





8 Chemistry -
101

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H Let's continue the journey - January $8^{H} \quad \AA^{\circ} \circ^{\circ}$


Which of the following is possible for the same element:
a) different number of electrons?
b) different number of protons?
c) different number of neutrons?

| Group $\downarrow$ Peric |  | 2 | 3 |  | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 1 $H$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 He |
| 2 | $\begin{gathered} 3 \\ \mathrm{Li} \end{gathered}$ | $\begin{gathered} 4 \\ \mathrm{Be} \end{gathered}$ |  |  |  |  |  |  |  |  |  |  |  | 5 | C | $\begin{aligned} & 7 \\ & \mathrm{~N} \end{aligned}$ | $\begin{aligned} & 8 \\ & 0 \end{aligned}$ | 9 | 10 Ne |
| 3 | $\begin{aligned} & 11 \\ & \mathrm{Na} \end{aligned}$ | $\begin{aligned} & 12 \\ & \mathrm{Mg} \end{aligned}$ |  |  |  |  |  |  |  |  |  |  |  | $\begin{aligned} & 13 \\ & \mathrm{Al} \end{aligned}$ | $\begin{aligned} & 14 \\ & \mathrm{Si} \end{aligned}$ | $\begin{gathered} 15 \\ \mathrm{P} \end{gathered}$ | $\begin{gathered} 16 \\ S \end{gathered}$ | $\begin{aligned} & \hline 17 \\ & \mathrm{Cl} \end{aligned}$ | 18 Ar |
| 4 | $\begin{aligned} & 19 \\ & \mathrm{~K} \end{aligned}$ | $\begin{aligned} & 20 \\ & \mathrm{Ca} \end{aligned}$ | $\begin{aligned} & 21 \\ & \mathrm{Sc} \end{aligned}$ |  | $\begin{aligned} & 22 \\ & \mathrm{Ti} \end{aligned}$ | $\begin{gathered} 23 \\ \mathrm{~V} \end{gathered}$ | $\begin{aligned} & 24 \\ & \mathrm{Cr} \end{aligned}$ | $\begin{array}{\|l\|} \hline 25 \\ \mathrm{Mn} \end{array}$ | $\begin{aligned} & 26 \\ & \mathrm{Fe} \end{aligned}$ | $\begin{aligned} & 27 \\ & \text { Co } \end{aligned}$ | $\begin{aligned} & 28 \\ & \mathrm{Ni} \end{aligned}$ | $\begin{array}{\|l\|} \hline 29 \\ \mathrm{Cu} \\ \hline \end{array}$ | $\begin{aligned} & 30 \\ & \mathrm{Zn} \end{aligned}$ | $\begin{aligned} & 31 \\ & \mathrm{Ga} \end{aligned}$ | $\begin{aligned} & 32 \\ & \mathrm{Ge} \end{aligned}$ | $\begin{aligned} & 33 \\ & \text { As } \end{aligned}$ | $\begin{aligned} & 34 \\ & \mathrm{Se} \end{aligned}$ | $\begin{aligned} & 35 \\ & \mathrm{Br} \end{aligned}$ | $\begin{aligned} & 36 \\ & \mathrm{Kr} \end{aligned}$ |
| 5 | $\begin{aligned} & 37 \\ & \mathrm{Rb} \end{aligned}$ | $\begin{aligned} & \hline 38 \\ & \mathrm{Sr} \end{aligned}$ | $\begin{gathered} 39 \\ Y \end{gathered}$ |  | $\begin{aligned} & 40 \\ & \mathrm{Zr} \end{aligned}$ | $\begin{aligned} & 41 \\ & \mathrm{Nb} \end{aligned}$ | $\begin{aligned} & 42 \\ & \text { Mo } \end{aligned}$ | $\begin{aligned} & 43 \\ & \mathrm{Tc} \\ & \hline \end{aligned}$ | $\begin{aligned} & 44 \\ & \mathrm{Ru} \end{aligned}$ | $\begin{aligned} & 45 \\ & \mathrm{Rh} \\ & \hline \end{aligned}$ | $\begin{aligned} & 46 \\ & \mathrm{Pd} \end{aligned}$ | $\begin{aligned} & 47 \\ & \mathrm{Ag} \\ & \hline \end{aligned}$ | $\begin{aligned} & 48 \\ & \mathrm{Cd} \end{aligned}$ | $\begin{aligned} & 49 \\ & \text { In } \end{aligned}$ | $\begin{aligned} & 50 \\ & \mathrm{Sn} \end{aligned}$ | $\begin{aligned} & 51 \\ & \mathrm{Sb} \end{aligned}$ | $\begin{aligned} & \hline 52 \\ & \mathrm{Te} \end{aligned}$ | $\begin{gathered} 53 \\ \mathrm{I} \end{gathered}$ | $\begin{aligned} & 54 \\ & \mathrm{Xe} \\ & \hline \end{aligned}$ |
