Yr11 – 12 Transition Activities

Subject: Chemistry

THE CITY OF LEICESTER COLLEGE

Contents

Part One – Using maths in chemistry

The first section of this booklet focuses on some of the mathematical application of A level Chemistry. You will be expected to rearrange equations, convert between units, use standard form and report data to an appropriate number of significant figures. There is a section for each of these skills below.

Standard form and Significant figures

In the calculations you will be asked to perform as part of your A level studies you will need to be confident with both representing numbers in standard form and giving them to a certain number of significant figures.

When numbers are very large or very small they are written in **standard form**. In standard form a number is written in the format;

$$a \times 10^{n} \text{ where } 1 \leq a < 10 \text{ and } n \text{ is an integer}$$

In an experiment, or from a calculation you may only be able to give your answer with a certain amount of accuracy. This accuracy is shown by giving your answer to a certain number of **significant figures**.

Worked example: Standard form

Question

Express 0.00268 in standard form.

Answer

Step <1>

Identify the value for ‘*a*.’ In this case it will be 2.68.

Step <2>

Work out how many places the decimal place must be moved to form this number.

0 . 0 0 2 6 8

The decimal place must move 3 places to the right to become 2.68.

This number of places is the value for the integer ‘*n*.’ If the decimal point moves to the right ‘*n*’ is negative. If the decimal place moves to the left ‘*n*’ is positive.

Step <3>

Substitute your values into the general format, $a \times 10^{n}$

Therefore in standard form 0.00268 is $\underline{2.68 \times 10^{-3}}$.

Worked example: Significant figures

Question

Express 0.56480900 to 3 significant figures.

Answer

Step <1>

Identify the numbers which are significant using the rules below;

Rule 1 Any number that isn't 0 is significant.

Rule 2 Any 0 that is between two numbers that are not 0 is significant.

Rule 3 Any 0 that is before all the non-zero digits is not significant.

Rule 4 Any 0 that is after all of the non-zero digits is only significant **if** there is a decimal point.

In this case the significant numbers are 0.56480900.

Step <2>

Identify the three most significant figures. These are the significant numbers which are furthest to the left (have the biggest values) i.e. 0.56480900.

Step <3>

Look at the next number. If this number is 5 or above, then round up. If this number is 4 or less, do not round up.

In this case the next number is 8, so we round up to 0.565.

1 This question is about expressing numbers in standard form.

a) Express the following numbers in standard form.

i. 0.0023

ii. 1032

iii. 2750000

iv. 0.000528

b) Write out the following numbers in ordinary form.

i. 2.01×10^{3}

ii. 5.2×10^{-2}

iii. 8.41×10^{2}

iv. 1.00×10^{-4}

c) For each of the pairs of numbers below identify which is the bigger number.

i. 1.43×10^{23} or 1.43×10^{24}

ii. 5.16×10^{-3} or 5.16×10^{-4}

iii. 12.4×10^{23} or 1.50×10^{24}

2 Express the following numbers to the number of significant figures indicated.

a) 4.74861 to 2 sig. fig.

b) 507980 to 3 sig. fig.

c) 809972 to 3 sig. fig.

d) 06.345 to 3 sig. fig.

e) 7840 to 3 sig. fig.

f) 0.007319 to 3 sig. fig.

3 Carry out the following calculations expressing the numbers in **standard form** to the degree of accuracy indicated;

a) $(4.567 \times 10^5) \times (2.13 \times 10^{-3})$ to 3 sig. fig.

b) $(1.567 \times 10^3) \div (2.245 \times 10^{-1})$ to 4 sig. fig.

c) $(5.4 \times 10^{-1}) \div (2.7 \times 10^{-3})$ to 1 sig. fig.

d) $(2.00 \times 10^{-2}) \times (2.00 \times 10^{-4})$ to 3 sig. fig.

Converting units

In A level chemistry we use SI units for making measurements.

