QEHS Chemistry
A Level Transition Pack

All A levels are a step up from GCSE, chemistry is typical of this. This transition pack contains:

(i) opportunities to practice some of the harder content from GCSE to help you bridge the gap to A level, so the start of year 12 is more in your comfort zone and
(ii) tasks to help combined students cover material triple students have covered
(iii) things that are just enjoyable !

We do not expect you to complete everything enclosed here as the things you need to practice will depend on your strengths. I would however advise you to dip into everything. Some of the questions on the test cannot be done without you having completed certain sections. Answers are at the back. The test is the compulsory submission for the Transition Work.

Contents

A Level Periodic Table

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	18
1 H hydrogen 1.0	2											13	14	15	16	17	2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89–103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium		114 Fl flerovium		116 Lv livermorium		

Key
atomic number
Symbol
name
relative atomic mass

57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium 144.9	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.2	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.0	71 Lu lutetium 175.0
89 Ac actinium	90 Th thorium 232.0	91 Pa protactinium	92 U uranium 238.1	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

Videos

Rough science – the Open University – 34 episodes available

Real scientists are 'stranded' on an island and are given scientific problems to solve using only what they can find on the island.

Great fun if you like to see how science is used in solving problems. There are six series in total.

LINK

A thread of quicksilver – The Open University

A brilliant history of the most mysterious of elements – mercury.

This program shows you how a single substance led to empires and war, as well as showing you come of the cooler properties of mercury.

LINK

The most AMAZING chemical Reactions

Good demonstration of reactions

LINK

NileRed/NileBlue YouTube

Lots of very interesting chemistry concepts that stretch from A Level to University-level chemistry.

Definitely a do-not-try-at-home style but very interesting!

LINK

LINK

Seneca

Join the A Level Transition class on Seneca
LINK

Assignment 1

The first assignment is a GCSE misconceptions one. During your own learning and revision for the exams, it's really common for misconceptions to creep in! This will go through most of the really common ones, and why they're not quite right!

LINK

Assignment 2

Love them or hate them, calculations form a really important part of A Level Chemistry. This assignment is a refresher on all of the different calculations that you need to be able to do for GCSE/A Level transition

LINK

Balancing Equations

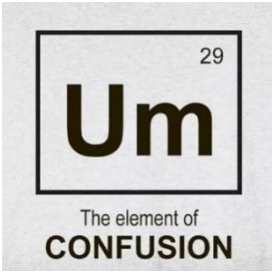
Balancing chemical equations is the stepping stone to using equations to calculate masses in chemistry.

Some of the equations to balance may involve a strange chemical, don't worry about that, the key idea is to get balancing right

Here's a simulation to help with balancing if you find it hard: LINK

Balance the following equations:

1. .....C + ...O_2 ⟶ .....CO
2. .....Ba + ...H_2O ⟶ .....$Ba(OH)_2$ + ...H_2
3. .....C_2H_6 + ...O_2 ⟶ .....CO_2 + ...H_2O
4. .....HCl + ...$Mg(OH)_2$ ⟶ .....$MgCl_2$ + H_2O
5. .....N_2 + ...O_2 ⟶ .....NO
6. .....Fe_2O_3 + ...C ⟶ .....Fe + ...CO_2
7. .....CH_3CH_2OH + ...[O] ⟶ .....CH_3COOH + ...H_2O
8. .....HNO_3 + ...CuO ⟶ .....$Cu(NO_3)_2$ + H_2O
9. .....Al^{3+} + ...e^- ⟶ .....Al
10. .....$[Fe(H_2O)_6]^{3+}$ + ...CO_3^{2-} ⟶ .....$Fe(OH)_3(H_2O)_3$ + ...CO_2 + ...H_2O



Moles

From this point on you need to be using an A level periodic table which is at the beginning of this booklet.

Now that we have our chemical equations balanced, we need to be able to use them in order to work out masses of chemicals we need or we can produce.

The ***mole*** is the chemists equivalent of a dozen – it is just a word that represents a *number*. Atoms are so small that we cannot count them out individually, we weigh out chemicals and use moles to convert this weight to a number of particles.

For example: magnesium + sulphur → magnesium sulphide

Mg + S → MgS

We can see that one atom of magnesium will react with one atom of sulphur, 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 32.1g of sulphur then I would have 1 mole of sulphur atoms.

So 24.3g of Mg will react precisely with 32.1g of sulphur, and will make 56.4g of magnesium sulphide.

At this website you will find some videos and activities: LINK

Questions

a) How many moles of water are in 50g?

b) How many moles of potassium are in 100g of potassium choride?

c) How many moles of water are in 300g of hydrated magnesium sulphate(VI) ($MgSO_4.7H_2O$)? The dot followed by $7H_2O$ means that the molecule comes with 7 water molecules so these have to be counted in as part of the molecules mass.

d) What mass is 0.28 moles of ethanol (CH_3CH_2OH)?

e) If I have 2.4g of magnesium, how many g of oxygen(O_2) will I need to react completely with the magnesium?

