencium 103

Activity 2 Atoms

1. Give the atomic number of:
   a. Osmium
   b. Lead
   c. Sodium
   d. Chlorine

2. Give the relative atomic mass (A_r) of:
   a. Helium
   b. Francium
   c. Barium
   d. Oxygen

3. What is the number of neutrons in each of the following elements?
   a. Fluorine
   b. Beryllium
   c. Gold

Activity 3 Formulae of common compounds

Give the formulae of the following compounds:

1. Methane
2. Sulfuric acid
3. Potassium manganate (VII)
4. Water
5. Ammonia
6. Nitric acid
7. Ethane
8. Ethene
9. Ethanol
10. Phosphoric acid

Activity 4 Ions and ionic compounds

The table below lists the formulae of some common ions.

Positive ions		Negative ions	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^-
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^-
Calcium	Ca^{2+}	Fluoride	F^-
Copper(II)	Cu^{2+}	Iodide	I^-
Hydrogen	H^+	Hydroxide	OH^-
Iron(II)	Fe^{2+}	Nitrate	NO_3^-
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lead	Pb^{2+}	Sulfate	SO_4^{2-}
Lithium	Li^+	Sulfide	S^{2-}
Magnesium	Mg^{2+}		
Potassium	K^+		
Silver	Ag^+		
Sodium	Na^+		
Zinc	Zn^{2+}		

Use the table to write the formulae for the following ionic compounds.

1. Magnesium bromide
2. Barium oxide
3. Zinc chloride
4. Ammonium chloride
5. Ammonium carbonate
6. Aluminium bromide
7. Calcium nitrate
8. Iron (II) sulfate
9. Iron (III) sulfate

Activity 5 Balancing equations

1. Write balanced symbol equations for the following reactions, using the information on the previous pages to work out the formulae of the compounds. Remember some of the elements may be diatomic molecules.

   a. Aluminium + oxygen → aluminium oxide

   b. Methane + oxygen → carbon dioxide + water

   c. Calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide

2. Chalcopyrite is an important copper ore mineral with formula $CuFeS_2$. Copper can be produced from rock that contains $CuFeS_2$ in two stages.

   Balance the equations for the two stages in this process.
   Hint: remember that fractions can be used to balance equations.

   Stage 1: $CuFeS_2 + O_2 + SiO_2 \rightarrow Cu_2S + Cu_2O + SO_2 + FeSiO$

   Stage 2: $Cu_2S + CuO \rightarrow Cu + SO_2$

3. Balance the following equations:

   a. $H_2 + O_2 \rightarrow H_2O$

   b. $S_8 + O_2 \rightarrow SO_3$

   c. $HgO \rightarrow Hg + O_2$

   d. $Zn + HCl \rightarrow ZnCl_2 + H_2$

   e. $Na + H_2O \rightarrow NaOH + H_2$

   f. $C_{10}H_{16} + Cl_2 \rightarrow C + HCl$

   g. $Fe + O_2 \rightarrow Fe_2O_3$

   h. $C_6H_{12}0_6 + O_2 \rightarrow CO_2 + H_2O$

   i. $Fe_2O_3 + H_2 \rightarrow Fe + H_2O$

   j. $Al + FeO \rightarrow Al_2O_3 + Fe$

Activity 6 Moles

The amount of a substance is measured in moles. The mass of one mole of a substance in grams is numerically equal to the relative formula mass of the substance. One mole of a substance contains the same number of particles – atoms, molecules or ions - as one mole of any other substance. The number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is 6.02×10^{23} particles per mole.

1. Complete the table. Use the periodic table to help you.

Substance	Formula	Mass of substance in grams	Amount in moles	Number of particles
Helium				18.12×10^{23}
Chlorine (Cl)		14.2		
Methane			4	
Sulfuric acid		4.905		

2. Answer the following questions on moles.
   a) How many moles of phosphorus pentoxide (P_4O_{10}) are in 85.2g?

   b) How many moles of potassium are in 73.56g of potassium chlorate (V) ($KClO_3$)?

   c) How many moles of water are in 249.6g of hydrated copper(II) sulfate ($CuSO_4.5H_2O$)? For this one, you need to be aware the dot followed by $5H_2O$ means that the molecule comes with 5 water molecules, so these have to be counted in as part of the formula mass.

   d) What is the mass of 0.125 moles of tin sulfate ($SnSO_4$)?

   e) If I have 2.4g of magnesium, how many g of oxygen (O_2) will I need to react completely with the magnesium? $2Mg + O_2 \rightarrow MgO$

3. Answer the following questions.

a) What is the concentration (in mol dm^{-3}) of 9.53g of magnesium chloride ($MgCl_2$) dissolved in 100cm^3 of water?

b) What is the concentration (in mol dm^{-3}) of 13.248g of lead nitrate ($Pb(NO_3)_2$) dissolved in 2dm^3 of water?

c) If I add 100cm^3 of 1.00 mol dm^3 HCl to 1.9 dm^3 of water, what is the concentration of the new solution?

d) What mass of silver is present in 100cm^3 of 1 mol dm^{-3} silver nitrate ($AgNO_3$)?

e) The Dead Sea, between Jordan and Israel, contains 0.0526 mol dm^{-3} of Bromide ions (Br^-). What mass of bromide ions is in 1 dm^3 of Dead Sea water?

Extended writing

Name ……..

The ability to write coherently in a logical, well-structured way is an essential skill to develop. At GCSE the 6-mark extended response questions are used so students can demonstrate this skill. At A-level you will still need to write precise answers using precise scientific language.

The command word in a question, like at GCSE, is important as it gives you an indication of what to include in your answers. For example, 'explain' means you must give scientific reasons why things are happening, not just a description. A comparison needs advantages and disadvantages, or points for and against.

Activity 7 Types of bonding extended response question
Compare the similarities and differences between ionic, covalent, and metallic bonding. Do not bullet-point your answer. Ensure your response is communicated coherently and in a logical order.