5. Atomic Structure

Multiple Choice Questions

1. Question

Among the following the odd pair is

A. $^{18}_{8}O$, $^{37}_{17}Cl$

B. $^{40}_{18}Ar$, $^{14}_{7}N$

C. $^{30}_{14}Si$, $^{31}_{15}P$

D. $^{54}_{24}Cr$, $^{39}_{19}K$

Answer

Atoms	Protons	Electrons	Neutrons
$^{18}_{8}O$	8	8	10
$^{37}_{17}Cl$	17	17	20
$^{40}_{18}Ar$	18	18	24
$^{14}_{7}N$	7	7	7
$^{30}_{14}Si$	14	14	16
$^{31}_{15}P$	15	15	16
$^{54}_{24}Cr$	24	24	30
$^{39}_{19}K$	19	19	20

It can be seen that the third pair has atoms with same number of neutrons i.e. the two atoms are isotones. But, none other pair has isotenes.

2. Question

Change in the number of neutrons in an atom changes it to

A. an ion.

B. an isotope.

C. an isobar.

D. another element.

Answer

Isotope is defined as the elements having similar mass number. And we know that

Mass Number = Total no. Of Protons+ Total no. of Neutrons

Thus, if mass no. is same then the no. of neutrons must be same.

3. Question

The term nucleons refer to

A. Protons and electrons

B. only Neutrons

C. electrons and neutrons

D. Protons and neutrons

Answer

Nucleons are referred to the protons and the neutrons.

4. Question

The number of protons, neutrons and electrons present respectively in $^{80}_{35}Br$

A. 80, 80, 35

B. 35, 55,80

C. 35, 35, 80

D. 35, 45, 35

Answer

Atomic number = Total no. of electrons = 35

Now, No. of electrons = No. of Protons = 35

And, Mass Number = Protons + Neutrons = 80

$\therefore$ No. of neutrons = Mass no. – Protons

= 80 – 35 = 45

5. Question

The correct electronic configuration of potassium is

A. 2,8,9

B. 2,8,1

C. 2,8,8,1

D. 2,8,8,3

Answer

No. of electrons in Potassium = 19

∴ No. of electrons in K-shell = 2

L-shell = 8

M-shell = 8

N-shell = 1

True or False

1. Question

In an atom, electrons revolve around the nucleus in fixed orbits.

Answer

True

Yes, the electrons revolve around the nucleus in fixed orbits.

2. Question

Isotopes of an element have the different atomic numbers.

Answer

False

Isotopes of elements have different mass numbers.

3. Question

Electrons have negligible mass and charge.

Answer

False

Electrons have negligible mass but is has a charge of 1.602×10^{-19} Coulombs.

4. Question

Smaller the size of the orbit, lower is the energy of the orbit.

Answer

True

Since, as we go higher the energy starts increasing. Thus higher the orbit higher will be the energy and lower the orbit lower will be the energy.

5. Question

The maximum number of electron in L Shell is 10.

Answer

False

The no. of electrons in L shell is 8.

Since, No. of electrons = $2n^2 = 2(2)^2 = 2x4 = 8$

Fill In the Blanks

1. Question

Calcium and Argon are examples of a pair of _____.

Answer

Isobars

2. Question

Total Number of electrons that can be accommodated in an orbit is given by _____.

Answer

$2n^2$

3. Question

_____ isotope is used in the treatment of goitre.

Answer

iodine-131

4. Question

The number of neutrons present in $^{7}_{3}LI$ is _____.

Answer

4

5. Question

The valency of Argon is _____.

Answer

0

Since, argon is a noble gas thus its valency is zero.