$2Mg + O_2 \rightarrow MgO$

Solutions and Concentrations

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

LINK

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 $1.9dm^3$ of water, what is the molarity of the new solution?

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

e) 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?

Titrations

One of the early key principles you will review is the titration and the associated calculation.

LINK

Remember for any titration calculation you need to have a balanced symbol equation; this will tell you the ratio in which the chemicals react.

E.g. a titration of an unknown sample of sulphuric acid with sodium hydroxide.
A $25.00cm^3$ sample of the unknown sulphuric acid was titrated with 0.100moldm^{-3} sodium hydroxide and required exactly $27.40cm^3$ for neutralisation. What is the concentration of the sulphuric acid?

Step 1: the equation $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

Step 2; the ratios 2 : 1

Step 3: how many moles of sodium hydroxide $27.40cm^3 = 0.0274dm^3$
number of moles = c x v = 0.100 x 0.0274 = 0.00274 moles

step 4: Using the ratio, how many moles of sulphuric acid for every 2 NaOH there are 1 H_2SO_4 so, we must have 0.00274/2 =0.00137 moles of H_2SO_4

Step 5: Calculate concentration. conc = moles/volume ←in dm^3 = 0.00137/0.025 = ***0.0548 moldm^{-3}***

Here are some additional problems, which are harder. There is a link to the BBC Bitesize website to give you a refresher on the method.

LINK

Q1 A solution of sodium hydroxide contained 0.250 mol dm^{-3}.
Using phenolphthalein indicator, titration of 25.0 cm^3 of this solution required 22.5 cm^3 of a hydrochloric acid solution for complete neutralisation.

(a) write the equation for the titration reaction.
(b) what apparatus would you use to measure out (i) the sodium hydroxide solution? (ii) the hydrochloric acid solution?
(c) what would you rinse your apparatus out with before doing the titration ?
(d) what is the indicator colour change at the end-point?
(e) calculate the moles of sodium hydroxide neutralised.
(f) calculate the moles of hydrochloric acid neutralised.
(g) calculate the concentration of the hydrochloric acid in mol/dm^3 (molarity).

Q2 A solution made from pure barium hydroxide contained 2.74 g in exactly 100 cm^3 of water.
Using phenolphthalein indicator, titration of 20.0 cm^3 of this solution required 18.7 cm^3 of a hydrochloric acid solution for complete neutralisation. [atomic masses: Ba = 137, O = 16, H = 1)

(a) write the equation for the titration reaction.
(b) calculate the molarity of the barium hydroxide solution.
(c) calculate the moles of barium hydroxide neutralised.
(d) calculate the moles of hydrochloric acid neutralised.
(e) calculate the molarity of the hydrochloric acid.

Q3 4.90g of pure sulphuric acid was dissolved in water, the resulting total volume was 200 cm^3.
20.7 cm^3 of this solution was found on titration, to completely neutralise 10.0 cm^3 of a sodium hydroxide solution. [atomic masses: S = 32, O = 16, H = 1)

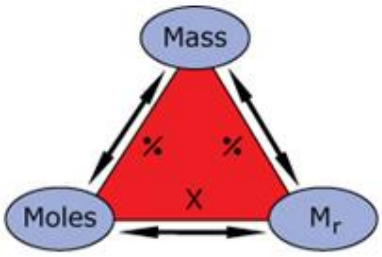
(a) write the equation for the titration reaction.
(b) calculate the molarity of the sulphuric acid solution.
(c) calculate the moles of sulphuric acid neutralised.
(d) calculate the moles of sodium hydroxide neutralised.
(e) calculate the concentration of the sodium hydroxide in mol dm^{-3} (molarity).

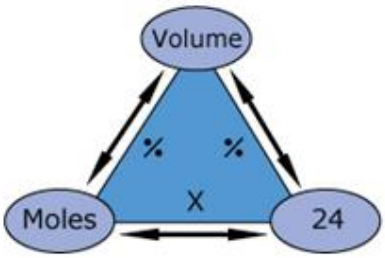
Q4 100 cm^3 of a magnesium hydroxide solution required 4.5 cm^3 of sulphuric acid (of concentration 0.100 mol dm^{-3}) for complete neutralisation. [atomic masses: Mg = 24.3, O = 16, H = 1)

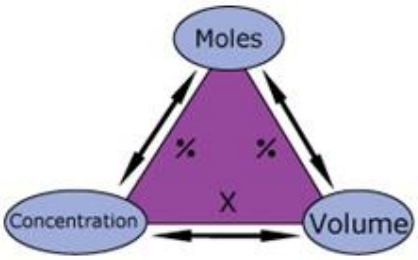
(a) give the equation for the neutralisation reaction.
(b) calculate the moles of sulphuric acid neutralised.
(c) calculate the moles of magnesium hydroxide neutralised.
(d) calculate the concentration of the magnesium hydroxide in mol dm^{-3} (molarity).
(e) calculate the concentration of the magnesium hydroxide in g cm^{-3}.

