

9th Science Lesson 11 Questions in English**11] Atomic Structure**

1. Who among the following did gold foil experiment?

- a) J.J. Thomson
- b) Rutherford**
- c) Neil's Bohr
- d) Marie Curie

Explanation

In 1911, Lord Rutherford, a scientist from New Zealand, performed his famous experiment of bombarding a thin gold foil with very small positively charged particles called alpha (α) particles. He selected a gold foil because, he wanted as thin layer as possible and gold is the most malleable metal.

2. Which of the following were observed by Rutherford in his gold foil experiment?

- 1) Most of the alpha particles passed straight through the foil.
 - 2) Some alpha particles were slightly deflected from their straight path
 - 3) Very few alpha particles completely bounced back.
- a) 1, 2
 - b) 1, 3
 - c) 2, 3
 - d) All the above**

Explanation

Rutherford observed that:

- 1. Most of the alpha particles passed straight through the foil.
- 2. Some alpha particles were slightly deflected from their straight path.
- 3. Very few alpha particles completely bounced back.

Rutherford generalized these results of alpha particles scattering experiment and suggested a model of the atom that is known as Rutherford's Atomic model.

3. Which of the following statement is correct about Rutherford's Atomic model?

- 1) The atom contains large empty space.
 - 2) A nucleus as a whole is electrically neutral
 - 3) The size of the nucleus of an atom is very small compared to the size of an atom.
- a) 1, 2

- b) 1, 3
- c) 2, 3
- d) All the above

Explanation

According to Rutherford's Atomic model:

- i. The **atom** contains **large empty space**.
 - ii. There is a **positively charged mass at the centre of the atom, known as nucleus**.
 - iii. The **size of the nucleus** of an atom is **very small compared to the size of an atom**.
 - iv. The electrons revolve around the nucleus in close circular paths called orbits.
 - v. An **atom as a whole is electrically neutral**, i.e., the number of protons and electrons in an atom are equal.
4. Who's atomic structure is similar to the structure of the solar system?
- a) J.J. Thomson
 - b) Rutherford**
 - c) Neil's Bohr
 - d) Marie Curie

Explanation

Rutherford's model of the atom was somewhat like that of the **solar system**. Rutherford's model of atomic structure is similar to the structure of the solar system. Just as in the solar system, the Sun is at the centre and the planets revolve around it, similarly in an atom the nucleus present at the centre and the electrons revolve around it in orbits or shells.

5. Assertion (A): Rutherford's model failed to explain the stability of an atom.

Reason (R): According to Electromagnetic theory, a moving electron should accelerate and continuously lose energy. Due to the loss of energy, path of electron may reduce and finally, the electron should fall into the nucleus.

- a) Both (A) and (R) are correct, but (R) does not explain (A)
- b) Both (A) and (R) are wrong
- c) Both (A) and (R) are correct and (R) explains (A)**
- d) (A) is Correct and (R) is wrong

Explanation

According to Electromagnetic theory, a moving electron should accelerate and continuously lose energy. Due to the loss of energy, path of electron may reduce and finally the electron should fall into the nucleus. If it happens so, atom becomes unstable. But atoms are stable. Thus, Rutherford's model failed to explain the stability of an atom.

6. Who among the following explained the causes of the stability of the atom?

- a) J. J. Thomson
- b) Rutherford
- c) **Neil's Bohr**
- d) James Chadwick

Explanation

In 1913, Neil's Bohr, a Danish physicist, explained the causes of the stability of the atom in a different manner.

7. Which of the following are postulates of Bohr's model of an atom?

- 1) While revolving around the nucleus in an orbit, an electron neither loses nor gains energy
- 2) An electron in a shell can move to a higher or lower energy shell by absorbing or releasing a fixed amount of energy
- 3) The orbits or shells are represented by the letters K, L, M, N, ... or the numbers, $n = 1, 2, 3, \dots$
 - a) 1, 2
 - b) 1, 3
 - c) 2, 3
 - d) **All the above**

Explanation

The main postulates of Bohr's model of an atom are:

- i. In atoms, the electrons revolve around the nucleus in stationary circular paths called orbits or shells or energy levels.
- ii. While revolving around the nucleus in an orbit, an electron neither loses nor gains energy.
- iii. An electron in a shell can move to a higher or lower energy shell by absorbing or releasing a fixed amount of energy.
- iv. The orbits or shells are represented by the letters K, L, M, N, ... or the numbers, $n = 1, 2, 3, 4, \dots$

8. According to Bohr's model of atom which orbit has least amount of energy?

- a) **K**
- b) L

- c) M
- d) N

Explanation

The orbit closest to the nucleus is the K shell. It has the least amount of energy and the electrons present in it are called K electrons, and so on with the successive shells and their electrons. These orbits are associated with fixed amount of energy, so Bohr called them as energy level or energy shells.

9. Which of the following element was/were able to be explained by Bohr's model?

- a) Hydrogen
- b) He⁺
- c) Li²⁺
- d) **All the above**

Explanation

One main limitation was that Bohr's model was applicable only to hydrogen and hydrogen like ions (example, He⁺, Li²⁺, Be³⁺, and so on). **It could not be extended to multi electron nucleus.**

10. Who invented neutrons?

- a) J. J. Thomson
- b) Rutherford
- c) Neil's Bohr
- d) **James Chadwick**

Explanation

In 1932 James Chadwick observed when Beryllium was exposed to alpha particles, particles with about the same mass as protons were emitted. In 1920, Rutherford predicted the presence of another particle in the nucleus as neutral. **James Chadwick, the inventor of neutron** was student of Rutherford.