Match The Following

1 A. Question

Match the following:

a) Dalton	1. Hydrogen atom model
b) Thomson	2. Planetary model
c) Rutherford	3. First atomic theory
d) Neils Bohr	4. Plum pudding model
	5. Discovery of neutrons

Answer

a) Dalton	3. First atomic theory
b) Thomson	4. Plum pudding model
c) Rutherford	5. Discovery of neutrons
d) Neils Bohr	1. Hydrogen atom model 2. Planetary model

1 B. Question

Match the following:

a) Mass of proton	1) 1.6×10^{-19} C
b) Mass of electron	2) -1.6×10^{-19} C
c) Charge of electron	3) 9.31×10^{-28} g
d) Charge of proton	4) 1.67×10^{-24} g

Answer

a) Mass of proton	4) 1.67×10^{-24} g
b) Mass of electron	3) 9.31×10^{-28} g
c) Charge of electron	2) -1.6×10^{-19} C
d) Charge of proton	1) 1.6×10^{-19} C

Complete the following table

1. Question

Complete the following table

Atomic Number	Mass Number	Number of Neutrons	Number of Protons	Number of Electrons	Name of the Element
9	-	10	-	-	-
16	-	16	-	-	-
-	24	-	-	12	Magnesium
-	2	-	1	-	-
-	1	0	1	1	-

Answer

Atomic Number	Mass Number	Number of Neutrons	Number of Protons	Number of Electrons	Name of the Element
9	19	10	9	9	Fluorine
16	32	16	16	16	Silicon
12	24	12	12	12	Magnesium
1	2	1	1	1	Deuterium
1	1	0	1	1	Hydrogen

*Deuterium is an isotope of Hydrogen

Arrange the following

1. Question

Arrange the following in the increasing order of atomic number

Calcium, Silicon, Boron, Magnesium, Oxygen, Helium, Neon, Sulphur, Fluorine and Sodium

Answer

Rearranging in the increasing order of atomic number:

1. Helium

2. Boron

3. Oxygen

4. Fluorine

5. Neon

6. Sodium

7. Magnesium

8. Silicon

9. Sulphur

10. Calcium

Cross word Puzzle

1 A. Question

Cross word puzzle

Clues:

Down:

1. Helium Nuclei (Particle)

2. Positive Charge mass at the core of the atom

3. An atom whose valency is zero

4. One or two electrons in the outermost shell of atoms of elements are called as _____ electrons.

5. $^{14}_{6}C$ is used for carbon dating

6. Discovery of neutron

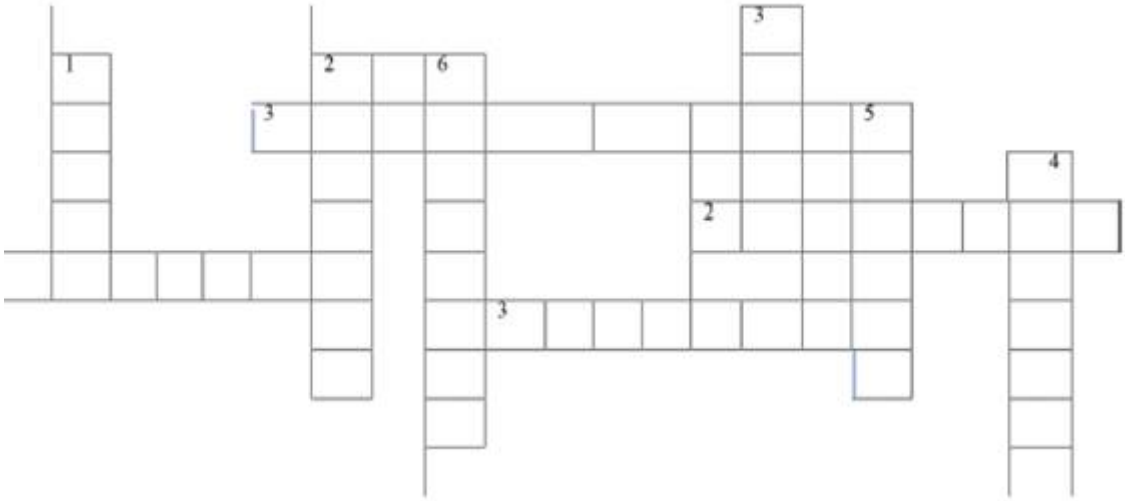
Across:

1. Electrons present in the outermost shell

2. This pair of atoms $^{40}_{20}Ca$, $^{40}_{18}Al$ are ___

3. An atom that does not have neutron

4. Scattering of α particles in the gold foil experiment



Answer

Down

1. Alpha

2. Hydrogen

3. Argon

4. Valence

5. Carbon

6. Chadwick

Across:

