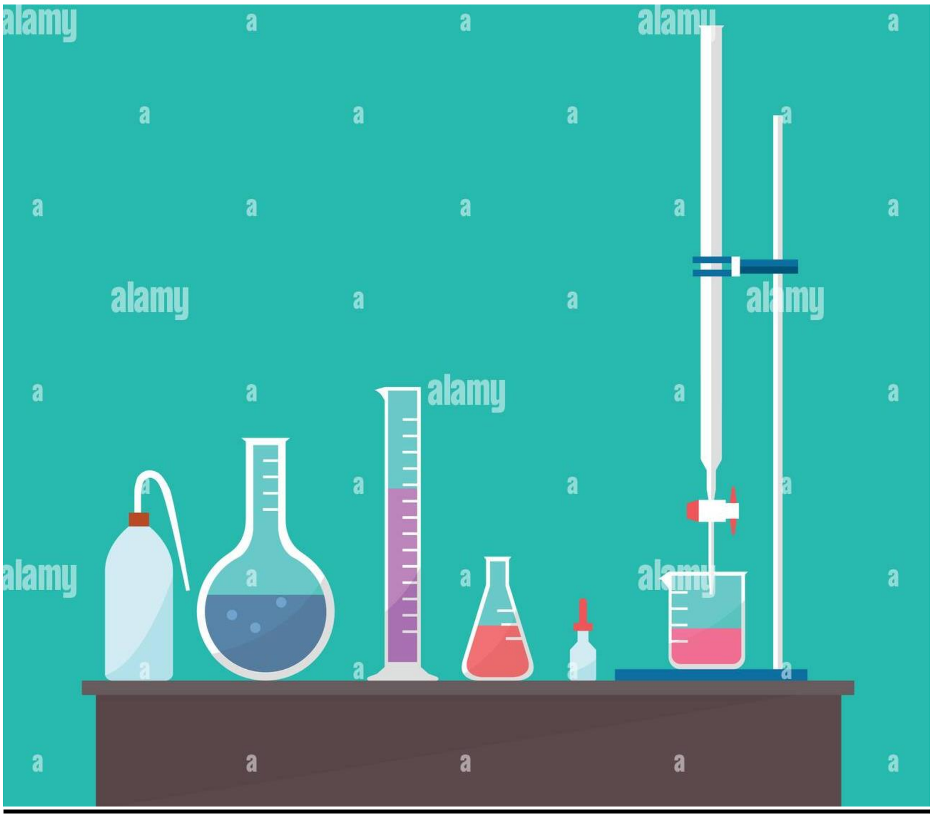
Name: ....

Yr 11 to Yr 12 Transition



MnO_4^- (aq) + $5e^-$ + $8H^+$ (aq) → Mn^{2+} (aq) + $4H_2O$ (l)

Fe^{2+} (aq) → Fe^{3+} (aq) + e^-

A Level Chemistry
2023/24

Course Overview: **Exam Board:** Edexcel

This GCE Advanced Level (A Level) qualification will take two years and is assessed by 3 exams at the end of the course:

1. Advanced Inorganic and Physical Chemistry (30% of the qualification)
2. Advanced Organic and Physical Chemistry (30% of the qualification)
3. General and Practical Principles in Chemistry (40% of the qualification)

There is also a Practical Endorsement which will assess pupils across a minimum of 12 Core Practicals on a 'Pass or Fail' basis. This will appear as a separate result on Award Certificates.

Note: a minimum of 20% of the marks on each of the 3 papers is awarded for mathematics at GCSE level or above.

Course Delivery:

The course will be delivered as 4 x 1 hour sessions per week. This will include:

- 2 Hours of Inorganic and Physical Teaching/ Organic and Physical Teaching
- 1 Hour of Practical Work
- 1 Hour of Exam-question based Workshop

In addition to this contact time, students are expected to complete 5-6 hours per week of directed independent study, this includes:

- Flipped learning – pre-reading and online test prior to lessons
- Preparation for Practical (researching equipment and techniques)
- Practical discussion questions to check understanding
- Exam-style questions
- Independent Revision

Assessment of Prior Knowledge:

Students will sit a 1 hour Chemistry Paper at GCSE Level during their first lesson in September. This will ensure that students have the necessary foundation of knowledge to complete the course.

