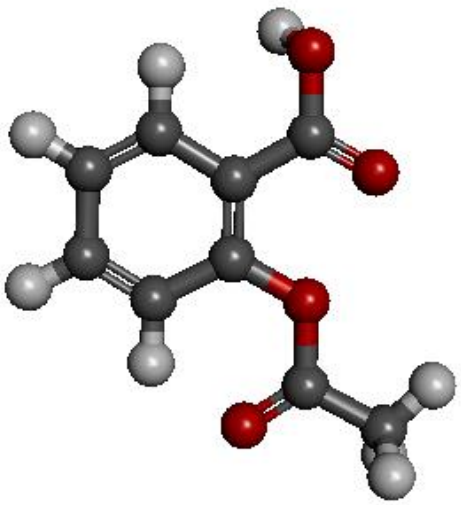
Plympton Academy

Introduction to A Level Chemistry 2020

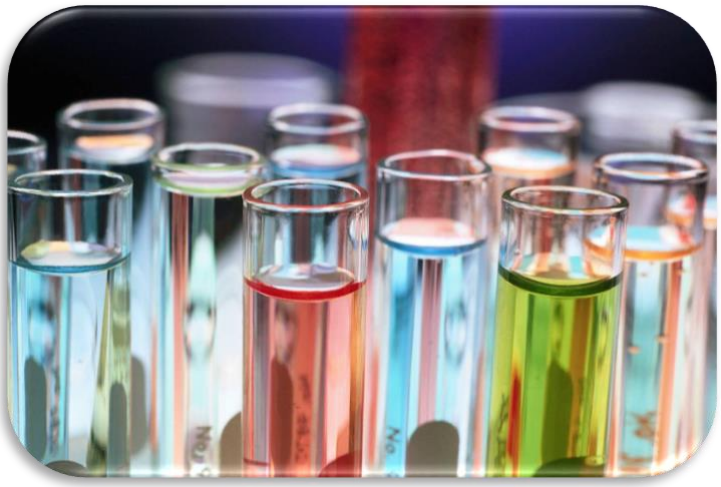
P.J.McCormack



Aspirin

Chemistry

A Level



Exam Board: OCR http://goo.gl/PBF0g8

What is the subject about?

Chemistry is the study of how the elements and their compounds behave. It overlaps with Physics and Biology as chemical principles underpin the physical environment in which we live, as well as all biological systems. In this course you will develop essential knowledge and understanding of fundamental chemical concepts, as well as a variety of areas of chemistry, and you will get to grips with how these relate to each other. You will also develop a deeper appreciation of how chemistry plays a major role in providing the comfortable modern lifestyle we appreciate and how it contributes to the success of the economy and to society more broadly.

For the AS level you will study:

Chemistry is a two year A-level course. In the first year you begin by studying chemical concepts and theories that bridge your knowledge between GCSE and A-level before building on this knowledge and understanding further. You will also apply your knowledge to the study of the chemistry of structure and bonding, organic chemistry including fuels and the contribution chemists make to the development of better and greener fuels, as well as to important chemical processes occurring in the atmosphere which relate to the ozone layer and the greenhouse effect. You also study the development of polymers and carry out three practical assessments during the year.

For the A2 level you will study:

A-level Chemistry builds on your knowledge and understanding of GCSE Chemistry. There is a particular focus on organic synthesis (for example in the design and development of drugs in the pharmaceutical industry), chemical kinetics, equilibria and chemical analysis.

How is the course assessed?

The course is assessed by three external examinations, in Year 13.

What skills will I need and develop in this course?

You will need numerical, problem solving and communication skills, which you will develop further. You will also develop your practical and research skills – i.e. how to find relevant scientific information and how to analyse and evaluate scientific data.

Subject combination advice:

We strongly advise you to take Maths and another science subject (especially if you are considering medicine) as many science degree courses related to Chemistry require Maths and two sciences at the top universities.

What can the course lead to in terms of higher education and future careers?