| 6 | $\begin{aligned} & 55 \\ & \mathrm{Cs} \end{aligned}$ | $\begin{aligned} & 56 \\ & \mathrm{Ba} \end{aligned}$ | $\begin{aligned} & 57 \\ & \mathrm{La} \end{aligned}$ | * | $\begin{aligned} & 72 \\ & \mathrm{Hf} \end{aligned}$ | $\begin{aligned} & 73 \\ & \mathrm{Ta} \end{aligned}$ | $\begin{aligned} & 74 \\ & 14 \end{aligned}$ | $\begin{aligned} & 75 \\ & \operatorname{Re} \end{aligned}$ | $76$ | $\begin{gathered} 77 \\ \mathrm{Ir} \end{gathered}$ | $\begin{aligned} & 78 \\ & \mathrm{Pt} \\ & \hline \end{aligned}$ | $\begin{aligned} & 79 \\ & \mathrm{Au} \end{aligned}$ | $\begin{aligned} & 80 \\ & \mathrm{Hg} \end{aligned}$ | $\begin{gathered} 81 \\ \mathrm{TI} \\ \hline \end{gathered}$ | $\begin{aligned} & 82 \\ & \mathrm{~Pb} \end{aligned}$ | $\begin{aligned} & 83 \\ & \mathrm{Bi} \\ & \hline \end{aligned}$ | $\begin{aligned} & 84 \\ & \text { Po } \\ & \hline \end{aligned}$ | $\begin{aligned} & 85 \\ & \text { At } \end{aligned}$ | $\begin{aligned} & 86 \\ & \text { Rn } \end{aligned}$ |
| 7 | $\begin{aligned} & 87 \\ & \mathrm{Fr} \\ & \hline \end{aligned}$ | $\begin{aligned} & 88 \\ & \mathrm{Ra} \\ & \hline \end{aligned}$ | $\begin{aligned} & \hline 89 \\ & \mathrm{Ac} \\ & \hline \end{aligned}$ | * | $\begin{gathered} 104 \\ \mathrm{Rf} \end{gathered}$ | $\begin{gathered} 105 \\ \mathrm{Db} \end{gathered}$ | $\begin{array}{\|c} \hline 106 \\ \mathrm{Sg} \\ \hline \end{array}$ | $\begin{gathered} 107 \\ \mathrm{Bh} \end{gathered}$ | $\begin{gathered} 108 \\ \mathrm{Hs} \end{gathered}$ | $\begin{gathered} 109 \\ \mathrm{Mt} \end{gathered}$ | $\begin{gathered} 110 \\ \text { Ds } \end{gathered}$ | $\begin{array}{\|c} \hline 111 \\ \mathrm{Rg} \\ \hline \end{array}$ | $\begin{array}{\|c} 112 \\ \mathrm{Cn} \end{array}$ | $\begin{aligned} & 113 \\ & \mathrm{Nh} \end{aligned}$ | $\begin{gathered} 114 \\ \mathrm{FI} \end{gathered}$ | $\begin{array}{\|c} \hline 115 \\ \mathrm{Mc} \\ \hline \end{array}$ | $\begin{gathered} 116 \\ \text { Lv } \end{gathered}$ | $\begin{gathered} 117 \\ \text { Ts } \\ \hline \end{gathered}$ | $\begin{array}{\|c} \hline 118 \\ \mathrm{Og} \\ \hline \end{array}$ |
|  |  |  |  | * | $\begin{array}{\|l} \hline 58 \\ \mathrm{Ce} \\ \hline \end{array}$ | $\begin{aligned} & 59 \\ & \mathrm{Pr} \\ & \hline \end{aligned}$ | $\begin{aligned} & 60 \\ & \mathrm{Nd} \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|} \hline 61 \\ \mathrm{Pm} \\ \hline \end{array}$ | $\begin{array}{r} \hline 62 \\ \mathrm{Sm} \\ \hline \end{array}$ | $\begin{aligned} & 63 \\ & \mathrm{Eu} \\ & \hline \end{aligned}$ | $\begin{aligned} & 64 \\ & \text { Gd } \end{aligned}$ | $\begin{aligned} & 65 \\ & \mathrm{~Tb} \\ & \hline \end{aligned}$ | $\begin{aligned} & 66 \\ & \text { Dy } \end{aligned}$ | $\begin{array}{r} 67 \\ \mathrm{Ho} \\ \hline \end{array}$ | $\begin{aligned} & 68 \\ & \mathrm{Er} \\ & \hline \end{aligned}$ | $\begin{array}{\|c\|} \hline 69 \\ \mathrm{Tm} \\ \hline \end{array}$ | $\begin{aligned} & 70 \\ & \mathrm{Yb} \end{aligned}$ | $\begin{aligned} & 71 \\ & \mathrm{Lu} \\ & \hline \end{aligned}$ |  |
|  |  |  |  | * | $\begin{aligned} & 90 \\ & \text { Th } \end{aligned}$ | $\begin{aligned} & 91 \\ & \mathrm{~Pa} \end{aligned}$ | $\begin{gathered} 92 \\ U \end{gathered}$ | $\begin{aligned} & 93 \\ & \mathrm{~Np} \end{aligned}$ | $\begin{aligned} & 94 \\ & \mathrm{Pu} \end{aligned}$ | $\begin{gathered} 95 \\ \text { Am } \end{gathered}$ | $\begin{aligned} & 96 \\ & \mathrm{Cm} \end{aligned}$ | $\begin{aligned} & \hline 97 \\ & \mathrm{Bk} \end{aligned}$ | $\begin{aligned} & 98 \\ & \text { Cf } \end{aligned}$ | $99$ | $\begin{aligned} & 100 \\ & \mathrm{Fm} \end{aligned}$ | $\begin{aligned} & 101 \\ & \text { Md } \end{aligned}$ | $\begin{aligned} & 102 \\ & \text { No } \end{aligned}$ | $\begin{gathered} 103 \\ \mathrm{Lr} \end{gathered}$ |  |