It is expected that students revise for this test as Summer Work, and should focus on the following areas:

i. Structure of the atom and isotopes
ii. The periodic table
iii. Intramolecular bonding (ionic, covalent and metallic)
iv. Empirical formulae
v. Calculation using moles
vi. Alkanes and alkenes
vii. Functional groups and homologous series
viii. Bond energy
ix. Rate of reaction
x. Dynamic equilibrium
xi. Atom economy
xii. Titration

Practical: How much iron is there in dried thyme?

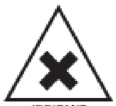
Introduction

Thyme contains a surprising amount of iron compounds. This experiment enables you to determine the amount of iron(II) present in dried thyme by means of a redox titration.

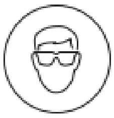
Requirements

- balance (weighing to 2 or 3 d.p.)
- 250 cm^3 glass beaker
- 250 cm^3 plastic beaker
- 100 cm^3 measuring cylinder
- Bunsen burner, tripod and gauze
- Buchner funnel and vacuum filtration apparatus
- 250 cm^3 volumetric flask
- funnel
- 25 cm^3 pipette and pipette filler
- 250 cm^3 conical flask
- burette and stand
- dried thyme (1 g)
- potassium manganate(VII) solution, 0.005 mol dm^{-3} (150 cm^3)
- sulfuric(VI) acid, 1.0 mol dm^{-3} (400 cm^3)
- protective gloves

sulfuric(VI) acid



CARE Eye protection must be worn.



CARE Take care when pouring potassium manganate(VII) solution as it stains the hands. Wear protective gloves if necessary.

What you do

1. Weigh accurately about 1 g of dried thyme and place it in a 250 cm^3 beaker. Record the mass of thyme used.
2. Using a measuring cylinder, add 50 cm^3 of 1.0 mol dm^{-3} sulfuric(VI) acid and boil gently for 5 minutes.
3. Allow the mixture to cool for a few minutes then filter it, using either gravity or vacuum filtration. Wash the residue in the funnel once with a little sulfuric acid and collect all the filtrate.
4. Pour all the filtrate and washings into a 250 cm^3 volumetric flask. Make up to 250 cm^3 with 1.0 mol dm^{-3} sulfuric(VI) acid. Stopper the flask and invert several times to thoroughly mix the solution.
5. Fill the burette with 0.005 mol dm^{-3} potassium manganate(VII) solution.
6. Pour some of your thyme extract solution into a 250 cm^3 plastic beaker. Using a pipette, transfer 25.0 cm^3 of the extract into a 250 cm^3 conical flask.
7. Using a measuring cylinder, add 50 cm^3 of 1.0 mol dm^{-3} sulfuric(VI) acid to the thyme extract in the conical flask.
8. Titrate the solution in the conical flask with the potassium manganate(VII) solution until a pale pink colour persists for 10 seconds.
9. Repeat the titration until there are two titres within 0.1 cm^3 of each other. Record your results in a suitable table.

Using your results

During the titration, iron(II) ions are oxidised to iron(III) ions and manganate(VII) ions are reduced to manganese(II) ions. The half-equations for these reactions are:

$$Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$$

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$$

These equations can be combined to give an overall equation for the reaction. This shows that one mole of manganate(VII) ions reacts with 5 moles of iron(II) ions in acid solution.

$$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$$

10 Use your average titre to work out the number of moles of potassium manganate(VII) used.

11 Calculate how many moles of iron(II) ions were present in 25 cm^3 of your thyme extract.

12 Work out the total number of moles of iron(II) ions in 250 cm^3 of thyme extract.

13 Calculate the mass of iron in 250 cm^3 of the thyme extract. This must be the mass of iron in the sample of dried thyme that you weighed out.