This course is an excellent foundation (and indeed essential) for further study of chemistry, chemical engineering, medicine, veterinary science, dentistry, physiotherapy and related subjects such as pharmacy, pharmacology and biomedical sciences. It is also highly recommended for other sciences. This course also provides a valuable education if you take chemistry no further but wish to pursue a career in, for example, finance, publishing, patent law.

What are the formal entry requirements for this course?

A level Chemistry is both a theory and practical based course that is assessed by exams and internal controlled practicals and builds directly on GCSE work in Chemistry and Maths. National evidence suggests it is difficult to succeed unless you have an appropriate base of knowledge and a good track-record of success in exam based courses at GCSE. To ensure you have a reasonable chance of success the entry requirements are a minimum of **6-6 in GCSE Core Science and Additional Science (or 6 in GCSE Chemistry with a 6 grade in either Biology or Physics) together with 5 in GCSE Maths (Higher Level)**. Applied Science or Additional Applied Science or non-GCSE Science qualifications are not suitable as preparation for A level study.

Why should I consider taking an A level in Chemistry?

It will enable you to develop a wide range of transferable skills. It will also help develop your interest and enthusiasm for chemistry, including developing your interest in further study and careers in chemistry. It will help you appreciate how society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society. Chemistry has a great capacity to solve many of the global challenges that society faces in the 21st Century, including energy, food, climate change and health care. A new generation of chemists and scientists will be involved in tackling these global challenges. If you want to enhance your understanding and be in a position to make a difference, then Chemistry is for you.

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Course prerequisite:

In order to ensure you have the required academic ability and work ethos required to succeed on the A-level chemistry course you must complete the ten tasks below and bring your completed answers to the first chemistry lesson in September 2018. ***Failure to complete the tasks to a suitable level will result in not being enrolled onto the course.*** All questions must be attempted and will require you to carry out some background research.

During the first month of the course you will be given two formal assessments, of the A-level work covered up to this point. The outcome of this along with the pre-course assignments will determine your suitability to study the subject. A-level Chemistry is a very demanding course and as such a high level of self-motivation, dedication and academic ability is required to be successful and to benefit you in your future career and education pathway.

Expectations:

You must attend all lessons; poor attendance can result in being removed from the subject. If you know in advance that you are going to miss a lesson you must inform your teachers either verbally or via email to request the work. It is ***your*** responsibility to ensure you have catch up with work that you missed. All the key resources are placed on the departments Google Drive which you will be given access to.

You must come prepared to each chemistry lesson; this includes bringing the following equipment to each lesson:

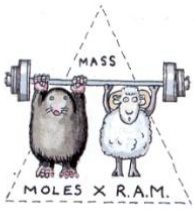
- A scientific calculator
- 2 x black ball point pens
- A ruler
- A rubber
- 2 x HB pencils
- Highlighters
- A folder with dividers to keep all your work in a neat order
- The core textbook (this will be issued to you in the first few weeks of the course)

Chemistry support session run weekly after school on a Thursday (3:05-4:05pm) on a voluntary basis for students who are finding the work difficult compulsory and those that fail to submit homework by the set deadlines, to a suitable standard or are underachieving in a unit assessment.

Assessment.

A Level Chemistry
Paper 1 – Periodic Table, Elements and Physics Chemistry Written exam paper 2 hour 15 minutes Multiple choice, structured and extended questions covering theory and practical skills 37% of A-level Chemistry
Paper 2 – Synthesis and Analytical Techniques Written exam paper 2 hour 15 minutes Multiple choice, structured and extended questions covering theory and practical skills 37% of A-level Chemistry
Paper 3 – Unified Chemistry Written exam paper 1 hour 30 minutes Structured and extended questions covering theory and practical skills 26% of A-level Chemistry

In addition to terminal examinations students will carry out a practical endorsement for Chemistry which involves 12 fundamental chemistry experiments.



Task 1 – The AS Chemistry Course.