For length: mm, cm and m

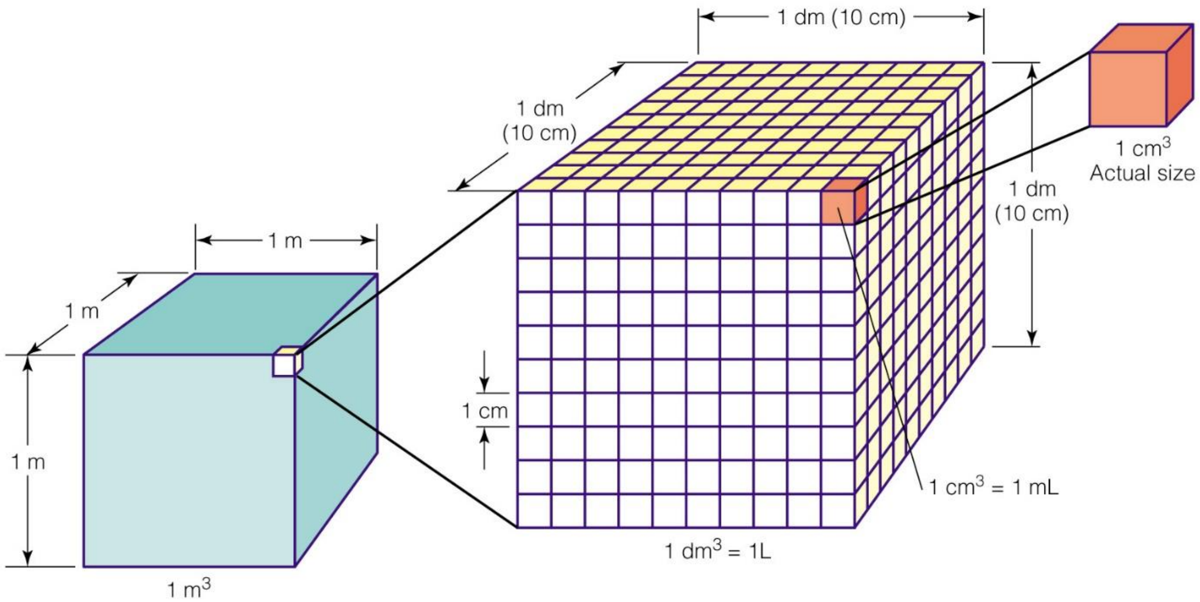
For volume: cm^3, dm^3 and m^3

For mass: g and kg.

For Concentration: mol/dm^3 (mol dm^{-3}) and g/dm^3 (g dm^{-3})

For temperature: ^{O}C and Kelvin, K https://www.youtube.com/watch?v=l-Rjs9qw9Bw

You need to be able to convert between these units so you can express yourself clearly and in the most appropriate manner.



Complete the table by converting between cm^3, dm^3 and m^3

cm^3	dm^3	m^3
1000000	1000	1
50		
	1	
		0.0034
	0.5	
25		
670		

1 Convert the following volumes;

a) 12.2 cm^3 into dm^3
b) 0.015 cm^3 into dm^3
c) 132 dm^3 into cm^3
d) 0.054 dm^3 into cm^3
e) 25 dm^3 into m^3
f) 0.48 m^3 into dm^3
g) 25 cm^3 into m^3
h) 381 m^3 into cm^3

2) Which is bigger?

a. What temperature is 0 ^oC in K?
b. What temperature is 1000 K in ^oC?
c. How many kg is 5 g?
d. How many m^3 is 14 dm^3
e. Order these from largest to smallest: 700 cm^3, 0.06 dm^3, 6.4×10^{-4} m^3
f. Order these from largest to smallest: 18 kg, 1.8×10^5 g, 1.8×10^{-4} g, 1.8×10^2 kg

Measuring chemicals – the mole

From this point on you need to be using an A level periodic table, not a GCSE one you can view one here:

https://www.ocr.org.uk/Images/363792-unit-h032-and-h432-data-sheet.pdf

The mole is the chemists equivalent of a dozen, atoms are so small that we cannot count them out individually, instead we weigh out chemicals. The standard unit for measuring is the mole. The mass number on the periodic table shows the mass of 1 mole of each element. We can refer to this as the M_r, or the relative molecular mass.

For example: magnesium + sulfur → magnesium sulphide

$$Mg + S \rightarrow MgS$$

We can see that one atom of magnesium will react with one atom of sulfur, if we had to weigh out the atoms we need to know how heavy each atom is.

From the periodic table: Mg = 24.3 and S = 32.1

If I weigh out exactly 24.3g of magnesium this will be 1 mole of magnesium, if we counted how many atoms were present in this mass it would be a huge number (6.02×10^{23}!!!!), if I weigh out 32.1g of sulfur then I would have 1 mole of sulfur atoms.

So 24.3g of Mg will react precisely with 32.1g of sulfur, and will make 56.4g of magnesium sulfide. The M_r of magnesium sulfide is 56.4g. This is the mass of 1 mole of magnesium sulfide. There are 6.02×10^{23} molecules in 56.4g of magnesium sulfide.

Here is a comprehensive page on measuring moles, there are a number of descriptions, videos and practice problems.