14 Convert the mass of iron in your thyme to mg of iron per 100 g of thyme.

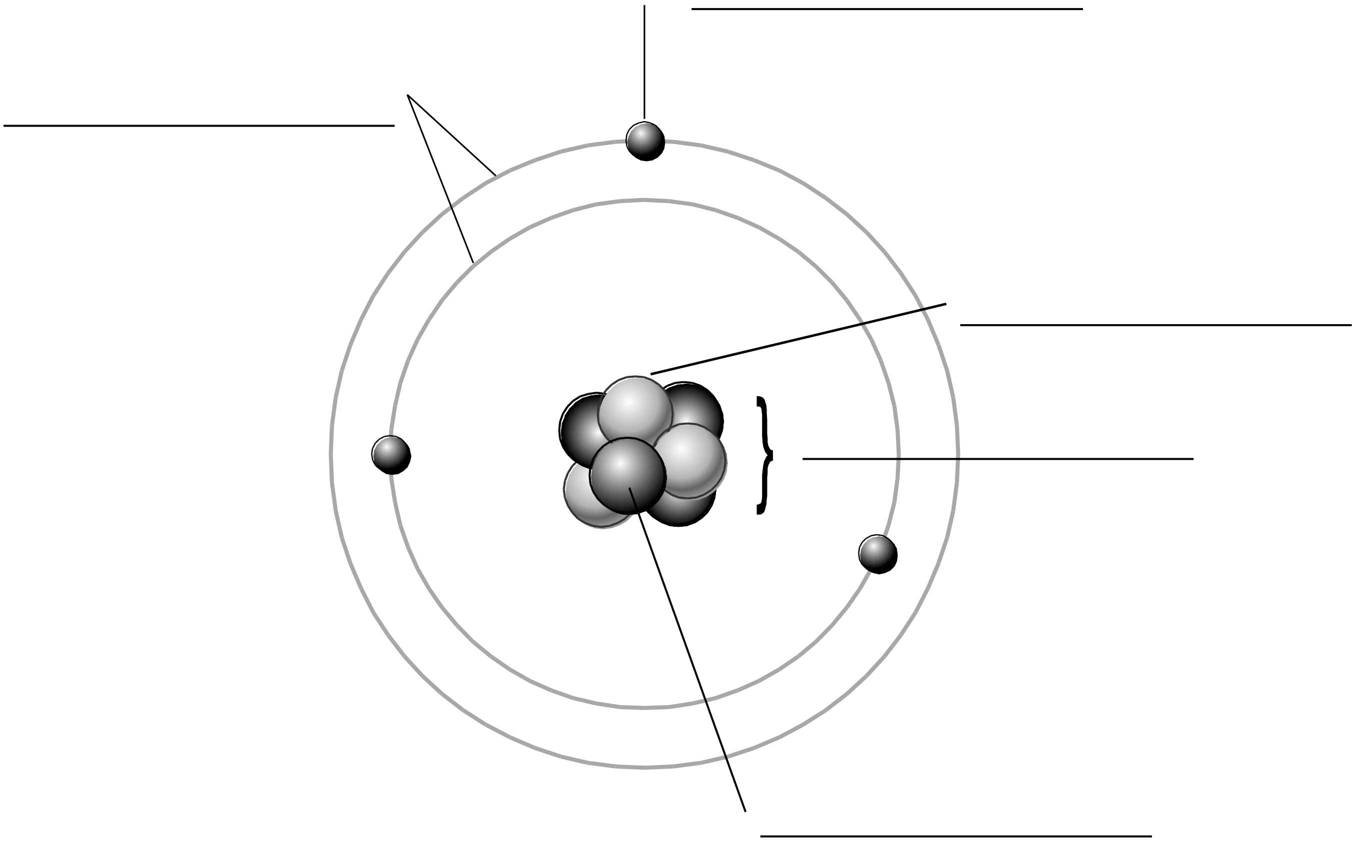
Questions

1. Calculate the percentage uncertainties associated with the pipette, the volumetric flask, the mass of thyme that you weighed out and your average titre.
2. How could the method be modified to decrease the percentage uncertainties associated with the measurements that you made?
3. Which steps of the titration procedure are important in ensuring that the result that you get is as accurate as possible?

Space for Notes/ Calculations:

Transition Work:

1. Complete the diagram below:



2. Complete the table below:

Subatomic particle	Relative charge	Relative mass
	+1	1
neutron		
electron		

3. Write the equation that links moles, mass and relative atomic mass

4. Write the equation that link moles, concentration and volume

5. Define Rate of Reaction

6. Define Exothermic

7. Define Endothermic

8. Describe how concentration affects the rate of reaction

9. Describe how temperature affects the rate of reaction

10. Describe how temperature affects the rate of reaction

Preparing for your A-Level Topics

Topic 1 – Electronic structure, how electrons are arranged around the nucleus

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the atom. You will have used the rule of electrons shell filling, where:

The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).

So, for Lithium…

$$^{7}_{3}Li$$

Atomic number =3, electrons = 3, arrangement 2 in the first shell and 1 in the second or

Li = 2,1

At A level you will learn that the electron structure is more complex than this and can be used to explain a lot of the chemical properties of elements.

