

Chemistry Exam level 4 18/01/2021

Q₁ (5 marks)

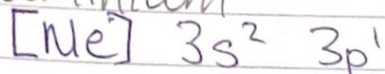
The particles that occur in the atomic nucleus are ~~the~~ protons and ~~the~~ neutrons. The proton has ~~a~~ ~~+~~ charge a positive charge (+1) and the neutrons have a neutral charge (0).

The term atomic number means the number of protons in the ~~the~~ nucleus of an atom which ~~determines~~ determines the element's place in the periodic table.

The term mass number means the total amount of protons and neutrons in an atom's nucleus.

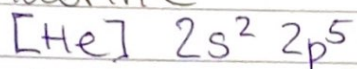
The term isotope refers to ~~two~~ an element that has two or more forms that contain an equal amount of protons but a different amount of neutrons in their nuclei.

Question 2
the electronic structure and valence of
Aluminium



valence of +3, Al^{3+} has the configuration
 $1s^2 2s^2 2p^6$ which is that of a full shell

the electronic structure and valence of
fluorine

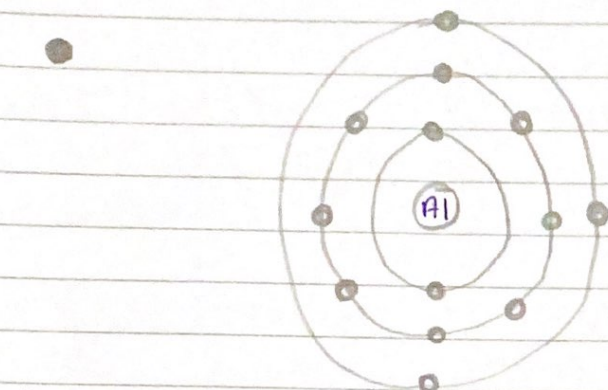


valence of -1, F^- has the structure
 $1s^2 2s^2 2p^6$ which is that of a full
shell

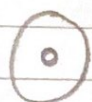
the formula of Aluminium fluoride
 AlF_3

Question 3

Orbital types
in Aluminium



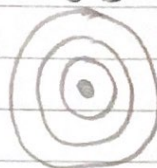
1s



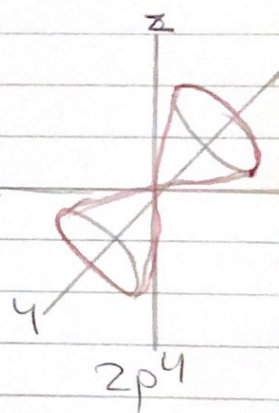
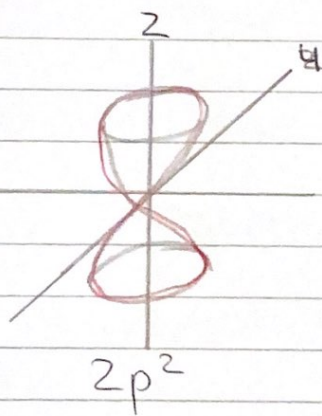
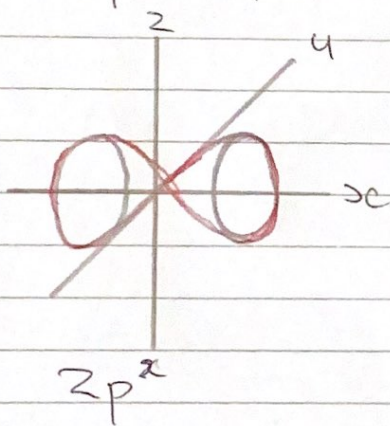
2s



3s



$2p(x, y, z)$



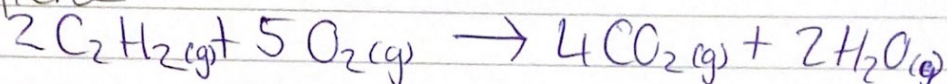
Question 4

The heat of formation is the amount of heat absorbed or evolved when one mole of the compound is formed from its constituent elements under standard conditions.

Endothermic is the reaction or process which absorbs heat

Exothermic is the reaction or process that releases heat.

Balanced equation for Combustion of Acetylene



$$\Delta H_f = (\text{product}) - (\text{reactants})$$

$$\Delta H_{\text{pro}} = 2 \times (+277) = 554 \text{ KJ mol}^{-1}$$

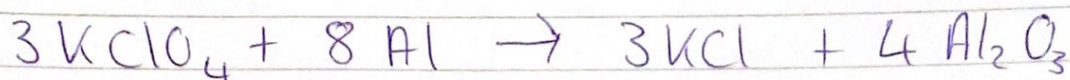
$$\begin{aligned}\Delta H_{\text{rea}} &= 4 \times (-393.5) + 2 \times (-241.8) \\ &= 2057.6 \text{ KJ mol}^{-1}\end{aligned}$$

$$\begin{aligned}\Delta H &= 554 - 2057.6 \\ &= 1503.6 \text{ KJ mol}^{-1}\end{aligned}$$

Question 5

~~Sto~~ Stoichiometry is the calculation of the quantities of chemical elements or compounds in a chemical equation.