1. Valence

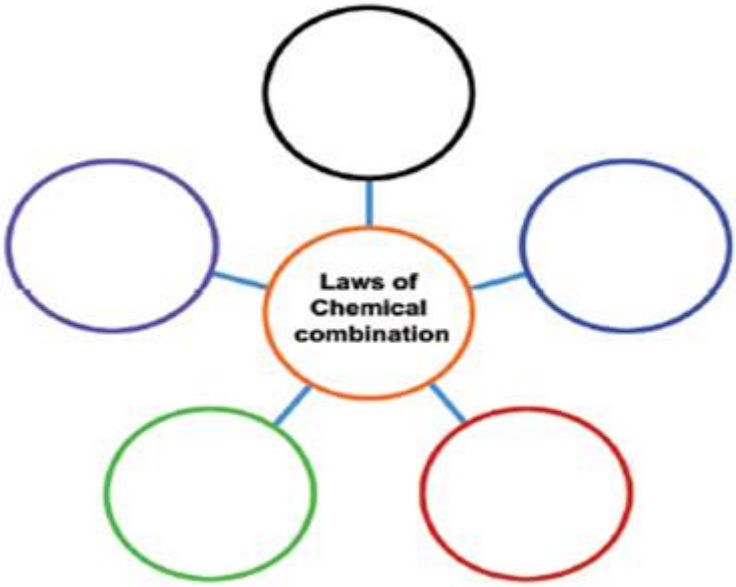
2. Lone Pair

3. Hydrogen

4. Rutherford

1 B. Question

Copy the following and write the names of the laws and their simple definitions in the space provided.



Answer

● Box-1: Law Of Multiple Proportions:

This law states that when two elements combine with each other to form more than one compound, the weights of one element that combine with a fixed weight of the other are in a ratio of small whole numbers.

● Box-2: Law of Conservation of Mass:

This law states that the mass in an isolated system is neither created nor destroyed by chemical reactions or physical transformations.

According to the law of conservation of mass, the total mass of the reaction in a chemical reaction must equal the mass of the reactants.

● Box-3: Law of constant Proportions:

The law of constant composition says that, in any particular chemical compound, all samples of that compound will be made up of the same elements in the same proportion or ratio.

● Box-4: Law of Reciprocal proportions:

This law states that if two different elements combine separately with the same weight of a third element, the ratio of the masses in which they do so are either the same or a simple multiple of the mass ratio in which they combine.

● Box-5: Gay Lussac's Law of Gaseous volumes:

This law states that the ratio between the volumes of the reactant gases and the gaseous products can be expressed in simple whole numbers. 2 molecules of hydrogen + 1 molecule of oxygen = 2 molecules of water.

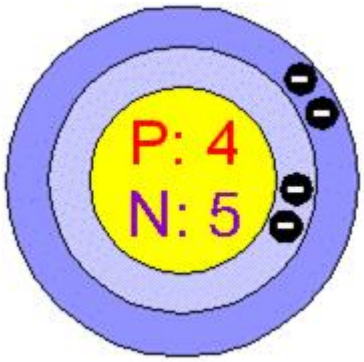
Very Short Answer Type

1. Question

Name an element which has the same number of electrons in its first and second shell.

Answer

Berilium (atomic number: 4)



2. Question

Write the electronic configuration of K^+ and Cl^-

Answer

Electronic configuration of K^+:

K-shell: 2

L-shell: 8

M-shell: 8

(Since one electron is lost thus the electronic configuration will be like this)

Electronic configuration of Cl^-:

K-shell: 2

L-shell: 8

M-shell: 8

(Since one electron is added thus the electronic configuration will be like this)

3. Question

Compare the charge and mass of protons and electrons.

Answer

Charge:

The electronic charge of the proton and the electron both are same. Only there is a change on sign.

Since proton has a positive charge thus its charge is $+1.6 \times 10^{-19}$ C

Whereas electron has negative charge so the charge of electron is -1.6×10^{-19} C.

Mass:

The proton is much heavier in weight whereas electrons have negligible weight.