You will find the first 6 tutorials of most use here, and problem sets 1 to 3.

http://bit.ly/pixlchem9

http://www.chemteam.info/Mole/Mole.html

Answer the following questions on moles.

Q1 Arrange the terms mole, M_r and mass into 3 equations so each one is the subject. Use the triangle above for help.

Q2

a) How many moles of phosphorus pentoxide (P_4O_{10}) are in 85.2g?

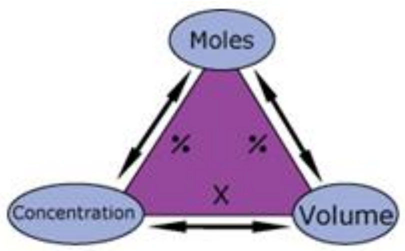
b) How many moles of potassium in 73.56g of potassium chlorate (V) ($KClO_3$)?

c) How many moles of water are in 249.6g of hydrated copper sulfate(VI) ($CuSO_4.5H_2O$)? 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 molecules 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? $2Mg + O_2 \rightarrow MgO$

Measuring chemicals - Solutions and concentrations



In chemistry a lot of the reactions we carry out involve mixing solutions rather than solids, gases or liquids.

You will have used bottles of acids in science that have labels saying 'Hydrochloric acid 1M', this is a solution of hydrochloric acid where 1 mole of HCl, hydrogen chloride (a gas) has been dissolved in $1dm^3$ of water.

The dm^3 is a cubic decimetre, it is actually 1 litre, but from this point on as an A level chemist you will use the dm^3 as your volume measurement. $1\ dm^3 = 1000\ cm^3$

http://bit.ly/pixlchem10

http://www.docbrown.info/page04/4_73calcs11msc.htm

Concentration

The concentration of a solution is defined in units of moles per cubic decimetre (mol/dm^3). Since $1/dm^3$ can also be represented as dm^{-3} the unit of concentration can also be represented by $mol\ dm^{-3}$.

By looking at the units of concentration of mol dm^{-3} we can see that the equation for determining the concentration of a solution must be;

$$\text{Concentration (mol dm}^{-3}\text{)} = \frac{\text{no. of moles (mol)}}{\text{volume (dm}^3\text{)}}$$

When calculating the concentration of a solution the volume must be given in units of dm^3. Therefore we need to be able to readily convert between units of m^3, dm^3 and cm^3 in order to correctly give the concentration of a solution. The diagram below shows how to do this.

Worked example

Question

Determine the concentration of a solution in which 0.0158 mol of sodium chloride is dissolved in 25 cm^3 of water.

Answer

Step <1>

Change the volume to dm^3 by dividing by 1000:

25 cm^3 = 0.025 dm^3

Step <2>

Substitute the values into the equation remembering to use the units to help;

$$\text{Concentration (mol/dm}^3\text{)} = \frac{0.0158\text{ mol}}{0.025\text{ dm}^3}$$

$$= 0.632\text{ mol dm}^{-3}$$

$$= \underline{0.63\text{ mol dm}^{-3}}\text{ (to 2 sig. fig)}$$

Remember you can only give your final answer to the same degree of accuracy (significant figures) as the least accurate value used in the calculation. In this case to two significant figures.

1 Give the concentrations of the following aqueous solutions in mol dm^{-3}.
Give all final answers to an appropriate degree of accuracy.

a) 2.46 mol dissolved in 2.50 dm^3

b) 0.00500 mol dissolved in 24.6 cm^3

c) 1.5 mol dissolved in 0.020 cm^3

d) 63.2 mol dissolved in 2.00 m^3

e) 0.021 mol dissolved in 4.5×10^{-3} m^3

f) 81.9 g of calcium carbonate, $CaCO_3$ dissolved in 34.1 cm^3

g) 23.4 g of hydrated copper sulfate, $CuSO_4{\bullet}5H_2O$ dissolved in 2.5 dm^3

2 Calculate the following. Give all final answers to an appropriate degree of accuracy.

a) The number of moles of substance in;

i. 0.025 dm^3 of a 0.100 mol dm^{-3} solution,

ii. 24.3 cm^3 of a 0.150 mol dm^{-3} solution

iii. 1.8×10^{-3} m^3 of a 1.28 mol dm^{-3} solution

b) The mass of solid in each of the following solutions;

i. 0.0186 dm^3 of a 0.012 mol dm^{-3} solution of NaOH

ii. 36.3 cm^3 of a 4.21 mol dm^{-3} solution of $Ca(OH)_2$

iii. 1.23×10^{-3} m^3 of a 0.254 mol dm^{-3} solution of $NaHCO_3$.

