1. Periodic table and electronic configuration

Let us Assess

1. Question

Which are the subshells in which electrons are filled in the s block elements of the third period? Write the subshell electronic configuration of the last element of this period.

Answer

The subshells in which electrons are filled in the s block elements of the third period are 1s,2s,2p,3s.

$_{18}Ar–\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

The s block elements of the third period are Na and Mg. So 1s,2s,2p,3s are the subshells in which electrons are filled.

The last element of third period is Argon which has atomic number 18.

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2. Question

When the last electron of an atom was filled in the 3d subshell, the subshell electronic configuration was recorded as $3d^8$. Answer the questions related to this atom.

• Complete subshell electronic configuration

• Atomic number

• Block

• Period number

• Group number

Answer

Complete subshell electronic configuration = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$

Atomic number = 28

Block = d-block

Period number = 4

Group number = 10

It is the electronic configuration of Ni. Ni is the element of d-block. Ni has atomic number 28 and it is the element of 4 period and 10 group in periodic table.

3. Question

Pick out the wrong ones from the subshell electronic configurations given below.

a) $1s^2\ 2s^2\ 2p^7$

b) $1s^2\ 2s^2\ 2p^2$

c) $1s^2\ 2s^2\ 2p^5\ 3s^1$

d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^1$

e) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$

Answer

The wrong electronic configurations are a), c), d).

In a) $1s^2\ 2s^2\ 2p^7$, p subshell can have a maximum of only 6 electrons.

In c) $1s^2\ 2s^2\ 2p^5\ 3s^1$, According to Aufbau rule electrons will be filled first in that subshell which has less energy and when less energy subshell will become full filled then after this next subshell will be filled.

In d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^1$, here 4s subshell will be full filled first and after this 3d subshell will fill because 4s subshell has less energy than 3d subshell.

4. Question

The element X in group 17 has 3 shells. If so,

a) Write the subshell electronic configuration of the element.

b) Write the period number

c) What will be the chemical formula of the compound formed if the element X reacts with element Y of the third period which contains one electron in the p subshell?

Answer

a) Subshell electronic configuration = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

b) Period number = 3

c) Chemical formula when element X reacts with element Y= YX_3

Element X has 3 shells means it is the element of 3 period. So, element X is Chlorine which is the element of 3 period and 17 group.

And element Y of the third period has 3 valence electrons because there is one electron in a 3p subshell and 2 electrons are in 3s subshell because s subshell filled first than p subshell. So, the chemical formula will be YX_3.

5. Question

The element Cu with atomic number 29 undergoes chemical reaction to form an ion with oxidation number +2.

a) Write down the subshell electronic configuration of this ion.

b) Can this element show variable valency? Why?

c) Write down the chemical formula of one compound formed when this element reacts with chlorine ($_{17}Cl$).

Answer

a) $Cu^{2+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9$

b) Yes. Because in d-block elements there is very small energy difference between the outer most s subshell and the penultimate d subshell. Hence under suitable conditions, the electrons of d subshell also take part in chemical reactions. So, Cu shows variable valency.

c) $CuCl_2$

Cu shows +2 oxidation state and Cl shows -1 oxidation states in the chemical reaction so when these two elements will react then the chemical formula will be $CuCl_2$.

6. Question

Certain subshells of an atom are given below. 2s, 2d, 3f, 3d, 5s, 3p

a) Which are the subshells that are not possible?

b) Give the reason.

Answer

a) 2d, 3f

b) In the first shell, there is only 1s subshell because this shell can have a maximum of only 2 electrons. So 1p subshell does not exist.

In the second shell, there are 2s and 2p subshells because this shell can have a maximum of 8 electrons. So 2d does not exist.

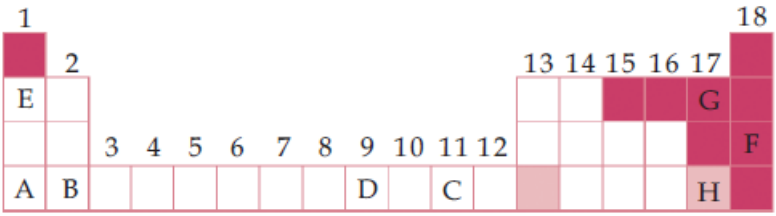
In the third shell, there are 3s, 3p, and 3d subshells because this shell can have a maximum of 18 electrons. So 3f does not exist.

In fourth shell, there are 4s, 4p, 4d and 4f subshells because this shell can have maximum of 32 electrons.

Extended Activities

1. Question

A part of the periodic table is given below. The symbols of elements given in the columns are not real.



a) Which are the elements having only one electron in the 4s subshell?

b) Which is the element in s block with the smallest atomic radius?

c) Which are the elements likely to form coloured compounds?

d) Which is the metal with the highest reactivity?

e) Which is the element with the least reactivity?

f) Which is the element in which the last electron is filled in the 4p sub shell? Find its atomic number.

g) Frame as many questions as possible to get each element in this table as the answer.

Answer

a) A and C.

Since the element has one electron in a 4s subshell so from this we can find that this element of 4 periods and 1 group.

In d-block elements, the group number will be equal to the sum of total electrons of s subshell and the electrons in preceding d subshell. So A and C are the elements which have one electron in 4s subshell.

b) E

When we go from up to down in a group then a number of shells increases so the radius is also increased. Therefore, the element with the smallest radius in s block is E.

c) D and C

d-block elements (transition elements) form coloured compounds due to the presence of transition element ions. So, element D and C will form coloured compounds.

d) A

Since A is in the bottom in group 1 and the size of A is greater than the other metals due to increment in

shells. So, A will loss his 1 electron more easily than other metals and will make compound easily.

e) F

Noble gases are less reactive due to full filled octet. So, F is less reactive.

f) H, Atomic number = 35

If we compare this periodic table ‘s part to the modern periodic table then H is Br which has atomic number 35 and so electronic configuration will be $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ $4s^2$ $3d^{10}$ $4p^5$. We can also calculate atomic number by count the elements 2+8+8+17=35.

g)

(i) The lightest metal in s-block?

(ii) The second lightest metal in s-block?

(iii) Which metal is important for strong bones?

(iv) Which transition element ‘s chloride is blue in the dry state?

(v) Which is the most reactive element in the periodic table?

(vi) Which noble gas is used in welding along with Helium?

(vii) Which element in halogen family is used for unsaturation test?

(viii) Which element is used with zinc to make brass alloy?