Calculations

Remember these formula triangles – including the volume one in the middle 24 dm^3 = 1 mole of any gas!







1. Use this formula to calculate the mass of each of the following

   (a) 2.50 mol of hydrogen, H_2.

   (b) 0.500 mol of sodium chloride, NaCl.

2. Use this formula to calculate the amount (in mol) of each substance listed below....

   a) 31.0 g of phosphorus molecules, P_4

   b) 50.0 g of calcium carbonate, $CaCO_3$.

3. Use this formula to calculate the molar mass of an 11g gas sample of compound X, which is 0.25mol.

   Molar mass: _____ $gmol^{-1}$

   Possible identity of the gas sample X: _____

4. Use this formula to calculate the amount of gas (in mol) of....

   (a) 3600cm^3 of hydrogen gas, H_2

   Amount of H_2 gas: _____ mol

   (b) 4dm^3 of hydrogen gas, CO_2

   mount of CO_2 gas: _____ mol

5. Use this formula to calculate the volume of gas....

   (a) 6 mol of hydrogen gas, SO_2

   Volume of SO_2 gas: _____ dm^3

   (b) 0.25mol of oxygen gas, O_2

   Volume of CO_2 gas: _____ cm^3

6. Use this formula to calculate the volume produced in the following solutions....

   (a) a solution with a concentration of 2 $moldm^{-3}$ that contains 2 moles of solute.

   Volume of solution: _____ dm^3

(b) a solution with a concentration of 0.25 moldm^{-3} that contains 0.005 moles of solute.

Volume of solution: _____ dm^3

7. Use this formula to calculate the concentration (in moldm^{-3}) for the following solutions....

(a) 0.5 moles of solid dissolved in 250cm^3 of solution

Concentration: _____ moldm^{-3}

(b) 0.00875 moles of solid dissolved in 25cm^3 solution

Concentration: _____ moldm^{-3}

8. Find the mass concentration, in gdm^{-3}, for the following solutions:

(a) 0.0042 moles of HNO_3 dissolved in 250cm^{-3} of solution

Mass concentration: _____ gdm^{-3}

(b) 0.5 moles of HCl dissolved in 4dm^3 of solution

Mass concentration: _____ gdm^{-3}

9. The following reaction can take place, shown in this equation: $NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$

(a) Balance the equation shown above

(b) What volume of CO_2 is formed by the decomposition of 5.04g of $NaHCO_3$?

Volume of CO_2: _____ dm^3

10. The following reaction can take place, shown in this equation:

$$MgCO_{3(s)} + HNO_{3(aq)} \rightarrow Mg(NO_3)_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$

(a) Balance the equation shown above

(b) 2.529g of $MgCO_3$ reacts with an excess of HNO_3. What volume of CO_2 is formed?

(c) The final volume of the solution is 50.0cm^3. What is the concentration of $Mg(NO_3)_{2(aq)}$ formed?

11. The following reaction can take place, shown in this equation:

$$KOH + HCl \rightarrow KCl + H_2O$$

Calculate the concentration of the potassium hydroxide in moldm^{-3}. Use the following steps to help:

1. Number of moles in 20cm^3 of 0.200moldm^{-3} of hydrochloric acid
2. Number of moles of potassium hydroxide neutraLISED.
3. Average titre in cm^3 using titration 2, 3 and 4

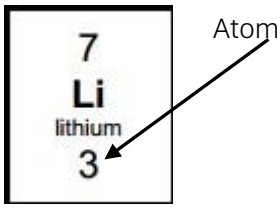
titration number	1	2	3	4
final burette reading in cm^3	26.9	27.6	27.0	28.2
initial burette reading in cm^3	0.5	2.5	2.0	3.3
titre (volume of alkali used) in cm^3	26.4	25.1	25.0	24.9

Electronic Structure

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).



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.

An electron SHELL is really and ENERGY LEVEL rather than a position in space. Electrons do not really orbit aa nucleus like planets round a solar system.

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

You can read about orbitals here: LINK

You will be taught this is in your first topic, Elements of Life. Please move on if you don't want to practice these. THIS IS NEW.

If you want to practice then now that you know electrons are in principle energy levels (1,2,3,4,5 etc) which are divided up into sublevels called orbitals labelled as s, p and d orbitals.

Try these problems, write your answer in the format: **$1s^2$, $2s^2$, $2p^6$** etc.

Questions

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

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+}

Oxidation and Reduction

At GCSE you know that oxidation is adding oxygen to an atom or molecule and that reduction is removing oxygen, or that oxidation is removing hydrogen and reduction is adding hydrogen. You may have also learned that oxidation is removing electrons and reduction is adding electrons.

At A level, we use a term OXIDATION NUMBER, which helps us understand when something has been oxidised or reduced. If the number gets smaller, then it is reduced; bigger and it is oxidised.

The OXIDATION NUMBER is the charge an element has if it was an ion!

You know that the metals in group 1 react to form ions that are +1, i.e. Na^+ and that group 7, the halogens, form -1 ions, i.e. Br^-.