The 'shells' can be broken down into 'orbitals', which are given letters: 's' orbitals, 'p' orbitals and 'd' orbitals.

You can read about orbitals here:
http://www.chemguide.co.uk/atoms/properties/atomorbs.html#top

Now that you are familiar with s, p and d orbitals try these problems, write your answer in the format:

1s2, 2s2, 2p6 etc.

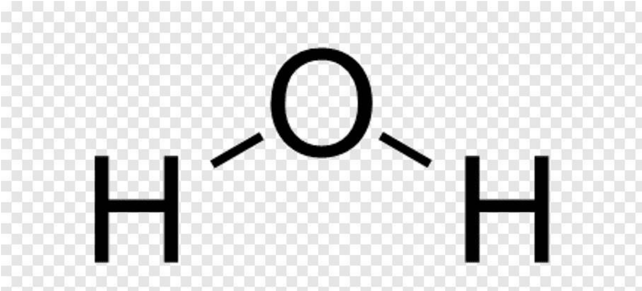
Q1.1 Write out the electron configuration of:

a) Ca b) Al c) S d) Cl e) Ar f) Fe g) V h) Ni i) Cu j) Zn k) As

Q1.2 Extension question, can you write out the electron arrangement of the following ions: a) K^{+} b) O^{2-} c) Zn^{2+} d) V^{5+} e) Co^{2+}

Topic 2 – The shapes of molecules and bonding.

Have you ever wondered why your teacher drew a water molecule like this?



The lines represent a covalent bond, but why draw them at an unusual angle? If you are unsure about covalent bonding, read about it here: http://www.chemguide.co.uk/atoms/bonding/covalent.html#top

At A level you are also expected to know how molecules have certain shapes and why they are the shape they are. You can read about shapes of molecules here: http://www.chemguide.co.uk/atoms/bonding/shapes.html#top

Q2.1 Draw a dot and cross diagram to show the bonding in a molecule of aluminium chloride ($AlCl_3$)

Q2.2 Draw a dot and cross diagram to show the bonding in a molecule of ammonia (NH_3) Q2.3 What is the shape and the bond angles in a molecule of methane (CH_4)?

Topic 3 – Chemical equations

Balancing chemical equations is the stepping stone to using equations to calculate masses in chemistry.

There are loads of websites that give ways of balancing equations and lots of exercises in balancing. Some of the equations to balance may involve strange chemicasl, don't worry about that, the key idea is to get balancing right.

http://www.sciencegeek.net/Chemistry/taters/EquationBalancing.htm

Topic 4 – Organic chemistry – Functional groups

At GCSE you would have come across hydrocarbons such as alkanes (ethane etc) and alkenes (ethene etc). You may have come across molecules such as alcohols and carboxylic acids. At A level you will learn about a wide range of molecules that have had atoms added to the carbon chain. These are called functional groups; they give the molecule certain physical and chemical properties that can make them incredibly useful to us.

Here you are going to meet a selection of the functional groups, learn a little about their properties and how we give them logical names. You will find a menu for organic compounds here:

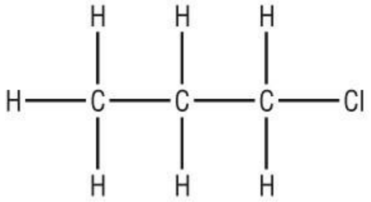
http://www.chemguide.co.uk/orgpropsmenu.html#top And how to

name organic compounds here:

www.chemguide.co.uk/basicorg/conventions/names.html#top

Using the two links see if you can answer the following questions: Q4.1

Halogenoalkanes What is the name of this halogenoalkane?



Q4.2 How could you make ethanol from ethene?

Q4.3 Draw the structures of a) propanal b) propanone. How are these two functional groups different?

Answers:

Mark your work using green pen.