3. a) Arrange the terms Moles, Concentration and Volume into 3 equations so each term is the subject.

b) For these questions you will need to combine mass and concentration equations. If these are too tricky at the moment go back to the examples and problems in the link above, then come back to them.

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

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

iii. If I add 100cm^3 of 1.00 mol dm^3 HCl to 1.9dm^3 of water, what is the molarity of the new solution?

iv. What mass of silver is present in 100cm^3 of 1moldm^{-3} silver nitrate ($AgNO_3$)?

v. The Dead Sea, between Jordan and Israel, contains 0.0526 moldm^{-3} of Bromide ions (Br^-), what mass of bromine is in 1dm^3 of Dead Sea water?

Answers to Part One

Standard form and significant figures

1 a) i. 2.3×10^{-3} ii. 1.032×10^{3} iii. 2.75×10^{6} iv. 5.28×10^{-4}
b) i. 2010 ii. 0.052 iii. 841 iv. 0.0001
c) i. 1.43×10^{24} ii. 5.16×10^{-3} iii. 1.50×10^{24}

2 a) 4.7
b) 508000
c) 810000
d) 6.35
e) 7840
f) 0.00732

3 a) 9.73×10^{2}
b) 6.980×10^{3}
c) 2×10^{2}
d) 4.00×10^{-6}

Converting units

1 a) 0.0122 dm^3
b) 0.000015 dm^3 or 1.5×10^{-5} dm^3
c) 132000 cm^3
d) 54 cm^3
e) 0.025 m^3
f) 480 dm^3
g) 0.000025 or 2.5×10^{-5} m^3
h) 381000000 cm^3 or 3.81×10^{8} cm^3

2. Which is bigger?

a. 273 K
b. 727 ^oC?
c. $5 \times 10^{-3-}$
d. 0.014 m^3
e. 700 cm^3 > 6.4×10^{-4} m^3 > 0.06 dm^3,
f. 1.8×10^{2} kg = 1.8×10^{5} g > 18 kg > 1.8×10^{-4} g,

Measuring chemicals – the mole

1. mole = mass / M_r M_r = mass / mole mass = mole x M_r

2. a) 85.2/284 = 0.3 moles b) 73.56/122.6 = 0.6 moles c) 249.5/249.5 = 1.0 moles d) 0.125 x 212.8 = 26.6g

e) 2Mg : 2O or 1:1 ratio 2.4g of Mg = 0.1moles so we need 0.1 moles of oxygen (O_2): 0.1 x 32 = 3.2g

Measuring chemicals - Solutions and concentration

1 a) 2.46 mol / 2.50 dm^3 = 0.984 mol dm^{-3} (to 3 sig. fig.)

b) 24.6 cm^3 = 0.0246 dm^3 ; 0.005 mol / 0.0246 dm^3 = 0.203 mol dm^{-3} (to 3 sig. fig.)

c) 0.02 cm^3 = 2×10^{-5} dm^3 ; 1.5 mol / 2×10^{-5} dm^3 = 75000 mol dm^{-3} (to 2 sig. fig.)

d) 2 m^3 = 2000 dm^3 ; 63.2 mol / 2000 dm^3 = 0.0316 mol dm^{-3} (to 3 sig. fig.)

e) 4.5×10^{-3} m^3 = 4.5 dm^3 ; 0.021 mol / 4.5 dm^3 = 0.0047 mol dm^{-3} (to 2 sig. fig.)

f) 81.9 g / 100.1 g mol^{-1} = 0.818 mol; 34.1 cm^3 = 0.0341 dm^3 ; 0.818 mol / 0.0341 dm^3 = 24.0 mol dm^{-3} (to 3 sig. fig.)

h) 23.4 g / 249.6 g mol^{-1} = 0.0938 mol; 0.0938 mol / 2.5 dm^3 = 0.038 mol dm^{-3} (to 2 sig. fig.)

