According to the internet, the ionisation energy of Hydrogen is 2.18x10⁻¹⁸ J. You can verify this by looking at the graph. The frequency where the lines converge is about 3.3 PHz. E=hf, so the energy is $3.3 \times 10^{15} \text{ S}^{-1} \text{ x}$ 6.63×10^{-34} JS = 2.188×10^{-18} J. The Lyman series is in the UV part of the spectrum.

The Balmer series is the energy required to promote the electron from n=2. The Balmer series is in the visiBle part of the spectrum (B for Balmer).

The absorption spectrum and the emission spectrum are the same. The amount of energy required to promote an electron to a higher shell is the same amount of energy that's released when it falls back down. An electron will always fall down to the lowest energy level possible, as it's more stable.

If the graph is shown in terms of wavelength, it's reversed - the lines get closer as you go left, not right, and the Lyman series is to the left of the Balmer series, not to the right.

3: CHEMICAL CALCULATIONS UNIT

MASS

Atomic Mass (Ar): The average mass of an atom relative to one twelfth of the mass of one Carbon - 12 atom.

Molecular Mass (Mr): The total mass of all of the atoms in a molecule added up. The Mr of a substance is the mass of one mol of that substance in grams.

MASS SPECTROMETER

The main function of a mass spectrometer is to find the relative abundance of different is cover and hence calculate it's Ar. There are five steps to the process:

- 1. Vaporisation: The substance is torped in
- 2. Ionisation: The substance hot w an electron g t moving electrons knock electrons out of the shell of t
- a job. The substance is passed worse charged plates, which accelerates it to very high speeds. Acc 3.
- Deflection: The substance passes an electromagnet, which deflects it. Different atoms are deflected 4. different amounts, depending on their mass and charge.
- 5. Detection: The ions pass through a slit, and are detected on the other side.

The inside of a mass spectrometer is a vacuum, so none of the ions collide with other particles, which could alter their course. At the end you get the mass/charge ratio.

SIMPLE MASS SPECTRA



THE PH SCALE

The pH scale measures proton density. It's a logarithmic scale, and uses base 10. The formula is:

 $pH = -\log[H^+]$



Molecules in a homologous series all have the same functional group, but all have a different number of carbons. As you add more and more carbons, the surface area of the molecule gets larger. This means that the Van der Waals' forces acting on that molecule are greater, so that substance's boiling point is higher. If something has a certain isomer which has a smaller surface area, that isomer will have a lower boiling point.

FORMULAE

Molecular formula - the numbers of each atom in a compound, e.g.

$$C_3H_6O_2, C_4H_{10}$$

Displayed formula - the whole picture, drawn out. This shows exact structure, e.g.



Shortened Formula - like the molecular formula, but shows the functional group and structure as well, e.g.

*C*₂*H*₅*COOH*, *CH*₃*CH*₂ *CH*₂ *CH*₃

Skeletal formula - shows the spine of the molecule, leaving out any unimportant molecule O.g.



An isomer is a molecule made of the exact same elements, but which is arranged differently and has different properties.

Positional Isomerism - this is when the positon of the active group changes, e.g. 1-bromo-butane and 2-bromobutane.

Functional Group Isomerism - this is when the functional group changes, e.g. Ethanoic Acid and Methyl -Methanoate.

Chain Isomerism - this is when the carbon chains are re-arranged, e.g. Butane and 2 - Methyl - Propane.

ELECTROPHILES, NUCLEOPHILES AND FREE RADICALS

An electrophile is a species that's attracted to a negative charge (electro - electron, phile - attracted to).

A nucleophile is a species that's attracted to a positive charge (nucleo - nucleus (where the protons are), phile attracted to). A nucleophile has an unbonded pair, which goes on to form a covalent bond with a negatively charged molecule.

A radical is a species with a lone electron. Because of this, radicals are very reactive, and react very quickly.

Propogation: $CH_4 + Cl^{\bullet} \rightarrow CH_3^{\bullet} + HCl$

Termination: $CH_3^* + Cl^* \rightarrow CH_3Cl$

GEOMETRIC ISOMERISM

Geometric isomerism occurs when both sides of a double covalent bond both contain more than one different species. If both species are on the same side of the bond (both above or both below) this is the Z isomer (Z for zammen (same)). If both are on different sides, it's the E isomer. e.g.



(E) -1,2-dichloroethene (Z)-1,2-dichloroethene

Priority is always given to the species with the highest mass, so, for example, if around a bond you had Chlorine, Hydrogen, Bromine and Bromine, the geometric isomers depend on where the two Bromines are, not the Chlorine. It's always easiest to draw out the Carbon double bond, and then everything attached to it in shorthand, so you'd write a 7 carbon chain as C₇H₁₅, you wouldn't draw out all seven, and their hydrogens. This makes it much easier to visualise the isomerism, like in the picture below:



Curly arrows are used to show the movement of a pair of electrons. As the Br₂ approaches the π bond, the electrons are repelled, and one of the bromines becomes δ^+ , and the other δ^- . In step one, the positive bromine takes the two electrons from the π bond, and forms a covalent σ bond with the carbon on the left. The Br-Br bond then breaks hetrolytically, giving both electrons to the unattached Br, making it negative. The C on the right becomes positive. This is because when the π bond broke, it lost an electron.

In step 2, the negative bromine is a nucleophile, as it's attracted to the positive charge, and has an unbonded pair of electrons. It goes on to share its electrons with the Carbon, and forms a covalent σ bond.

BIOFUEL

Alcohol can be used as a biofuel. Alcohols burn well in air, to produce water and CO₂. This is the reaction for complete combustion:

$$CH_3CH_2OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

This is the reaction for incomplete combustion:

$$CH_3CH_2OH + 2O_2 \rightarrow 2CO + 3H_2O$$

You must remember to count the Oxygen from the alcohol when balancing the equation.

Here are some advantages and disadvantages to using biofuel instead of fossil fuels:

Advantages	Disadvantages
It has the potential to be Carbon neutral	It makes less energy gram for gram than fossil fuels
It's renewable	It's more expensive
It can be produced from waste	It uses large amounts of land, which could be used for growing food
It can be produced locally	The process is never really Carbon neutral, as heavy machinery is almost always used.
	It needs large amounts of water, which can be hard to get in desert regions
DEHYDRATION OF ALCOHOLS	
The equation for the dehydration of alcohol is as follows: $G(H_2O)_2O_4 \rightleftharpoons CH_2 \equiv CH_2 + M_2O_3$ The catalyst for the relation in the FORWARD direction (to produce ethane) is concentrated sulphuric acid. The catalyst for this reaction in the FORWARD direction (to produce ethanol) is an excess of water.	

In the forward direction it's an elimination reaction. Backwards, it's an addition reaction.

PRIMARY, SECONDARY AND TERTIARY ALCOHOLS

Alcohols are categorised as primary, secondary, and tertiary. This simply refers to the number of R groups the carbon attached to the OH group is attached to. One is primary, two is secondary and three is tertiary.



As alcohols get longer, the polar OH group has less and less of an effect on the molecule. In small alcohols the OH group forms hydrogen bonds, and so are very polar and soluble. As the chains get longer, alcohols act more like regular hydrocarbons. Decanol, for example, wouldn't be soluble at all. This is because the relative stability of all of the C - H bonds cancels out the polar OH bond.