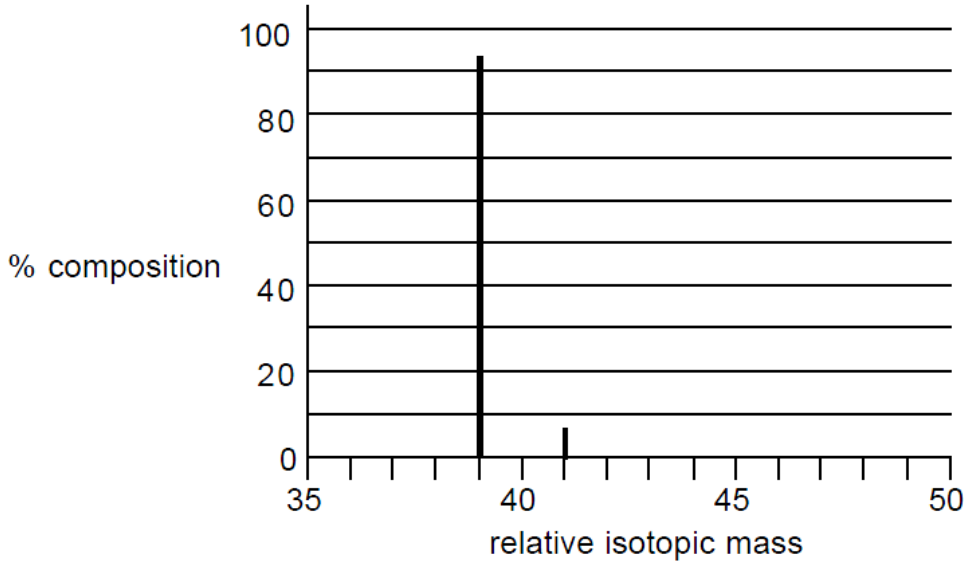
Using the following link to the OCR Chemistry website, to answer questions 1-3 regarding the AS Chemistry course. http://goo.gl/PBF0g8

1. What are the four modules of the AS chemistry course?

2. What topics are studied as part of the first module?

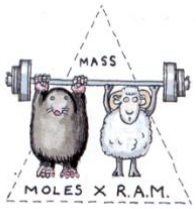
3. What topics are studied as part of the second module?

4. Potassium was discovered and named in 1807 by the British chemist Sir Humphrey Davy. The mass spectrum of a sample of potassium is shown below:



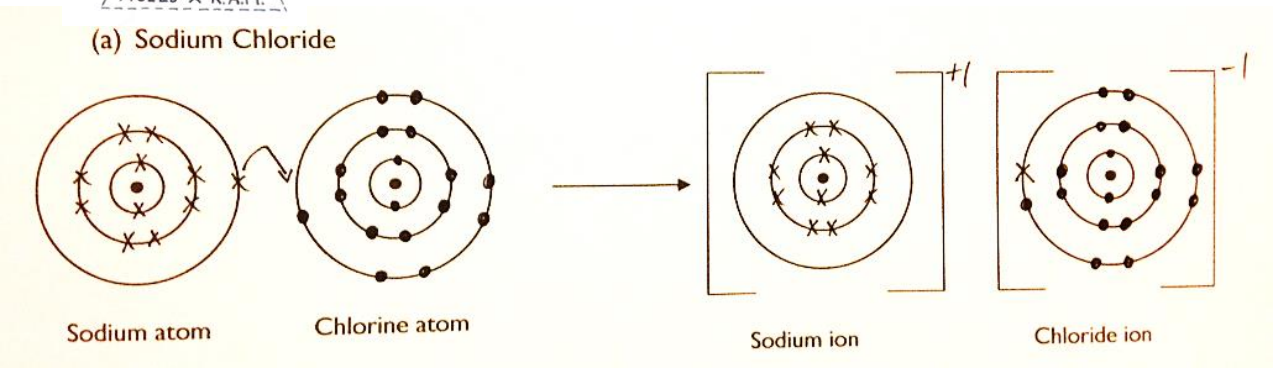
(a) Use this mass spectrum to complete the table below to show the percentage composition and atomic structure of each potassium isotope in the sample.

isotope	percentage composition	protons	neutrons	electrons
^{39}K				
^{41}K				



Task 2 - Ionic Dot and Cross Diagrams

Draw dot and cross diagrams to illustrate the bonding in the following ionic compounds using the format in the example below.