2 a) i. 0.025 dm^3 × 0.100 mol dm^{-3} = 0.0025 mol

ii. 24.3 cm^3 = 0.0243 dm^3; 0.0243 dm^3 × 0.150 mol dm^{-3} = 3.65×10^{-3} mol (to 3 sig. fig.)

iii. 1.8×10^{-3} m^3 = 1.8 dm^3; 1.8 dm^3 × 1.28 mol dm^{-3} = 2.3 mol dm^{-3} (to 2 sig. fig.)

b) i. 0.0186 dm^3 × 0.012 mol dm^{-3} = 2.23×10^{-4} mol; 2.23×10^{-4} mol × 40.0 g mol^{-1} = 8.9×10^{-3} g (to 2 sig. fig.)

ii. 36.3 cm^3 = 0.0363 dm^3; 0.0363 dm^3 × 4.21 mol dm^{-3} = 0.153 mol; 0.153 mol × 74.1 g mol^{-1} = 11.3 g (to 3 sig. fig.)

iii. 1.23×10^{-3} m^3 = 1.23 dm^3; 1.23 dm^3 × 0.254 mol dm^{-3} = 0.312 mol; 0.312 mol × 84.0 g mol^{-1} = 26.2 g (to 3 sig. fig.)

3.a) Concentration = mole / volume   Volume = moles / concentration   moles = concentration x volume

b) i) 9.53g/95.3 = 0.1 moles, in 100cm^3 or 0.1dm^3 in 1dm^3 0.1moles/0.1dm^3 = 1.0 mol dm^{-3}

ii) 13.284g/331.2 = 0.04 moles, in 2dm^3 in 1dm^3 0.04moles /2dm^3 = 0.02 mol dm^{-3}

iii) 100cm^3 of 0.1 mol dm^{-3} = 0.01 moles added to a total volume of 2 dm^3 = 0.01moles/2dm^3 = 0.005 mol dm^{-3}

iv) in 1dm^3 of 1 mol dm^{-3} silver nitrate, 1 mole of Ag = 107.9g in 0.1dm^3 = 107.9 x 0.1 = 10.79g

v) 0.0526 x 79.7 = 42.0274g

Part Two – Skills for Practical Chemistry

Tables

Independent variable in column 1

Dependent variable in column 2

Volume of acid added	Temperature of solution
2 cm	19.6 °C
4 cm	20.3 °C
6 cm	21.1 °C
8 cm	21.9 °C

Independent variable in column 1 → The variable the Investigator changes

Dependent variable in column 2 → This is what we want to find out about. It varies Depending on the independent variable.

The units go in the column heading (Incorrect: units in the data cells; Correct: units in the heading)

Write the column heading across the top of all columns that are repeats

Volume of acid added / cm^{-3}	Temperature of solution / °C			
	Test 1	Test 2	Test 3	Average
2	19.6	19	20.01	
4	20.3	19.9	20.6	20.2667
6	21.1	21.1	21.3	21.2
8	21.9	22	22	

The average is the mean of all the repeated results with anomalous results removed. Report the mean to the same level of accuracy as the collected data (Incorrect: 20.2667; Correct: 21.2)

Use the same accuracy (number of decimal places) for all measurements (Correct: Test 1; Incorrect: Test 2; Incorrect: Test 3)

Below are three situations in which data is used to find an answer to a research question. For each situation:

1. Write the research question
2. Identify the Independent variable
3. Identify the Dependent variable
4. List as many Control variables as possible
5. Determine if the results will be qualitative or quantitative
6. Draw a table for the results, include suitable headings with units (if appropriate)

1, Emilia was making strawberry jam. She tried four different recipes each with a different ratio of sugar to fruit to see which consistency she preferred.

2, Traffic management scientists were measuring the speed of cars to find if the time of day was a factor in speeding.

3, How does the volume of acid added to an alkali affect the pH?

Submit your response to this task

The A level chemistry course has 12 Required Practicals. They are used to develop your skills in handling equipment, making accurate measurements, developing a method, communication of data and minimising risk. You will carry out this one, Qualitative tests for anions, in Year 12.

Five solutions contain the following anions. Sulfate ion, SO_4^{2-}, carbonate ion, CO_2^{2-}, Chloride, Cl^-, Bromide, Br^-, and Iodide, I^-.

1. Describe how to test for and identify each anion. Use the links below to help.
2. List every chemical required. Include the reagents and the solutions to be tested.

Qualitative tests were carried out. The results were: solution 1,2 and 4 had no reaction with hydrochloric acid, solutions 3 and 5 effervesced. Solutions 1,2 and 4 formed precipitates with silver nitrate solution. The colours of the precipitates for solutions 2 and 4 were difficult to distinguish between, the precipitate of solution 1 was white. Solution 3 also formed a white precipitate when reacted with barium chloride.

3. Draw and complete a table for these results. Include the identity of each anion.
4. Identify the advantages of a table over the prose format above. The results provide a response to the question "What is found in the research performed?".