We say that sodium, when it has reacted has an oxidation number of +1 and that bromide has an oxidation number of -1.

All atoms that are involved in a reaction can be given an oxidation number.

An element, Na or O_2 is always given an oxidation state of zero (0), any element that has reacted has an oxidation state of + or -.

As removing electrons is **reduction**, if, in a reaction the element becomes **more** negative it has been reduced, if it becomes more positive it has been oxidised.

You can read about the rules for assigning oxidation numbers here:
LINK

Elements that you expect to have a specific oxidation state actually have different states, so for example you would expect chlorine to be -1, it can have many oxidation states: NaClO, in this compound it has an oxidation state of +1

There are a few simple rules to remember:

- Metals have a + oxidation state when they react.
- Oxygen is 'king' it always has an oxidation state of -2 Hydrogen has an oxidation state of +1 (except metal hydrides)
- The charges in a molecule must cancel.

Examples: what is the oxidation number of Nitrogen in Sodium nitrate, $NaNO_3$?

	Na +1	3x O^{2-}	
Total charge	+1	-6	but overall $NaNO_3$ has no charge so +1 -6 +(N) = 0 so N must be +5
	N = +5		

What is the oxidation number of sulphur in a sulphate ion, SO_4^{2-}

4xO^{2-}	
-8	overall ionic charge is 2- so -9 + (S) = -2, so S must be +6
S = +6	

Questions

Work out the oxidation state of the **underlined** atom in the following:

a) Mg<u>C</u>O_3 b) <u>S</u>O_3 c) Na<u>Cl</u>O_3 d) <u>Mn</u>O_2 e) <u>Fe</u>$_2O_3$ f) <u>V</u>$_2O_5$

g) K<u>Mn</u>O_4 h) <u>Cr</u>$_2O_7^{2-}$ i) <u>Cl</u>$_2O_4$

Organic Chemistry

You know what molecules look like that are called alkanes, alkenes, alcohols, carboxylic acids and esters. These different molecules behave different due to the different FUNCTIONAL GROUPS in them.

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: LINK
And how to name organic compounds here: LINK

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

Questions

1) Draw a) heptane b) but-1-ene c) 2methylbutane
d) propanoic acid e) propyl ethanoate f) ethyl propaoate

2) What is made when propene reacts with Cl_2?

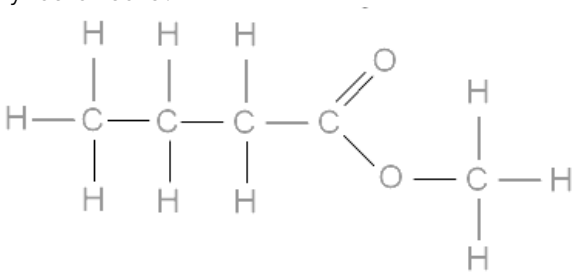
3) What two different molecules can be made when propene reacts with HCl?

4) Alcohols - How could you make ethanol from ethene?

5) How does ethanol react with sodium, in what ways is this
a) similar to the reaction with water, b) different to the reaction with water?

6) NEW MOLECULES - Aldehydes and ketones
Look up and draw the structures of
a) propanal b) propanone
How are these two functional groups different?

7) How would you go about making methyl butanoate?



Acids, Bases and pH

At GCSE you will know that an acid can dissolve in water to produce H^+ ions, at A level you will need a greater understanding of what an acid or a base is.

Read the following page on Theory of acids and bases: LINK

Read the following pages on Weak acids and bases: LINK

Questions

1) Write your own new definition of an acid and a base.

2) Show how sulphuric acid acts as an acid.

3) Show how ammonia acts as a base.

4) Explain the idea of strong and weak acids and why this is different to concentrated or dilute acids.

5) Explain why ethanoic acid is a weaker acid than HCl.

6) EXTRA – why is fluoroethanoic acid and stronger acid that ethanoic acid?

7) If a solution of acid which has a pH = 2 is diluted 1cm^3 into 100cm^3 volume, what is the new pH?

8) If the pH = 2 solution is diluted into 50cm^3, what is the pH (trickier?)

Research

Use your online searching abilities to see if you can find out as much about the topic as you can.

Remember you are a prospective A level student of chemistry so go one step beyond your understanding.

Try using Cornell Notes to make a 1-page summary for each one you research. Or a short presentation.

Task 1: The chemistry of fireworks (explosions for some reason are not in the specification!)

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 some plastic, like polyacetylene can conduct electricity

Organic materials are always insulators, aren't they? Have you thought why?

Task 3: Why is copper sulphate blue? (cover this in Developing Metals, Year 13)

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

Task 4: Aspirin (cover this in What's in a Medicine? Year 12)

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

Task 5: The hole in the ozone layer (cover this in Ozone, Year 12)

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 6: ITO and the future of touch screen devices (rare earth metals – we don't cover)

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?