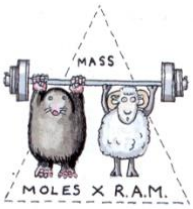
(2 marks for each correct diagram)

1. Lithium fluoride, LiF

2. Magnesium chloride, $MgCl_2$

3. Magnesium oxide, MgO

4. Lithium hydroxide, LiOH



Task 3 – Covalent Dot and Cross Diagrams

Draw dot and cross diagrams to illustrate the bonding in the following covalent compounds. If you wish you need only draw the outer shell electrons.

(2 marks for each correct diagram)

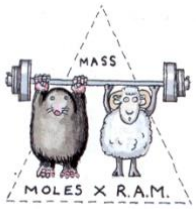
1. Hydrogen H_2

2. Oxygen, O_2

3. Water, H_2O

4. Carbon Dioxide, CO_2

5, Ethyne, C_2H_2

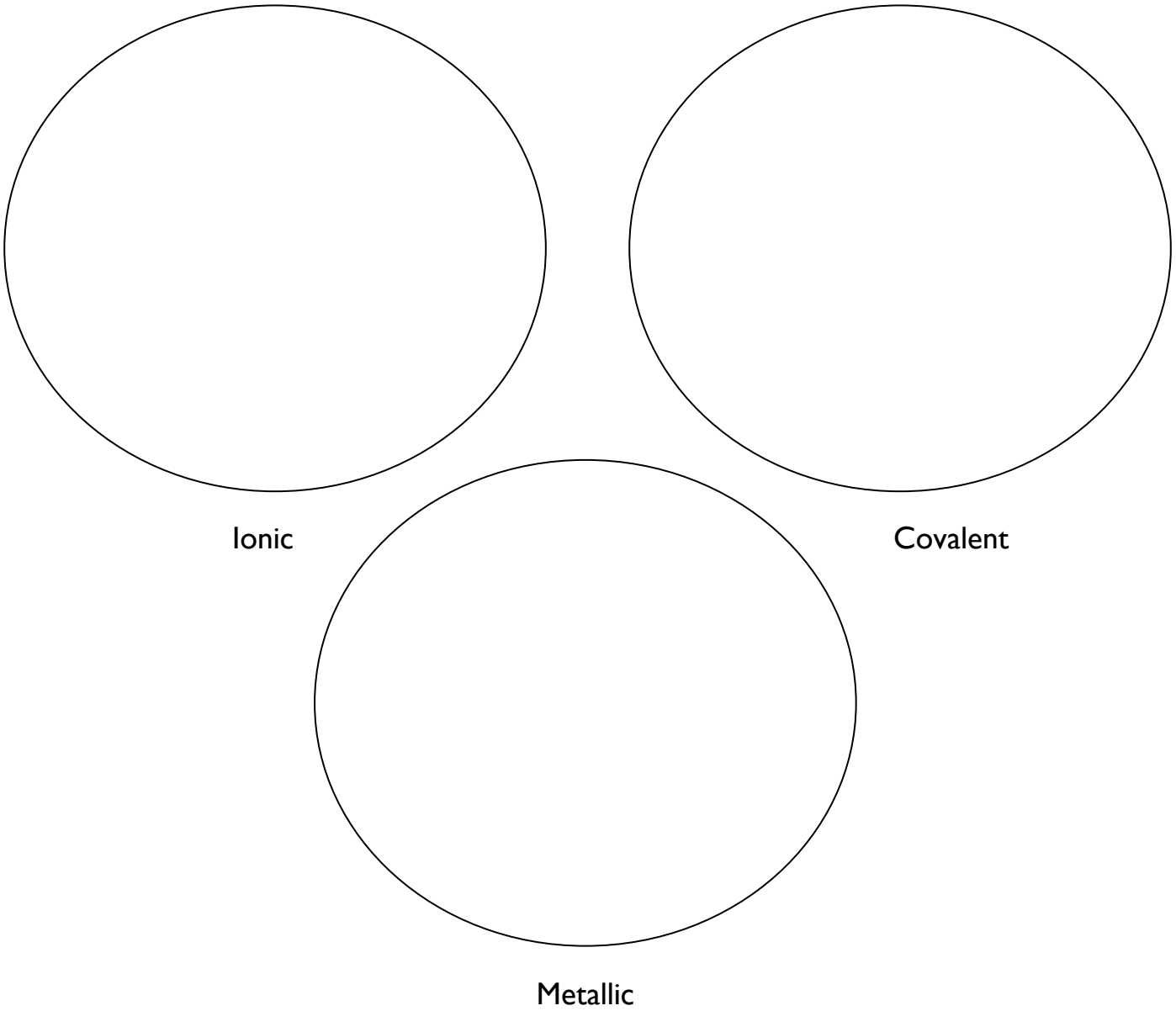


Task 4 – Which Type of Chemical Bond.

There are three types of strong chemical bonds; **ionic**, **covalent** and **metallic**.

1. Sort the compounds below into groups within the circles below according to their chemical bonding;

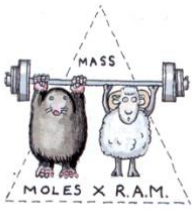
Sodium chloride, NaCl	Magnesium, Mg	Magnesium oxide, MgO
Methane, CH_4	Oxygen, O_2	Barium iodide, BaI_2
Aluminium, Al	Ammonia, NH_3	Caesium, Cs



2. For each of the types of compound, indicate if you would expect them to;

(a) have a high or a low melting point

(b) conduct electricity



Task 5 - Bonding Summary.

A student has written the revision cards below to help her prepare for the exam. However she has made a number of mistakes. Can you correct her cards to make sure she has accurate information to revise from.

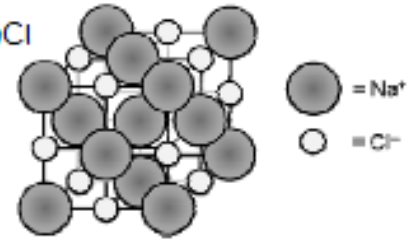
(1 mark for each correct correction made)

Ionic bonding

Between a metal and a non-metallic atom, e.g. NaCl

Electrons are shared between the atoms

The molecules have high melting points owing to the strong electrostatic attraction between the ions