CGSE refresher of how to test for carbonate ions, sulfate ions and halide ions.
https://www.youtube.com/watch?v=mWTgHjdea4Y

A level - how to distinguish between halide ions
https://www.chemguide.co.uk/inorganic/group7/testing.html

A level – how to distinguish between halide ions https://www.youtube.com/watch?v=__96chpEILg

A level - how to test for anions https://www.youtube.com/watch?v=CwHjlgDqXNA

Answers – Part 2

1. Write the research question
2. Identify the Independent variable
3. Identify the Dependent variable
4. List as many Control variables as possible
5. Determine if the results will be qualitative or quantitative
6. Draw a table for the results, include suitable headings with units (if appropriate)

1, Emilia was making strawberry jam. She tried four different recipes each with a different ratio of sugar to fruit to see which consistency she preferred.

Which strawberry jam recipe do I prefer?
IV – ratio of sugar to fruit
DV – consistency of jam
CV – type of fruit, ratio of other ingredients, length of time to cook, temperature of heat applied
Qualitative results

Ratio of fruit to sugar as stated in recipe	Consistency	Preference rank order
1	This is descriptive, leave plenty of space.	
2		
3		
4		

2, Council management scientists were measuring the speed of cars to find if the time of day was a factor in speeding.

Does time of day affect traffic speed?
IV – time
DV – speed
CV – location, amount of warning drivers have about the speed check, type of warning drivers have about the speed check
Quantitative results

Time	Speed mph or ms^{-1}	Average speed
The smaller the time intervals the more precise the data.	This needs to measure multiple vehicles so will have multiple columns under the same heading	

3, How does the volume of acid added to an alkali affect the pH?

How does the volume of acid added to an alkali affect the pH?
IV – volume of acid added
DV – pH
CV – concentration of acid, concentration of alkali, type of acid, type of alkali
Quantitative results

Volume of acid added / cm^3	pH

Part 3: Research activities

Submit your response to this task

Choose task 1 and at least one other task from the list of topics below. Use your online searching abilities to find out as much about the topic as you can. Remember you are a prospective A level chemist so you should aim to push your knowledge. Present your information as Cornell notes with references. You will be marked on your research and referencing as part of the 12 Required Practicals in the A level course. Now is a good time to get to grips with how to reference accurately and quickly.

How to make Cornell notes: https://www.youtube.com/watch?v=lsR-10piMp4

How to reference:
https://www.google.com/search?q=how+to+reference&rlz=1C1SQJL_enGB797GB817&oq=how+to+reference&aqs=chrome..69i57j0j69i59j0l5.2666j0j7&sourceid=chrome&ie=UTF-8#kpvalbx=_CBS_XsyEN4PwxgOa6LDACw51

You can make a 1-page summary for each one you research using Cornell notes:

http://coe.jmu.edu/learningtoolbox/cornellnotes.html

You must choose this: Task 1: Development of the atomic model What were the major ideas about atoms that led to the current model of the atom? Who were the Scientists involved? How was new information found? How were new information and ideas shared and reviewed?

Choose at least one from the rest of the list:

Task 2: Why is copper sulphate blue?

Copper compounds like many of the transition metal compounds have got vivid and distinctive colours – but why?

Task 3: Aspirin

What was the history of the discovery of aspirin, how do we manufacture aspirin in a modern chemical process?

Task 4: The hole in the ozone layer

Why did we get a hole in the ozone layer? What chemicals were responsible for it? Why were we producing so many of these chemicals? What is the chemistry behind the ozone destruction?

Task 5: ITO and the future of touch screen devices

ITO – indium tin oxide is the main component of touch screen in phones and tablets. The element indium is a rare element and we are rapidly running out of it. Chemists are desperately trying to find a more readily available replacement for it. What advances have chemists made in finding a replacement for it?

Task 6: The chemistry of fireworks

What are the component parts of fireworks? What chemical compounds cause fireworks to explode? What chemical compounds are responsible for the colour of fireworks?

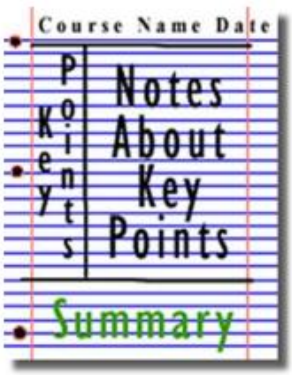


Figure 1: http://coe.jmu.edu/learningtoolbox/images/noteb4.gif

Part 4 – Minimising risk

Part of being a good scientist is staying safe! Some of the chemicals you will use in your Chemistry course can be dangerous if handled carelessly, or mixed incorrectly.