Transition Work Submission

Test

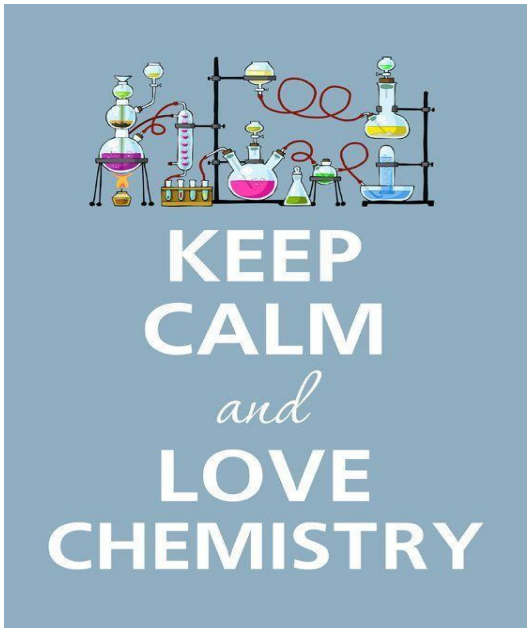
Please find below a link to a short transition work test. It is designed to be self-marked, but be sure to take your time as you will only have one attempt! The test should take you no more than 40 minutes.

LINK

GCSE to A level

transition booklet

Chemistry



Answers

Balance the following equations

1. …2..C + …1..O_2 ⟶ …2.CO

2. …1..Ba + …2..H_2O ⟶ …2..$Ba(OH)_2$ + …1..H_2

3. …2..C_2H_6 + …7..O_2 ⟶ …4..CO_2 + …6..H_2O

4. …2..HCl + …1..$Mg(OH)_2$ ⟶ …1..$MgCl_2$ + H_2O

5. …1..N_2 + …1..O_2 ⟶ …2..NO

6. …2..Fe_2O_3 + …3..C ⟶ ….4.Fe + ….3.CO_2

7. ….1.CH_3CH_2OH + ….2.[O] ⟶ ….1.CH_3COOH + …1..H_2O

8. …2..HNO_3 + …2..CuO ⟶ …2..$Cu(NO_3)_2$ + H_2O

9. …1..Al^{3+} + …3..e^- ⟶ …1..Al

10. 2..$[Fe(H_2O)_6]^{3+}$ + 3..CO_3^{2-} ⟶ ….2.$Fe(OH)_3(H_2O)_3$ + …3..CO_2 + …3..H_2O

2 – The mole

Question

a) How many moles of water are in 50g?

$Mr(H_2O) = 18$ $n(H_2O) = 50/18 = 2.78$ moles

b) How many moles of potassium are in 100g of potassium chloride?

$Mr(KCl) = 74.5$ $n(KCl) = 100/74.5 = 1.34g$

c) How many moles of water are in 300g of hydrated magnesium sulphate(VI) ($MgSO_4.7H_2O$)? The dot followed by $7H_2O$ means that the molecule comes with 7 water molecules so these have to be counted in as part of the molecules mass.

$Mr(MgSO_4.7H_2O) = 96 + 126 = 222$ $n(MgSO_4.7H_2O) = 300/222 = 1.351$ moles

Each contains 7 moles of water so $n(H_2O) = 7 \times 1.351 = 9.46$ moles

d) What mass is 0.28 moles of ethanol (CH_3CH_2OH)?

$Mr(CH_3CH_2OH) = 46$ $n(CH_3CH_2OH) = 0.28 \times 46 = 12.88g$

e) If I have 2.4g of magnesium, how many g of oxygen(O_2) will I need to react completely with the magnesium?

$2Mg + O_2 \rightarrow MgO$

Mr 24 32

n(Mg) = 2.4/24 = 0.1 moles

ratio Mg : O_2

2 : 1

0.1 : 0.05 moles *$m(O_2) = 0.05 \times 32 = 1.6g$*

3 – Solutions and concentrations (In Y12 topic Elements of life)

Question

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

$Mr(MgCl_2) = 95$ $n(MgCl_2) = 9.53/95=0.1003$moles $c(MgCl_2) = 0.1003/0.1 = 1.003$mol/$dm^3$

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?

$Mr(Pb(NO_3)_2) = 331$ $n(Pb(NO_3)_2)=13.248/331 = 0.04002$moles $c(Pb(NO_3)_2)=0.04/2 = 0.02$mol/$dm^3$

c) 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?

$n(HCl) = c \times v = 1 \times 0.1 = 0.1$ moles new vol = 2.0dm^3 so new $c(HCl) = 0.1/2 = 0.05$mol/dm^3

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

$Mr((AgNO_3) = 107.9$ $n(AgNO_3) = 1 \times 0.1 = 0.1$ moles $m(AgNO_3) = 0.1 \times 107.9 = 10.79$g

e) 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?

$Mr(Br) = 80$ $m(Br) = 0.0526 \times 80 = 4.208$g

4 – Titrations

1. Use this formula to calculate the mass of each of the following

(a) 2.50 mol of hydrogen, $H_2(g)$

$(Hm_2) = 2.5 \times 2 = 5.0g$

(b) 0.500 mol of sodium chloride, NaCl.