The weight of proton is 1.67×10^{-24} g whereas the mass of the electron is 9.31×10^{-28} g.

4. Question

For an atom 'X', K, L and M shells are completely filled. How many electrons will be present in it?

Answer

We know that maximum no of electrons in:

K-shell = 2

L-shell = 8

M-shell = 18

Therefore; total no. of electrons = 2+8+18 = 28.

5. Question

Ca^{2+} has completely filled outer shell. Justify your answer.

Answer

Ca^{2+} means that calcium has lost 2 electrons.

Now; atomic number of Ca = 20

Since, it has lost 2 electrons, thus the no of electrons left are = 18

Thus, atomic configuration of Ca^{2+} = 2, 8, 8

This shows that the Ca^{2+} has a completely filled outer shell.

Short Answer Type

1. Question

State the law of multiple proportions.

Answer

Law of Multiple Proportions:

This law states that when two elements combine with each other to form more than one compound, the weights of one element that combine with a fixed weight of the other are in a ratio of small whole numbers.

2. Question

List the uses of isotopes?

Answer

Uranium235: This isotope of uranium is used as fuel in nuclear reactor.

Cobalt60: This isotope of cobalt is used in treatment of cancer.

Iodine131: This isotope of iodine is used in treatment of goitre.

Carbon14: This isotope of carbon is used in Carbon dating (that is to find the age of plants and animals).

3. Question

What is isotone? Give an example

Answer

Isotone is defined as two or more atoms having the same number of neutrons.

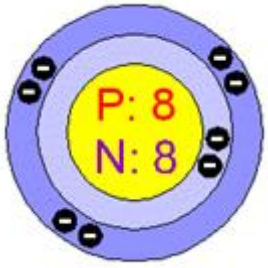
Example: chlorine-37 and potassium-39 are isotones, because the nucleus of this species of chlorine consists of 17 protons and 20 neutrons, whereas the nucleus of this species of potassium contains 19 protons and 20 neutrons.

4. Question

Draw the structure of oxygen and sulphur atoms.

Answer

Structure of oxygen atom:



Structure of sulphur atom:

5. Question

Calculate the number of neutrons, protons and electrons (i) atomic number 3 and mass number 7 (ii) atomic number 92 and mass number238.

Answer

i) Given,

Atomic Number = 3

Mass Number = 7

Therefore,

No. of electrons = atomic number = no. of protons = 3

And,

Mass Number = no. of protons+ no. of neutrons = 7

Thus, no. of neutrons = 4

ii) Given,

Atomic Number = 92

Mass Number = 238

Therefore,

No. of electrons = atomic number = no. of protons = 92

And,

Mass Number = no. of protons+ no. of neutrons = 238

Thus, no. of neutrons = 238-92 = 146

Numerical Problem

1. Question

Calculate the volume of oxygen required for the complete combustion of 20 cm^3 of methane[$CH_{4(g)} + 2O_2 \rightarrow CO_{2(g)} + 2H_2O_{(g)}$].

Answer

$CH_4(g)$	$+2O_2(g)$	→	$CO_2(g)$	$+2H_2O(g)$
1 Volume	2 Volume		1 Volume	2 Volume
1× 20 cm^3	2×20 cm^3		1× 20 cm^3	2×20 cm^3
20 cm^3	40 cm^3		20 cm^3	40 cm^3

Thus, the Volume of oxygen used is 40 cm^3

2. Question

A metal combines with oxygen to form two oxides having the following composition

i) 0.398 gram of metal oxide I contains 0.318 gram of metal

ii) 0.716 gram of metal oxide II contains 0.636 gram of metal. So that the above data agrees with the law of multiple proportions.

Answer

i) 0.398g metal oxide contains 0.318g of metal.

Therefore, amount of oxygen combining with

0.318g metal oxide I = 0.398-0.318 = 0.080g

ii) 0.716g metal oxide contains 0.636g of metal.

Therefore, amount of oxygen combining with

0.318g metal oxide I = 0.716-0.636 = 0.080g

Thus, for fixed mass of oxygen (0.080g), the metal forma oxides in the ratio = 0.318:0.636 = 1:2

Since, it is a simple ratio therefore the above data agrees with the law of multiple proportion.