The Consortium of Local Education Authorities for the Provision of Science Services (CLEAPPS) provide information for practical science to schools in many forms, including Student Safety Sheets. Click here to download a copy https://www.yumpu.com/en/document/read/22294738/student-safety-sheets-cleapss

You will use these sheets to find information about the chemicals and methods you will use during your A level study. Before completing any practical work in lessons, either you, your teacher or the Science Technicians, will complete a risk assessment. This identifies the possible dangers and identifies ways to minimise the dangers to an acceptable, safe level.

- Each chemical has its own entry in the risk assessment, which includes the concentration (where known) and the appropriate response for this concentration.
- The methods used (eg, heating, use of glassware, putting gases under pressure) have their own entry in the risk assessment.
- The disposal of the chemicals and contaminated equipment is noted.

How to use the student safety sheets:
In this example I shall use silver nitrate, this is used to test for aldehydes in Tollen's reagent and to test for halogenoalkanes.

1. Use the contents page to find the chemical

Student safety sheets

Contents (2nd edition, 2018)

2. Silver compounds are on sheet 46.

CLEAPSS

Student safety sheets **46**

Silver and its compounds

including **Silver bromide, chloride, iodide, nitrate(V)** *and* **oxide**

Substance	Hazard	Comment
Silver (metal) Solid	LOW HAZARD	It is used in jewellery. It is an approved food additive, E174.
Silver halides, ie, **silver bromide, chloride and iodide** Solids	LOW HAZARD	Widely used in photographic emulsions. They are decomposed by light to give silver metal and the halogen (which then reacts with other substances in the emulsion).
Silver nitrate(V) Solid and fairly-concentrated solutions *(if 0.3 M or more)*	OXIDISER CORROSIVE ENVIRONMENTAL HAZARD	DANGER: oxidiser; causes severe skin burns and eye damage; very toxic to aquatic life. If swallowed, it may cause internal damage due to absorption into the blood, followed by deposition of silver in various tissues. The solid explodes dangerously with magnesium powder and a drop of water. Accidents have caused many injuries and a very careful risk assessment is required before attempting this.
Silver nitrate(V) Dilute solutions *(if less than 0.3 M but 0.18 M or more)*	CORROSIVE	DANGER: causes severe eye damage; irritating to skin. It may produce black stains on the skin, which, however, wear off in a few days.
Silver nitrate(V) Very dilute solutions *(if less than 0.18 but 0.06 M or more).*	IRRITANT	WARNING: irritating to eyes and skin. Very dilute solutions are adequate for most school work when testing for halides in solution.
Silver nitrate(V) Extremely dilute solutions *(if less than 0.06 M)*	LOW HAZARD	
Silver nitrate(V) (ammoniacal) ie, in ammonia solution *(Tollen's Reagent)*	EXPLOSIVE IRRITANT	It is used for aldehyde tests and should be prepared **only on a test-tube scale**, when needed, and discarded into plenty of water within ½ hour, otherwise explosives may form. Failure to do this has caused accidents.
Silver oxide Solid	LOW HAZARD	It is used in some batteries, eg, button cells for watches and calculators.

Typical control measures to reduce risk

- Use the lowest possible concentration; wear eye protection.
- Avoid keeping solutions of silver compounds and ammonia for more than a few minutes.
- Avoid handling solid silver nitrate.

Assessing the risks

- ***What are the details of the activity to be undertaken? What are the hazards?***
- ***What is the chance of something going wrong?***
  Eg, Silver nitrate accidentally coming into contact with the skin.
- ***How serious would it be if something did go wrong?***
  Eg, Are there hazardous reaction products, eg, from solutions of silver compounds with ammonia?
- ***How can the risk(s) be controlled for this activity?***
  Eg, can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?

Emergency action

- **In the eye** — Flood the eye with gently-running tap water for at least 10 minutes. Consult a medic.
- **Swallowed** — Do no more than wash out the mouth with water. Do **not** induce vomiting. Consult a medic.
- **Spilt on the skin or clothing** — Remove contaminated clothing and rinse it. Wash off the skin with plenty of water. If the silver nitrate produces more than small burns, consult a medic.
- **Spilt on floor, bench, etc** — Wear eye protection and gloves. Scoop up the solid. Rinse the area with water and wipe up, rinsing repeatedly. Rinse the mop or cloth thoroughly.

3. Sheet 46 has several silver compounds, we are looking for silver nitrate.
4. The method specified 0.1M concentration, choose the most appropriate information.