Topic 1:

Q1.1a) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6 4s^2$ b) $1s^2\ 2s^2\ 2p^6 3s^2 3p^1$ c) $1s^2\ 2s^2\ 2p^6 3s^2 3p^4$ d) $1s^2\ 2s^2\ 2p^6 3s^2 3p^5$

e) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6$ f) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 3d^6 4s^2$ g) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 3d^3 4s^2$

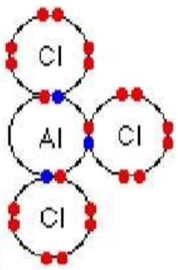
h) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 3d^8 4s^2$ i) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 3d^{10}\ 4s^1$ j) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 3d^{10}\ 4s^2$

k) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 4s^2\ 3d^{10}\ 4p^3$

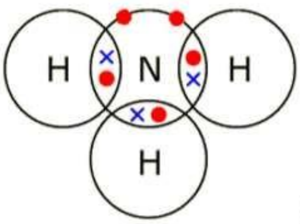
Q1.2a) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6$ b) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6$ c) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 3d^{10}$

d) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6$ e) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6\ 3d^7$

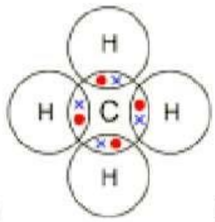
Topic 2:

a) 

120°

b) 

107°

c) 

109.5°

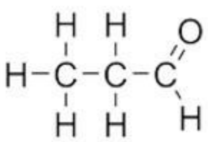
Topic 4:

Q4.1 1-chlorobutane

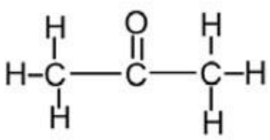
Q4.2 react ethene with water vapour at high temperature and pressure with a phosphoric acid catalyst

Q4.3

propanal



propanone

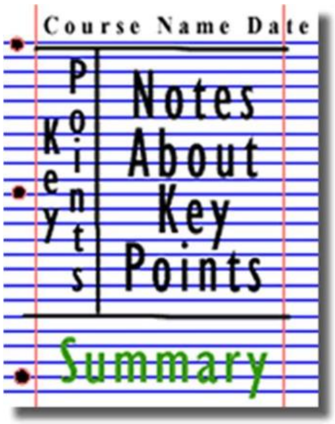


The carbon atom joined to oxygen in propanal has a hydrogen attached to it, it does not in propanone.

Optional Extra – Independent Research

Research activities

Use your online searching abilities to find out as much about the topic below as you can. Remember if you are a prospective A level chemist; you should aim to push your knowledge. Make a 1-page summary for each one you research using Cornell notes:
http://coe.jmu.edu/learningtoolbox/cornellnotes.html



Task 1: 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?

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?

Practice Exam – Style Questions:

Q1.

This question is about sodium sulfide.

(a) Complete the electronic configuration of sulfur.

(1)

$1s^2\ 2s^2$

(b) Sulfur reacts with sodium to form the compound sodium sulfide, Na_2S.

(i) Draw a dot-and-cross diagram for sodium sulfide ; only the outer electrons need be shown. Include the charges present.

(2)

(ii) Which statement about the electrical conductivity of sodium sulfide is correct?

(1)

☐ **A** it conducts when solid and liquid

☐ **B** it conducts when solid but not when liquid

☐ **C** it conducts when liquid but not when solid

☐ **D** it does not conduct when solid or liquid

(iii) The melting temperature of sodium sulfide is higher than that of sodium chloride, even though both contain ionic bonding.
Explain this difference in melting temperature.

(2)

....

....

....

....

....

....

....

Q2.

Which of the following species contains the same number of electrons as neutrons?

☒ **A** $^{11}_{5}B$

☒ **B** $^{23}_{11}Na^{+}$

☒ **C** $^{24}_{12}Mg^{2+}$

☒ **D** $^{19}_{9}F^{-}$

(Total for question = 1 mark)

Q3.

Sodium and chlorine react together to produce sodium chloride. The bonding in the product is different from that in both of the reactants. Evidence for the type of bonding present can be obtained in a number of different ways.

Sodium chloride is ionically bonded. What is meant by the term **ionic bond**?

(1)

....

....

....

Q4. A particle with a **single** positive charge and with the electronic configuration $1s^2\ 2s^2\ 2p^6$ is

☒ **A** a sodium ion.

☒ **B** a fluoride ion.

☒ **C** an oxide ion.

☒ **D** a potassium ion.

(Total for question = 1 mark)

Q5. Which one of the following elements undergoes the change in electronic configuration shown when it forms the stated ion?

Atom $1s^2 2s^2 2p^6 3s^2 3p^3$ Ion $1s^2 2s^2 2p^6 3s^2 3p^6$

☒ **A** B to B^{3+}

☒ **B** Al to Al^{3+}

☒ **C** N to N^{3-}

☒ **D** P to P^{3-}

(Total for question = 1 mark)