3. Question

Calculate the mass of a proton, given its charge = + 1.60×10^{-19} C

charge / mass = 9.58×10^7 C kg^{-1}

Answer

Given:

Charge of proton = + 1.60×10^{-19} C

And, charge / mass = 9.58×10^7 C kg^{-1}

$$\frac{1.60 \times 10^{-19}\,\mathrm{C}}{\text{mass}} = 9.58 \times 10^{7}\,\mathrm{CKg^{-1}}$$

$$\therefore \text{mass} = \frac{1.60 \times 10^{-19}\,\mathrm{C}}{9.58 \times 10^{7}\,\mathrm{CKg^{-1}}} = 0.167 \times 10^{-26}\mathrm{Kg}$$

Thus, the mass of proton is $0.167 \times 10^{-26}\mathrm{Kg}$

Long Answer Type

1. Question

What conclusions were made from the observations of Gold foil experiment?

Answer

From the Gold foil experiment, Rutherford and his team observed that:

● Most of the fast moving α-particles passed straight through the gold foil.

● Some α particles were deflected by small angles and a few by large angles.

● Surprisingly very few α particles completely rebounded.

Thus the conclusions made were:

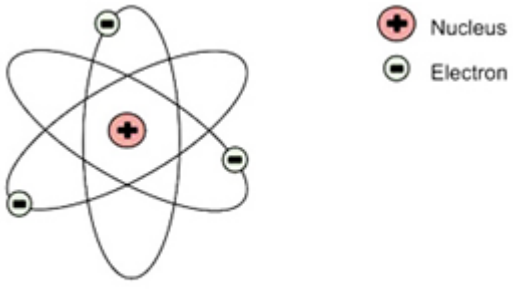
● Atom has a very small nucleus at the centre.

● There is large empty space around the nucleus.

● Entire mass of an atom is concentrated in a very small positively charged region which is called the nucleus.

● Electrons are distributed in the vacant space around the nucleus.

● The electrons move in circular paths around the nucleus.



Rutherford Model of the Atom

2. Question

Explain the postulates of Bohr's atomic model.

Answer

The main postulates of Bohr's atomic model are:

● In atoms, electrons revolve around the nucleus in certain special or permissible orbits known as orbits or shells or energy levels.

● While revolving in these orbits the electrons do not radiate energy.

● The circular orbits are numbered as 1, 2, 3, 4, … or named as K, L, M, N, shells. These numbers are referred to as principal quantum numbers (n).

● K shell (n = 1) is closest to the nucleus and is associated with lowest energy. L, M, N, …. etc are the next higher energy levels. As the distance from the nucleus increases the energy of the shells also increases.

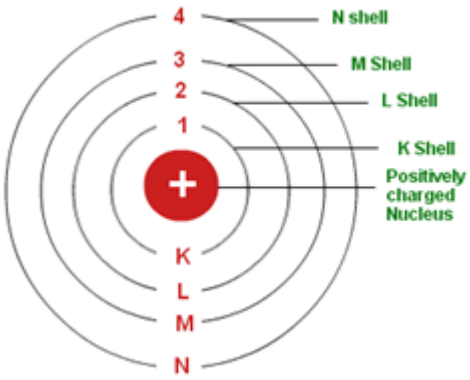
● The energy of each orbit or shell is a fixed quantity and the energy is quantized.

● As the distance from the nucleus increases, the size of the orbits also increases.

● Maximum number of electrons that can be accommodated in an energy level is given by $2n^2$ where n is the principal quantum number of the orbit.

● When an electron absorbs energy, it jumps from lower energy level to higher energy level.

● When an electron returns from higher energy level to lower energy level, it gives off energy.



3. Question

State the Gay Lussac's law of combining volumes, explain with an illustration.

Answer

Gay Lussac's law of combining volumes:

This law states that when gases react, they do so in volumes which bear a simple ratio to one another, and to the volume of the product(s) formed if gaseous, provided the temperature and pressure remain constant.

The law explains experimental facts about how gaseous atoms combine.