Balanced equation:-



$$\begin{aligned} \% \text{ by mass of Al} &= \frac{\text{atomic mass} \times \text{moles}}{\text{molecular mass}} \times 100 \\ &= \frac{27 \times (4 \times 2)}{3(39 + 35.5) + 4(27 \times 2 + 16 \times 3)} \times 100 \end{aligned}$$

$$= \frac{27 \times 8}{283.8} \times 100$$

$$\% \text{ by mass of Al} = \frac{27 \times 8}{176.5} \times 100$$

$$= 30.6\%$$

Question 6

the lines in a line spectra are formed due to the transitions in which an element moves from a higher energy level to a lower energy level.

The lines shown by Barium, strontium and sodium are significant due to the ~~same~~ single line which appears, the exact colour of this line is also created during their respective flame tests.

Barium is Apple green

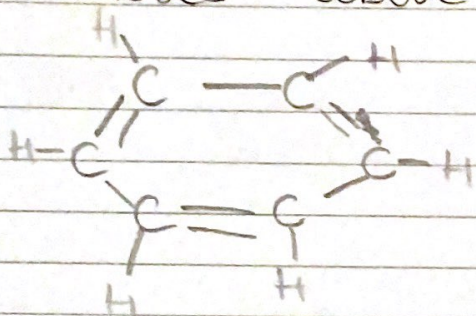
Sodium is yellow

Strontium is red

A pyrotechnic formulation can utilise these colours for coloured smoke screens used for day-time signalling and marking fall of shot/ bomb for practice.

Continuation Question 7

Benzene consists of 6 carbons arranged in a hexagonal shape bonded by sigma bonds. Each carbon is also bonded to a H atom with a sigma bond. The carbons are also joined via π bonds with lobes above and below the hexagon.



If a hydrogen is replaced by another atom or compound it can change the electron distribution in the π bond and causes some of the carbons to have different reactivity.

If you react benzene with a nitro group it will form nitrobenzene. If you repeat the reaction with the nitrobenzene, you'll get 1,3 dinitrobenzene or 1,6 dinitrobenzene.

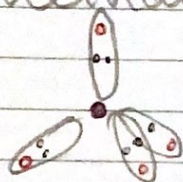
For the nitration of toluene (methyl benzene) a mixture of 2-nitrotoluene and 4-nitrotoluene is produced. Repeating the nitration would give 2,4 dinitrotoluene and 2,6 dinitrotoluene and then further nitration gives 2,4,6 trinitrotoluene.

Question 7

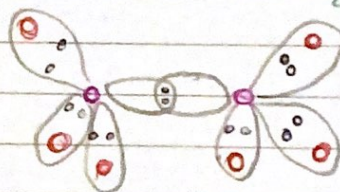
An Alkane (C_nH_{2n+2}) consists of one or more carbon atoms link to each other and to hydrogen atoms via Sigma bonds utilising sp^3 hybridised Carbon. Each C atom is linked to 4 other atoms either carbon or hydrogen.

Alkanes are considered to be saturated as they are unable to link any other atoms into their structure ~~without~~ without breaking any bonds.

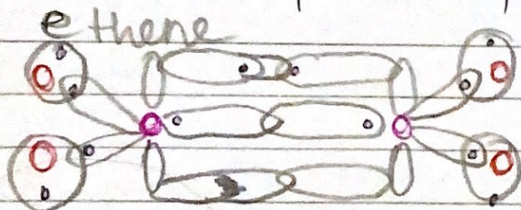
Methane CH_4



Ethane C_2H_6



Alkenes form unsaturated bonds and utilises sp and sp^2 hybridisation



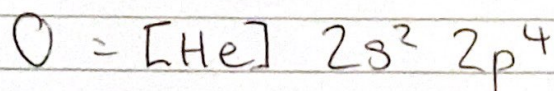
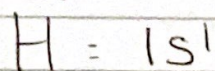
and Alkynes
Ethyne



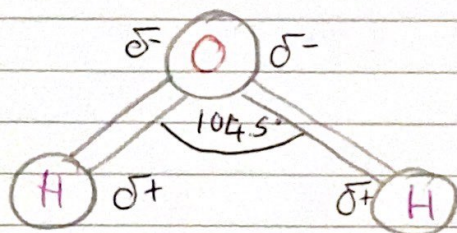
Other atoms can be added to these structures

Question 9.

Electronic structure of Hydrogen and Oxygen



A water molecule is made up of a oxygen atom and two hydrogen atoms.



Water molecules are polar as they form ~~perman~~^{hydrogen} bonds. This gives water a relatively high boiling point, high specific heat capacity, high adhesion and density. Water also illustrates amphoteric behavior. When it comes to OME devices water is considered to be an undesirable molecule as it causes corrosion the the shell of an explosive device. Also due to the presence of oxygen it can also cause premature ignition and reduce the shelf life of an explosive. The presence of water can also increase the sensitivity. If it starts a reaction with the high explosive compound in the OME device.