$m(NaCl) = 0.5 \times 58.5 = 29.25g$

2. Use this formula to calculate the amount (in mol) of each substance listed below....

a) 31.0 g of phosphorus molecules, P_4 $n(P_4) = 31/(4 \times 31) = 0.25$ moles

b) 50.0 g of calcium carbonate, $CaCO_3$. $n(CaCO_3) = 50/100 = 0.5$ moles

3. Use this formula to calculate the molar mass of an 11g gas sample of compound X, which is 0.25mol.

$n = m/Mr$ so $Mr = m/n = 11/0.25 = 44$

Molar mass: _____44_____ $gmol^{-1}$

Possible identity of the gas sample X: _____CO_2_____

4. Use this formula to calculate the amount of gas (in mol) of....

(a) $3600cm^3$ of hydrogen gas, H_2

$n = 3600/24000 = 0.15$ moles

Amount of H_2 gas: ____0.15 _____ mol

(b) $4dm^3$ of hydrogen gas, CO_2

$n = 4000/24000 = 0.167$ moles

mount of CO_2 gas: _____0.167 _____ mol

5. Use this formula to calculate the volume of gas....

(a) 6 mol of hydrogen gas, SO_2

$V = n \times 24 = 6 \times 24 = 144$

Volume of SO_2 gas: ____144_____ dm^3

(b) 0.25mol of oxygen gas, O_2

$V = n \times 24 = 0.25 \times 24 = 6$

Volume of CO_2 gas: ____6_____ cm^3

6. Use this formula to calculate the volume produced in the following solutions....

(a) a solution with a concentration of 2 moldm^{-3} that contains 2 moles of solute.

C = n/v so v = n/c = 2/2 = 1 dm^3

Volume of solution: _____1 ___ dm^3 (1 significant figures)

(b) a solution with a concentration of 0.25 moldm^{-3} that contains 0.005 moles of solute.

V = n/c = 0.005/0.25 = 0.002dm^3

Volume of solution: ____0.002_____ dm^3 (1 significant figures)

7. Use this formula to calculate the concentration (in moldm^{-3}) for the following solutions....

(a) 0.5 moles of solid dissolved in 250cm^3 of solution

C = n/v = 0.5/0.25 = 2

Concentration: ____2_____ moldm^{-3} (1 significant figures)

(b) 0.00875 moles of solid dissolved in 25cm^3 solution

C = n/v =0.00875/0.025 = 0.35

Concentration: ____0.35_____ moldm^{-3} (2 significant figures)

8. Find the mass concentration, in gdm^{-3}, for the following solutions:

(a) 0.0042 moles of HNO_3 dissolved in $250cm^{-3}$ of solution

$Mr(HNO_3) = 63$ $m = 0.0042 \times 63 = 0.2646g$ in $250cm^3$

$C = mass/volume = 0.2646/0.25 = 1.0584$

Mass concentration: ___1.06_____ gdm^{-3} (2 significant figures)

(b) 0.5 moles of HCl dissolved in $4dm^3$ of solution

$Mr(HCl) = 36.5$ $m = 0.5 \times 36.5 = 18.25$ g in 4 dm^4

$C = mass/volume = 18.25/4 = 4.5625$

Mass concentration: ____5_____ gdm^{-3} (1 significant figures)

9. The following reaction can take place, shown in this equation: **$NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$**

(a) Balance the equation shown above

2 $NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$

(b) What volume of CO_2 is formed by the decomposition of 5.04g of $NaHCO_3$?

$Mr(NaHCO_3) = 84$ $N = m/Mr = 5.04/84 = 0.06$ moles

$V = n \times 24 = 0.06 \times 24 = 1.44$

Volume of CO_2: ____1.44_____ dm^3

10. The following reaction can take place, shown in this equation:

$MgCO_{3(s)} + HNO_{3(aq)} \rightarrow Mg(NO_3)_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

(a) Balance the equation shown above

$MgCO_{3(s)}$ + 2 $HNO_{3(aq)} \rightarrow Mg(NO_3)_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

(b) 2.529g of $MgCO_3$ reacts with an excess of HNO_3. What volume of CO_2 is formed?

$Mr(MgCO_3) = 84$ $n = 2.529/84 = 0.0301$ moles

Ratio $MgCO_3$: CO_2 1 : 1 so 0.0301 moles CO_2 made

$V(CO_2) = 0.301 \times 24 = 0.7224\ dm^3$

(c) The final volume of the solution is $50.0cm^3$. What is the concentration of $Mg(NO_3)_{2(aq)}$ formed?