Ionic compounds do not conduct electricity at all as the ions that carry the current are held in a fixed position in the lattice structure

Corrections;

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Metallic bonding

In metallic bonding, the outer electrons from the metal atoms merge to produce a lattice of negative metal ions in a sea of delocalised electrons

The strength of the metal depends on two things;
- the charge on the metal ion
- the size of the metal ion

Therefore sodium is stronger than magnesium

Metals have low melting points because of the repulsive forces between the negative electrons which need little energy to be broken

Metals conduct electricity because of the sea of delocalised electrons which can move through the structure to carry the charge

Corrections;

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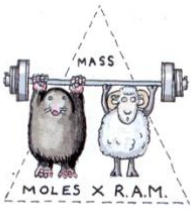
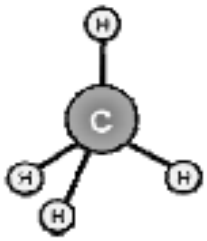


Covalent bonding

Between two non-metallic atoms, e.g. CH_4

Electrons are transferred between the atoms

Covalent molecules have high melting points because of the strong covalent bonds which must be broken



Covalent compounds do not conduct electricity at all as there are no free electrons

Corrections;

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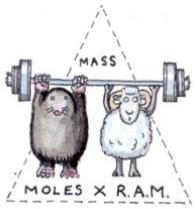
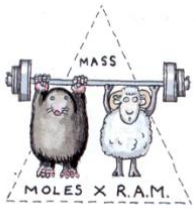


Task 6 – Properties and Bonding.

Match the compound on the left to its correct structure from the middle bank of statements and one or more statements from the column on the right. Aluminium has been done for you.