[cut off] Solids		
Silver nitrate(V) Solid and fairly-concentrated solutions *(If 0.3 M or more)*	OXIDISER CORROSIVE ENVIRONMENTAL HAZARD	DANGER: oxidiser; causes severe skin burns and eye damage; very toxic to aquatic life. If swallowed, it may cause internal damage due to absorption into the blood, followed by deposition of silver in various tissues. The solid explodes dangerously with magnesium powder and a drop of water. Accidents have caused many injuries and a very careful risk assessment is required before attempting this.
Silver nitrate(V) Dilute solutions (*if less than 0.3 M but 0.18 M or more)*	CORROSIVE	DANGER: causes severe eye damage; irritating to skin. It may produce black stains on the skin, which, however, wear off in a few days.
Silver nitrate(V) Very dilute solutions *(if less than 0.18 but 0.06 M or more).*	IRRITANT	WARNING: irritating to eyes and skin. Very dilute solutions are adequate for most school work when testing for halides in solution.
Silver nitrate(V) Extremely dilute solutions *(if less than 0.06 M)*	LOW HAZARD	
Silver nitrate(V) (ammoniacal) ie, in ammonia solution *(Tollen's Reagent)*	EXPLOSIVE IRRITANT	It is used for aldehyde tests and should be prepared **only on a test-tube scale**, when needed, and discarded into plenty of water within ½ hour, otherwise explosives may form. Failure to do this has caused accidents.
Silver oxide Solid	LOW HAZARD	It is used in some batteries, eg, button cells for watches and calculators.

Typical control measures to reduce risk

5. Take notice of the disposal information and emergency procedures. You should never need to use the emergency procedures because writing the risk assessment makes you aware of the risks, so therefore careful to avoid them!

Solid | LOW HAZARD | calculators.

Typical control measures to reduce risk

- Use the lowest possible concentration; wear eye protection.
- Avoid keeping solutions of silver compounds and ammonia for more than a few minutes.
- Avoid handling solid silver nitrate.

Assessing the risks

- ***What are the details of the activity to be undertaken? What are the hazards?***
- ***What is the chance of something going wrong?***
  Eg, Silver nitrate accidentally coming into contact with the skin.
- ***How serious would it be if something did go wrong?***
  Eg, Are there hazardous reaction products, eg, from solutions of silver compounds with ammonia?
- ***How can the risk(s) be controlled for this activity?***
  Eg, can it be done safely? Does the procedure need to be altered? Should goggles or safety spectacles be worn?

Emergency action

- **In the eye** — Flood the eye with gently-running tap water for at least 10 minutes. Consult a medic.
- **Swallowed** — Do no more than wash out the mouth with water. Do **not** induce vomiting. Consult a medic.
- **Spilt on the skin or clothing** — Remove contaminated clothing and rinse it. Wash off the skin with plenty of water. If the silver nitrate produces more than small burns, consult a medic.
- **Spilt on floor, bench, etc** — Wear eye protection and gloves. Scoop up the solid. Rinse the area with water and wipe up, rinsing repeatedly. Rinse the mop or cloth thoroughly.

6. Complete the Risk Assessment table with information from the sheets

A level Chemistry Risk assessment

<table>
<tr><td colspan="4">Title of practical:</td><td>Date:</td></tr>
<tr><td colspan="5">Outline of procedures:</td></tr>
<tr><td>Hazardous substance / procedure</td><td>Nature of hazard</td><td>Control measures (precautions)</td><td>Emergency action</td><td>Information sources (full url with date of access or, book title, author, publisher, date of publish and page number)</td></tr>
<tr><td>Silver nitrate solution (0.1M)</td><td>Irritant to eyes and skin</td><td>Wear safety glasses. Use only in test tube quantities. Discard of solutions within a few minutes.</td><td>In eye: Flood with gently running water for min 10 minutes. Get medical attention. In mouth: rinse only, do not induce vomiting. Get medical attention. On skin: wash skin. Seek medical attention if burns. Spilt: wipe and rinse cloth thoroughly.</td><td>CLEAPSS Student safety sheets, 2nd edition, 2018. Sheet 46.</td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Disposal of residues:</td><td></td><td>Carried out by:
checked by:
Date:</td></tr>
</table>

Submit your response to this task.

Complete the blank risk assessment on p19 with the chemicals required for the Qualitative Tests for Anions on page 12 of this booklet.

A level Chemistry Risk assessment

Title of practical:				Date:
Outline of procedures:				
Hazardous substance / procedure	Nature of hazard	Control measures (precautions)	Emergency action	Information sources (full url with date of access or, book title, author, publisher, date of publish and page number)
Disposal of residues:				Carried out by: checked by: Date: