

Chemistry Exam 18/01/2021

Frazer Graham – Dstl

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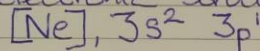
- ① Both protons & neutrons have a mass of 1.
Protons have a positive charge of 1.
Neutrons have no charge.

Atomic number is the number of protons an element has.

Atomic mass is the number of neutrons plus protons

Isotopes are elements with the same number of protons but have a different amount of neutrons.

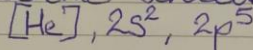
- ② ~~Electronic~~ electronic structure of aluminium:



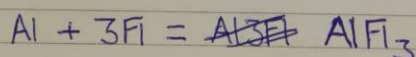
electrons with stable

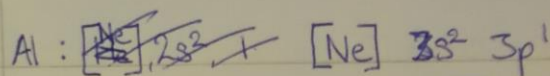
Valence Valency of +1 & +3 this is because to empty its sub-shells to become more stable. Additionally aluminium can become more stable by losing all of its 3rd principle quantum number sub shells.

Electronic structure of Fluorine:

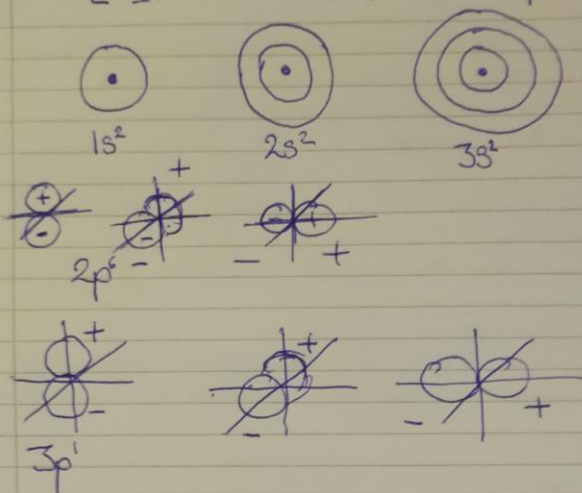


Has 7 valence electrons, because of the 2nd principle quantum number sub shells. Most likely to appear in states +5, +7 & -1.





(3)



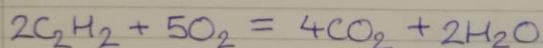
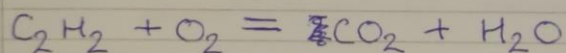
(4)

Heat of formation is the change of heat of formation to form one mole of the substance in its standard state from its constituent elements in their standard states.

$$\Delta H_f = \sum \Delta_f \text{ Products} - \sum \Delta_f \text{ Reactants}$$

Exothermic, is a reaction where energy is released into its environment.

Endothermic, is a reaction where energy is absorbed from its environment.



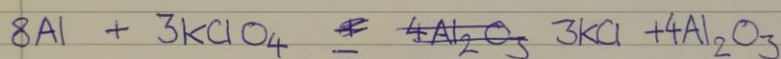
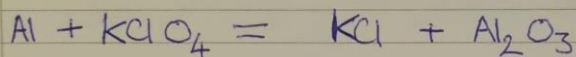
$$\begin{aligned} & (4 \times -393.5) + (2 \times -241.8) - (2 \times +227) \\ & \text{kJ/mol} \quad \text{kJ/mol} \quad \text{kJ/mol} \\ & -1574 \text{ kJ} + -483.6 \text{ kJ} - 454 \text{ kJ} = -2511.6 \text{ kJ} \end{aligned}$$

- ⑤ Stoichiometry determines the quantity of product & reactants to complete a reaction using the law of conservation of mass.

Therefore to completely combust 2 moles of acetylene, 5 moles of oxygen is required to ~~react~~ complete the reaction, to produce 4 moles of carbon dioxide & 2 moles of H_2O .

~~At~~ Air is 21% oxygen, therefore you would need to calculate the number of liters of air required to get 5 moles of oxygen for complete combustion.

$$\frac{22.4 \times 5}{L \text{ moles}} = 112 \quad (112 \div 21) \times 100 = 533.33L \text{ of air for 5 moles of oxygen.}$$



$$\frac{(8 \times 27) + (3 \times 39) + (3 \times 35.5) + (3 \times 4 \times 16)}{216 + 117 + 106.5 + 192} = 631.5$$

$$216 \div 631.5 = 34.2 \%$$

⑥

~~As~~ Barium produces green colours, Strontium red & sodium yellow. To make these colours more definite an electron ~~don~~ acceptor such as chlorine should be added.

As the ~~electrons~~ ^{& stretch} bonds vibrate, these can reflect & absorb Electromagnetic radiation. This ~~can~~ ^{then be} radiation which is reflected can be seen.

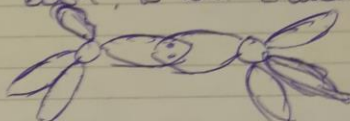
(E7)

~~Carbon has four bonds, some~~

Carbon has four possible bonds, in alkanes each bond would be a sigma bond between a H-C or C-C. Creating a sp^3 orbital Hybrid.



When another C is added such as ethane both, it will create the orbital hybrid

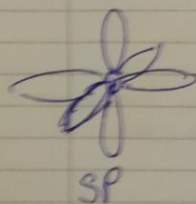


Ethene on the other hand, due to the double C=C bond, creates a pi bond. With electrons being ~~above &~~ possibly above and/or below.

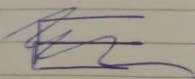
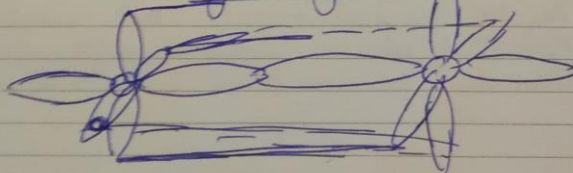


The orbital of alkenes.

←



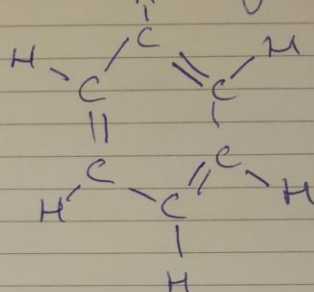
The orbitals of alkynes



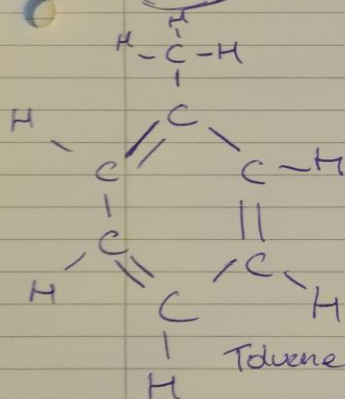
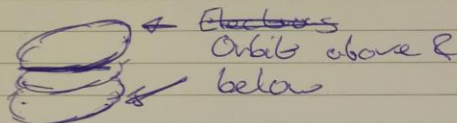
B7

Benzene has 6 carbons, & 6 Hydrogens. They create a Hexagonal structure with sigma bonds between C-C & H-C.

There are a pi bond between the carbons, that is above & below the sigma bonds of the C-ring.



Benzene.



Toluene.

When a Hydrogen is removed this effects the electronegativity of the entire molecule.

During the nitration the removal of a hydrogen makes every other carbon bond either negatively charged or positively.

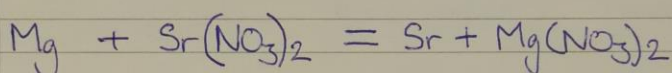
This can make it easier to nitrate as an electrophilic molecules can more easily attach to high areas of ~~electro~~ electronegativity ~~areas~~ electronegativity.

However by doing so can change areas. For example nitro groups joining onto ~~at~~ benzene & toluene creating nitrobenzene & nitrotoluene. Can make them ortho- or meta directing.

B8

An explosive molecule has both the oxidiser & fuel bonded together chemically. They can release greater amounts of energy & are self sustaining. Meaning even underwater they produce their own oxygen. Once an molecule has begun reacting, it cannot be stopped. Usually has loads of bonds such as TNT.

A pyrotechnic composition is two separate solid/colloidal elements /compounds mixed together. Usually these burn instead of detonating & can deflagrate if confined.



$$\begin{array}{r} (1 \times 24.3) + (87.62 \times 1) + (2 \times 14) + (6 \times 16) = \\ 24.3 + 87.62 + 28 + 96 = 235.92 \end{array}$$

$$\begin{array}{r} \cancel{24.3} \text{ The stoichiometric mix is 1:1} \\ 24.3 = 10.3\% \\ \hline 235.92 \end{array}$$

10.3% of magnesium is needed.
Therefore 1 part Mg for 9 parts $\text{Sr}(\text{NO}_3)_2$.

Other factors affecting rate of reaction of a mixture is particle size. If the mixture is more intimate & evenly spread/distributed this will increase rate of reaction. Confinement can also improve rate of reaction & ambient temperature.

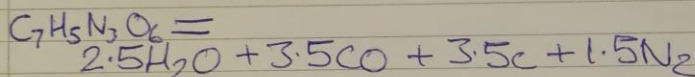
86
(68)

of an high explosive
To determine decomposition ^{first calculate} oxygen balance
of RDX & TNT is ~~required~~ ^{use}
Using the equation below

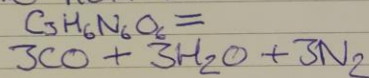
$$\Omega = \frac{[d - (2a) - (\frac{b}{2})] \times 1600}{M} \quad \text{RDX} \quad \text{C}_2\text{H}_6\text{N}_6\text{O}_6$$

RDX = -21.6%. From these if the Oxygen balance
TNT = -74%. is greater than -40%, so TNT,
the modified Kistiakowski-Wilson rules are
used. If oxygen balance is less than -40%, use, RDX,
the Kistiakowski-Wilson rules.

Therefore TNT is:



While RDX is:



The products can then be used to find the power index. ~~This would allow the comparison of how~~
By calculating the heat given off & the volume of gas produced.

We can then compare the power of high explosives.

$$P = \frac{Q \times V}{Q \times V \text{ (picric acid)}}$$

Power Index.

Furthermore by comparing the power to other explosives we can estimate the performance of a variety of explosive masses using Hopkinson scaling.