Going along a row from left to right, atoms get Smaller, and moving down a column, they get bigger.

Moving to the right, the bigger charge of the nucleus pulls electrons cloSer in.

Going down a column, the outer electrons are in higher shells, hence farther away from the nucleus.


Pefindic tabla of the olomonte
Oxidizing and non-metallic properties

## 



## Chemical reactions

In chemical reactions substances with certain compositions and properties turn into different substances with different compositions and properties BUT the nuclei of atoms DO NOT change.

## Combustion of methane in oxygen from the air



Coefficient Shows how many molecules participate or form in the reaction

Index show's the number of atoms in a molecules

## Combustion reaction

The number of atoms for each element is the same in the left and the right parts of the equation.

To equate the number of atoms in the left and the right parts of the equation we use coefficients that we write in front of the molecular formulas.

Unlike in math equations, left and right parts of chemical equations cannot be exchanged.

# Combination (Synthesis) reaction 

$$
\mathrm{CaO}+\mathrm{H}_{2} \mathrm{O} \rightarrow \mathrm{Ca}(\mathrm{OH})_{2}!
$$

## Decomposition reaction

$$
\mathrm{Ca}(\mathrm{OH})_{2} \xrightarrow{\Delta} \mathrm{CaO}+\mathrm{H}_{2} \mathrm{O}
$$

## Single and double replacement reactions

$$
\begin{gathered}
\mathrm{H}_{2}+\mathrm{CuO} \rightarrow \mathrm{Cu}+\mathrm{H}_{2} \mathrm{O} \text { (redox reaction) } \\
\mathrm{Zn}+2 \mathrm{HCl} \rightarrow \mathrm{H}_{2} \uparrow+\mathrm{ZnCl}_{2}
\end{gathered}
$$

$\mathrm{CaBr}_{2}+2 \mathrm{HF} \rightarrow \mathrm{CaF}_{2} \mid+2 \mathrm{HBr}$

This class uses the materials from the following books:
Larry Gonick and Graig Criddle "The cartoon guide to chemistry"
Manyuilov and Rodionov "Chemistry for children and adults" Kuzmenko, Eremin, Popkov "Beginnings of chemistry"