$n(Mg(NO_3)_2 = 0.0301$ $c = n/v = 0.0301/0.050 = 0.602\ mol/dm^3$

11

Look at the equation for the reaction between potassium hydroxide and hydrochloric acid.

$$KOH + HCl \longrightarrow KCl + H_2O$$

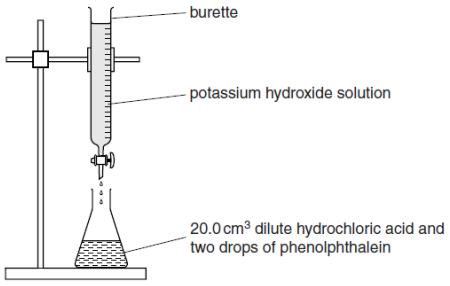
Calculate the **concentration** of potassium hydroxide in mol/dm^3.

These steps may help.

Work out the:

- number of moles in 20.0 cm^3 of 0.200 mol/dm^3 hydrochloric acid
- number of moles of potassium hydroxide neutralised
- average titre, in cm^3, using titration numbers **2**, **3** and **4**.

Look at the apparatus she uses.



titration number	1	2	3	4
final burette reading in cm^3	26.9	27.6	27.0	28.2
initial burette reading in cm^3	0.5	2.5	2.0	3.3
titre (volume of alkali used) in cm^3	26.4	25.1	25.0	24.9

n(HCl) = c x v = 0.200 x 020/1000 = 0.004 moles

average titre = (25.1 + 25.0 + 24.9)/3 = 25.0 (26.4 is an anomaly)

Ratio HCl : KOH is 1 : 1 so 0.004 moles KOH used which was in 25.0 cm^3

c = n / v = 0.004/0.025 = 0.16 mol/dm^3

12

A solution of barium nitrate will react with a solution of sodium sulphate to produce a precipitate of barium sulphate.

$Ba(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaNO_3(aq)$

What volume of 0.25moldm^{-3}sodium sulphate solution would be needed to precipitate all of the barium from 12.5cm^3 of 0.15 moldm^{-3} barium nitrate?

n($Ba(NO_3)_2$ = c x v = 0.15 x 12.5/1000 = 1.875 x 10^{-3} (0.001875) moles

Ratio ($Ba(NO_3)_2$: Na_2SO_4 is 1 : 1 so 0.001875 moles Na_2SO_4 needed

C = n / v so v = n / c = 0.001875 / 0.25 =7.5 x 10^{-3} dm^3 = 7.5 cm^3

5 – Electronic structure, how electrons are arranged around the nucleus (In Y12 Topic Elements of life)

Question

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

a) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6 4s^2$

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

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+}

a) $1s^2\ 2s^2\ 2p^6 3s^2 3p^6$

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

6 – Oxidation and reduction (In Y12 topic Elements from the Sea)

Question

Work out the oxidation state of the **underlined** atom in the following:

a) $Mg\underline{C}O_3$ b) $\underline{S}O_3$ c) $NaClO_3$ d) $\underline{Mn}O_2$ e) $\underline{Fe}_2O_3$ f) $\underline{V}_2O_5$

+4 +6 +5 +4 +3 +5

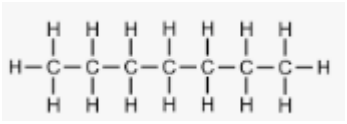
g) $K\underline{Mn}O_4$ h) $\underline{Cr}_2O_7^{2-}$ i) $\underline{Cl}_2O_4$

+7 +6 +4

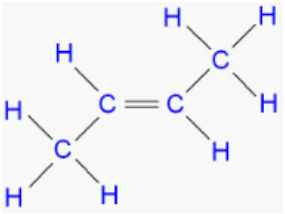
7 – Organic chemistry (in Y12 Topic Developing Fuels)

Questions

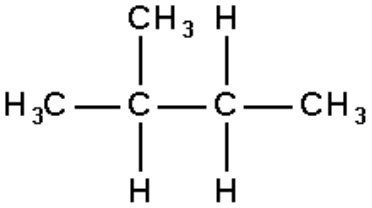
1 Draw



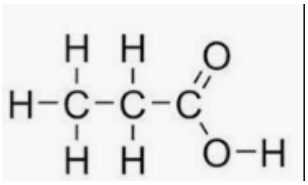
a) heptane



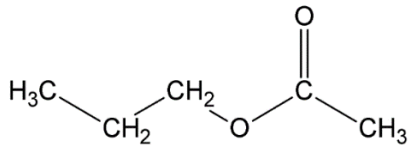
b) but-1-ene



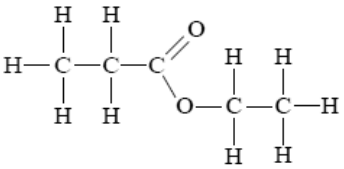
c) 2methylbutane



d) propanoic acid



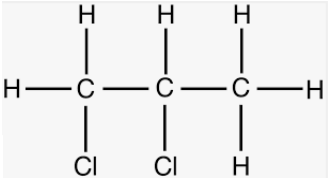
e) propyl ethanoate



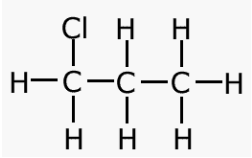
f) ethyl propaoate

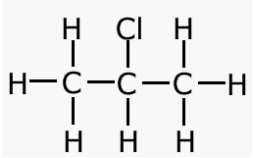
2 What is made when propene reacts with Cl_2?