Compound	Structure	
aluminium	metal	Weak intermolecular forces are broken when it boils
		High melting point
diamond	simple covalent molecule	Conducts electricity when molten
		Conducts electricity when in solution
iodine	ionic compound	Conducts electricity when solid
chlorine	molecular crystal	Low melting point
		An ionic bond is broken when it melts
potassium fluoride	macromolecular crystal	A covalent bond must be broken to melt it

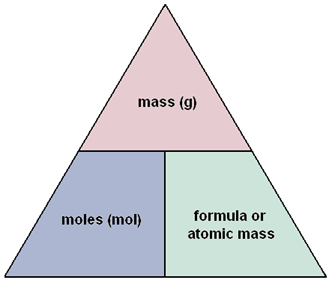


Task 7 – Chemical Calculations.

Calculate the number of moles in the following questions using the formula below.

- The standard unit of amount of a substance is a mole (mol)
- The number of atoms in a mole is known as Avogadro's constant (N_A)
- There are 6.02 x 1023 atoms in a mole

Number of moles = $\frac{\text{mass}}{\text{formula mass}}$



1. Calculate the formula mass of the following compounds.
   a. Water, H_2O

   b. Sodium hydroxide, NaOH

   c. Magnesium chloride, $MgCl_2$

   d. Lithium fluoride, LiF

   e. Magnesium sulfate ($MgSO_4$)

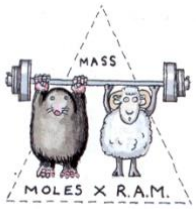
2. How many moles are there in 44g of carbon dioxide, CO_2?

3. How many moles are there in 17g of ammonia, NH_3?

4. How many moles are there in 200g of calcium carbonate, $CaCO_3$?

5. What is the mass of 0.05 moles of NaOH?

6. How many atoms are there in 4 moles of sodium chloride?



Task 8 – Astounding Numbers

The number of carbon atoms ($_{12}C$) in 12.0 g of carbon was first calculated by Avogadro and is named after him. Avogadro's number is $6.02 \times 10_{23}$ or 602,000,000,000,000,000,000,000. For ease of use we call this number 1 mole (or 1 mol for short). Avogadro's number is astoundingly big since atoms are so small.

Give your answer to an appropriate number of significant figures.

1. The age of the Earth is thought to be 4.5 billion years. Calculate the age of the Earth in seconds.

2. Sugar cubes have a volume of roughly 1 cm_3. Calculate how high the layer of sugar would be if you had a mole of sugar cubes spread out over the surface of the Earth.

3. A two pence coin has a width of 2 mm. Calculate how many towers of 2p coins you could make from the Earth to the Moon with 1 mole of 2p coins.

Data.

One billion = 1000 million
Avogadro number $6.02 \times 10_{23}$
Estimated age of the Earth 4.5 billion years
Radius of the Earth $6.4 \times 10_6$ m
Mass of the earth $6.0 \times 10_{24}$ kg
Distance between the moon and the earth $3.8 \times 10_8$ m
Volume of a sphere = $\frac{4}{3}\pi r^3$
Surface area of a sphere= $4\pi r_2$

Task 9 – Reaction Kinetics

This question is all about the reaction between zinc metal and hydrochloric acid to produce zinc chloride and hydrogen gas.