Example:

For the reaction: $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

1 vol. 3 vols. 2 vols.

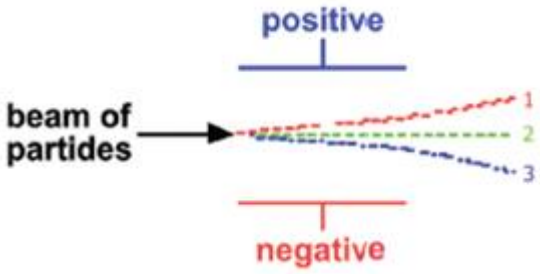
1 volume of nitrogen combines with 3 volumes of hydrogen to form 2 volumes of ammonia.

Thus, the ratio is 1:3:2.

This satisfies the Gay Lussac's law of combining volumes.

Unlock

1. Question



The particles represented above are

	1	2	3
a.	electrons	protons	neutrons.
b.	protons	electrons	Neutrons
c.	neutrons.	protons	electrons
d.	electrons	neutrons	Protons

Answer

1. a) and d) Electrons

2. d) Neutrons

3. d) Protons

2. Question

From the structures given below, Tabulate the following:

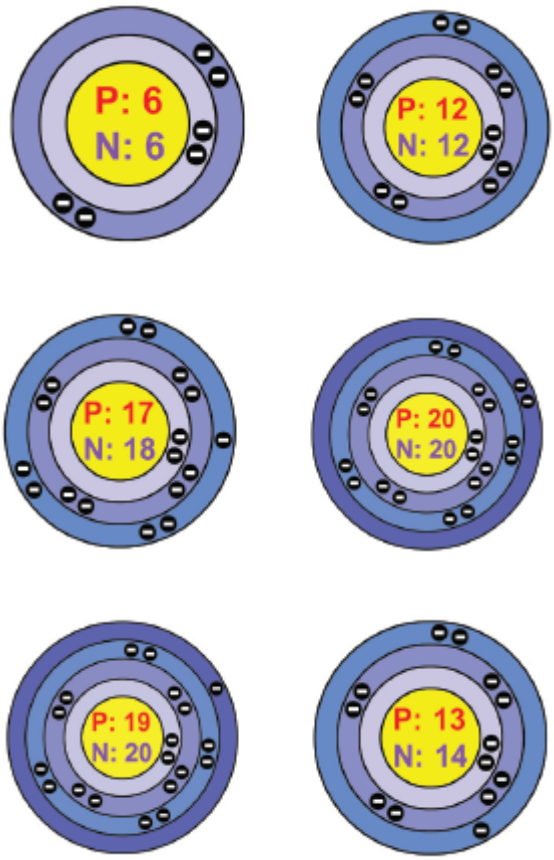
1. Valence electron

2. Valency

3. Atomic Number

4. Mass number

5. Electronic configuration



Answer

Figure1:

1. Valence electron: 4

2. Valency: 4

3. Atomic Number: 6

4. Mass number: 12

5. Electronic configuration: 2, 4

Figure2:

1. Valence electron: 2

2. Valency: 2

3. Atomic Number: 12

4. Mass number: 24

5. Electronic configuration: 2, 8, 2

Figure3:

1. Valence electron: 7

2. Valency: 1

3. Atomic Number: 17

4. Mass number: 35

5. Electronic configuration: 2, 8, 7

Figure4:

1. Valence electron: 2

2. Valency: 2

3. Atomic Number: 20

4. Mass number: 40

5. Electronic configuration: 2, 8, 8, 2

Figure5:

1. Valence electron: 1

2. Valency: 1

3. Atomic Number: 19

4. Mass number: 39

5. Electronic configuration: 2, 8, 8, 1

Figure6:

1. Valence electron: 3

2. Valency: 3

3. Atomic Number: 13

4. Mass number: 27

5. Electronic configuration: 2, 8, 3

3. Question

The correct numbers of protons and neutrons present in $^{23}_{11}Na^{+}$ are

	Protons	neutrons
a.	11	23
b.	10	12
c.	11	12
d.	11	22

Answer

c) 11, 12

(Since, the protons and neutrons remains same)