1,2-dichloropropane



3) What two different molecules can be made when propene reacts with HCl?





1-chloropropane and 2-chloropropane

4) Alcohols - How could you make ethanol from ethene?

Add water – conc sulphuric acid and water

5) How does ethanol react with sodium, in what ways is this

a) similar to the reaction with water, b) different to the reaction with water?

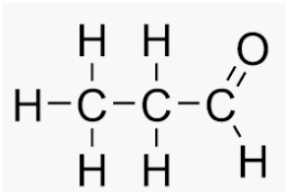
a) sodium reacts with water to make sodium HYDRoxide and Hydrogen (H lost from water leaving OH)

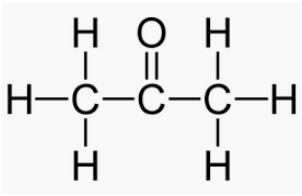
sodium reacts with ethanol to make sodium ETHoxide and Hydrogen (H lost from ethanol leaving OCH_2CH_3)

b) difference is that water reacts vigorously and with ethanol only very slowly.

6) NEW MOLECULES - Aldehydes and ketones

Look up and draw the structures of





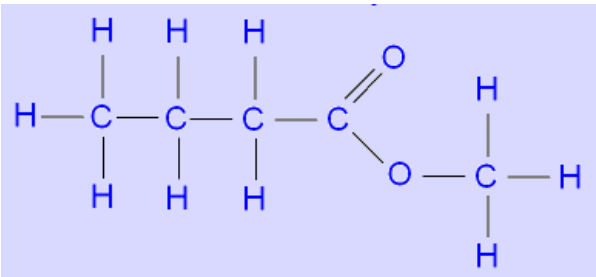
a) propanal b) propanone

How are these two functional groups different?

C=O is at the end in propanal – carbon on one side and H on the other (an aldehyde)

C=O is in the middle in propanone – carbon on both sides of it.

7) How would you go about making methyl butanoate?



React butanoic acid with methanol in the presence of conc sulphuric acid and warm.

Pour into sodium carbonate, to neutralise the conc sulphuric acid.

8 Acids, bases, pH

Questions

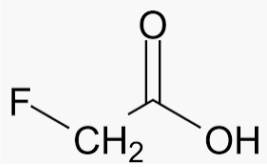
1) Write your own new definition of an acid and a base.
2) Show how sulphuric acid acts as an acid.
3) Show how ammonia acts as a base.
4) Explain the idea of strong and weak acids and why this is different to concentrated or dilute acids.
5) Explain why ethanoic acid is a weaker acid than HCl.
6) EXTRA – why is fluoroethanoic acid and stronger acid that ethanoic acid?
7) If a solution of acid which has a pH = 2 is diluted 1cm^3 into 100cm^3 volume, what is the new pH?
8) If the pH = 2 solution is diluted into 50cm^3, what is the pH (trickier?)

1) And acid donates protons and a base accept protons
2) $H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$
3) $NH_3 + H^+ \rightarrow NH_4^+$
4) A strong acid is fully dissosciated e.g. $HCl \rightarrow H^+ + Cl^-$ 100% is the right hand side.

   A weak acid is only partially dissosciated e.g. $HOOCCH_3 \rightleftharpoons H^+ + {}^-OOCCH_3$ only 1% is to the right hand side
   Concentration means how many particles / molecules are in a certain volume. Ethanoic acid can be concentrated (there is a lot in 100 cm^3) but is still weak (110 x weaker) compared to the same HCl concentration.

5) $HCl \rightarrow H^+ + Cl^-$ 100% is the right hand side.

   $HOOCCH_3 \rightleftharpoons H^+ + {}^-OOCCH_3$ only 1% is to the right hand side

6) 

   fluoroethanoic acid – the fluorine pulls electrons from the acid group causing the oxygen to hydrogen bond to have a lower electron density then the corresponding bond in ethanoic acid. Fluorine does this because it is a small atom with lots of protons in the nucleus which attracts electrons strongly (compared to the hydrogen in the equivalent place on ethanoic acid.
7) pH is a 10^x scale, so each pH increase (i.e. 1 to 2, or 5 to 6) is a reduction x 10 in concentration of H^+ ions. Therefore diluting 1cm^3 into 10cm^3 would change the pH by one (so pH2 → pH3), and diluting again 10 into 100cm^3 changes it again by pH one (so pH3 → pH 4)
   Another way of thinking about this is what power is 10 raised by to give 100 (which is the dilution). Answer $100 = 10^2$ so the pH changes by a pH of 2, from 2 to 4.
8) pH 2 solution diluted 1 into 50, so a 50 x dilution. So what power is 10 raised by to give 50.
   Or mathematically $10^x = 50$, what is x? On your calculator this is the Log function. $10^{1.69897} = 50$, so the pH increases by 1.7 to pH = 3.7