1. Write a balanced symbol equation for the reaction that occurs. (1 mark)

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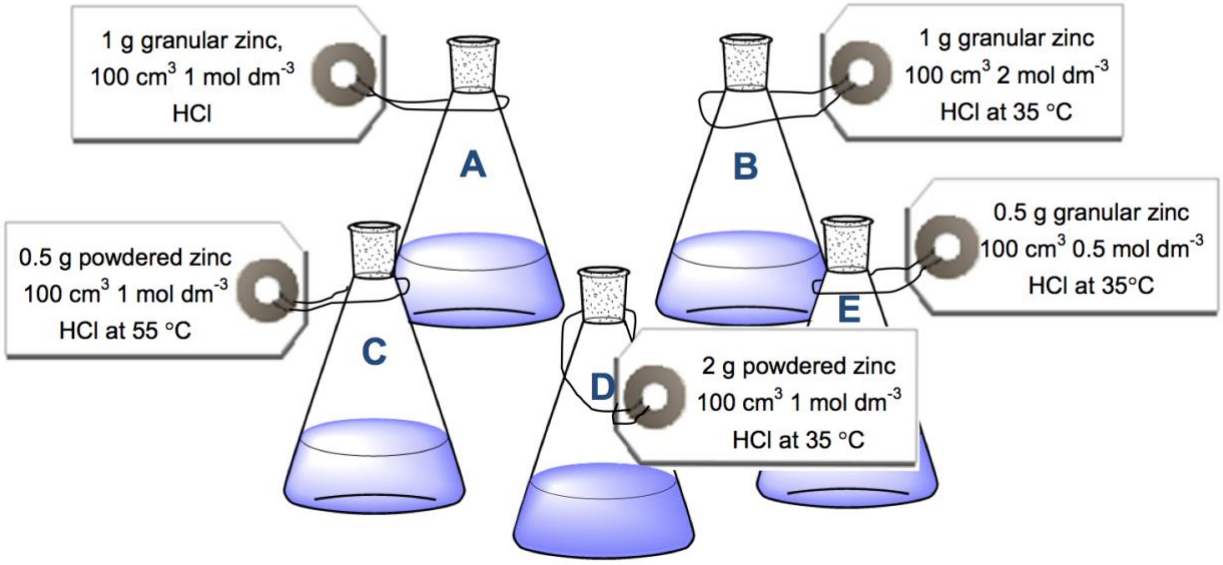
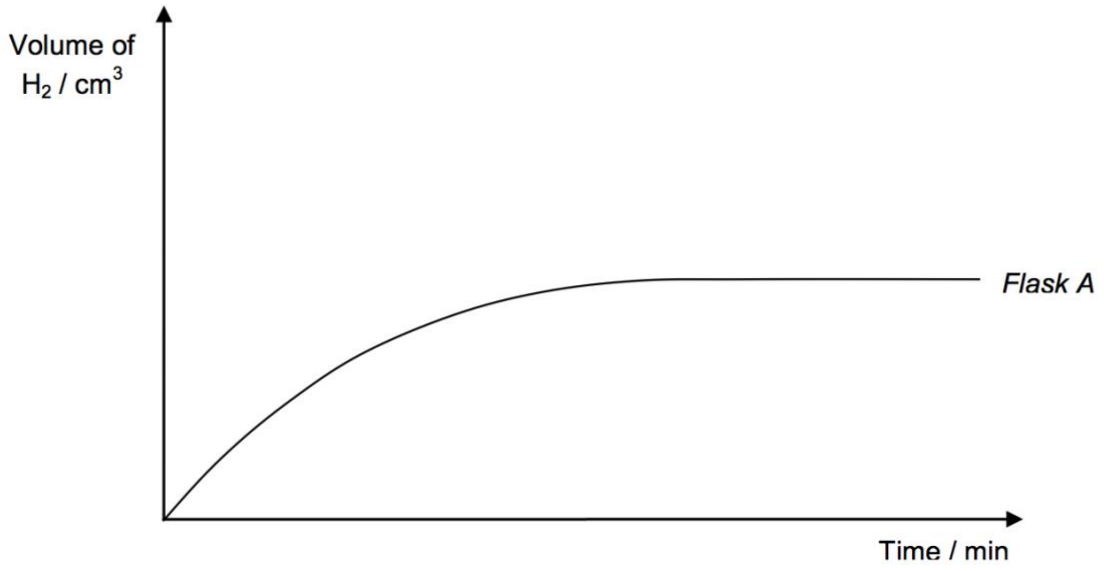
2. The reaction flasks below show the same reaction but under different conditions. The acid is in excess in all five flasks.



(a) In which flask is the reaction rate the slowest? ..... (1 mark)

(b) The graph below shows how the volume of hydrogen given off changed with time for the reaction that occurred in flask A. Sketch on the same set of axes, the curves you would expect to get if you repeated the measurements for *flasks B, C, D* and *E*.

(8 marks)



3. (a) Without using your notes, sketch on the axes below the Maxwell-Boltzmann distribution of molecular energies. Label this curve A. Make sure you include axes labels.

(4 marks)

(b) Add a line into the diagram to show the likely position of the activation energy for the reaction. Label this E_a. (1 mark)

Now consider what would happen to the distribution if the temperature of the system was raised. Sketch a new distribution onto the axes and label this curve B. (3 marks)

Using the two distributions you have drawn, explain why increasing the temperature of a reaction results in an increase in the rate of the reaction.

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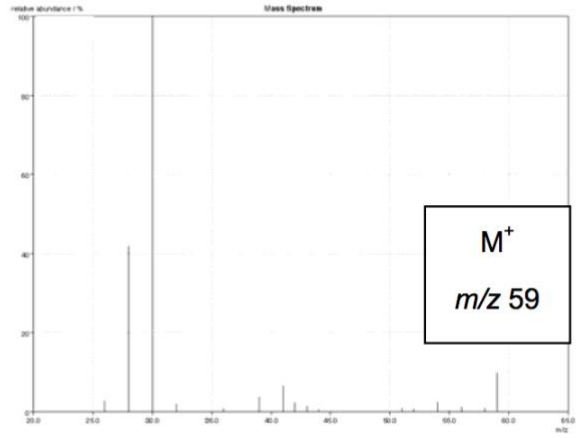
(2 marks)

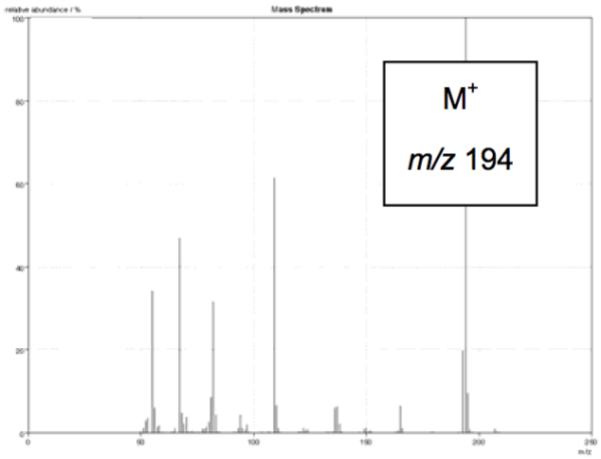
Task 10 - Analysis

Use the elemental analysis data together with the mass spectrum to propose a molecular formula for the unknowns A to C. Easy! (3 marks for each)



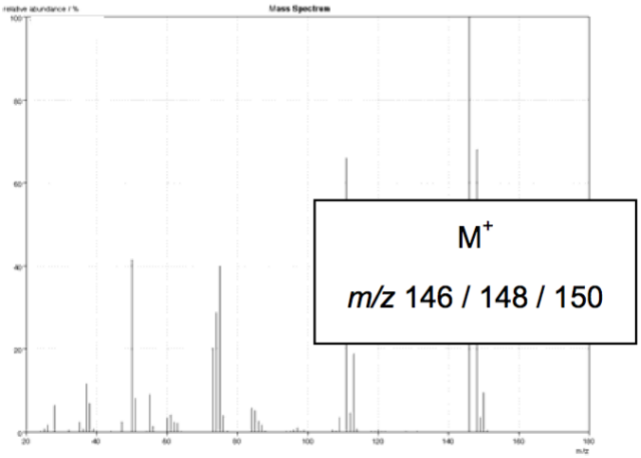
Unknown A

C 61.02%; H 15.25%; N 23.73%



Unknown B

C 49.48%; H 5.15%; O 16.49%; N 28.87%



Unknown C

C 49.02%; H 2.74%; Cl 48.23%

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1.0 H hydrogen 1										4.0 He helium 2
6.9 Li lithium 3	9.0 Be beryllium 4											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	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12											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	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	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	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	95.9 Mo molybdenum 42	[98] 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	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	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	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112–116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

140.1 Ce cerium 58	140.9 Pr praseodymium 59	144.2 Nd neodymium 60	144.9 Pm promethium 61	150.4 Sm samarium 62	152.0 Eu europium 63	157.2 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
232.0 Th thorium 90	[231] Pa protactinium 91	238.1 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103