11. What was the superscript of Neutron?

- a) 0
- b) 2
- c) 1
- d) 3

Explanation

Beryllium + alpha ray → carbon + neutron

The resultant emitted particles which carried no electrical charges. They were called as neutrons. It is denoted by ${}^1_0\text{n}$. The superscript 1 represents its mass and subscript 0 represents its electric charge.

12. What was the mass of neutron?

- a) $1.676 \times 10^{-24} \text{ g}$
- b) $1.676 \times 10^{24} \text{ g}$
- c) $1.676 \times 10^{-14} \text{ g}$
- d) $1.676 \times 10^{14} \text{ g}$

Explanation

Properties of Neutrons

1. This particle was not found to be deflected by any magnetic or electric field, proving that it is electrically neutral.
2. Its **mass** is equal to $1.676 \times 10^{-24} \text{ g}$ (1 amu).

13. Which sub-atomic particles is of great importance in understanding the structure of an atom?

- 1) Electrons
 - 2) Protons
 - 3) Positrons
 - 4) Neutrons
- a) 1, 2
 - b) 1, 3, 4
 - c) **1, 2, 4**
 - d) 2, 3, 4

Explanation

The atom is built up of a number of subatomic particles. The three sub-atomic particles of great importance in understanding the structure of an atom are electrons, protons and neutrons.

14. What is the mass of Proton?

- a) **1 amu**
- b) 2 amu
- c) $1/18379 \text{ amu}$
- d) 1.5 amu

Explanation

Particle	Symbol	Charge (electronic units)	mass (amu)	mass (grams)
Electron	${}_{-1}\text{e}^0$	-1	1/1837	9.1×10^{-28}
Proton	${}_{+1}\text{H}^1$	+1	1	1.6×10^{-24}
Neutron	${}_0\text{n}^1$	0	1	1.6×10^{-24}

15. Which of the following are collectively known as nucleons?

- 1) Protons
- 2) Electrons
- 3) Neutrons
- a) 1, 2
- b) 1, 3**
- c) 2, 3
- d) All the above

Explanation

There are two structural parts of an atom, the nucleus and the empty space in which there are imaginary paths called orbits. Orbit is defined as the path, by which electrons revolve around the nucleus. The **protons and neutrons [collectively called nucleons]** are found in the nucleus of an atom.

16. Which of the following are particles discovered in the nucleus of an atom?

- 1) Mesons
- 2) Neutrino
- 3) Antineutrino
- 4) Positrons
- a) 1, 2, 4
- b) 2, 3, 4**
- c) 1, 2, 3
- d) All the above

Explanation

Besides the fundamental particles like protons, electrons and neutrons some more particles are discovered in the nucleus of an atom. They include **mesons, neutrino, antineutrino, positrons** etc.

17. Which of the following decides which element it is?

- a) Electrons
- b) Protons**

- c) Neutrons
- d) None

Explanation

Only hydrogen atoms have one proton in their nuclei. Only helium atoms have two protons. Indeed, only gold atoms have 79 protons. This shows that the number of protons in the nucleus of an atom decides which element it is.

18. Atomic Number is equal to_____

- 1) Number of protons
- 2) Number of neutrons
- 3) Number of electrons
 - a) 1 alone
 - b) 1 or 3**
 - c) 2 or 3
 - d) All the above

Explanation

Atomic number (Z) = Number of protons = Number of electrons

This is a very important number is known as the atomic number (proton number, given the symbol Z) of an atom.

19. Mass number is the sum of_____

- 1) Number of protons
- 2) Number of neutrons
- 3) Number of electrons
 - a) 1, 2**
 - b) 1, 3
 - c) 2 alone
 - d) All the above

Explanation

Protons alone do not make up all of the mass of an atom. The neutrons in the nucleus also contribute to the total mass. The mass of the electron can be regarded as so small that it can be ignored. As a proton and a neutron have the same mass, the mass of a particular atom depends on the total number of protons and neutrons present. This number is called the mass number (or nucleon number, given the symbol A) of an atom.

Mass number = Number of protons + Number of neutrons

20. What is the Atomic number of Nitrogen?

- a) 8
- b) 7
- c) 14
- d) 16

Explanation

For any element, the atomic numbers are shown as subscripts and mass number are shown as superscripts. For example, nitrogen is written as $^{14}\text{N}_7$. **Here 7 is its atomic number and 14 is its mass number.**

21. In an atom, Z can be called as_____

- a) Mass number
- b) **Atomic number**
- c) Number of Neutrons
- d) None

Explanation

Z stands for Zahl, which means NUMBER in German. Z can be called Atomzahl or atomic number. A is the symbol recommended in the ACS style guide instead of M (massenzahl in German).

22. Calculate the atomic number of an element whose mass number is 39 & number of neutrons is 20?

- a) 21
- b) **19**
- c) 59
- d) 9

Explanation

Problem 1

Calculate the atomic number of an element whose mass number is 39 and number of neutrons is 20. Also find the name of the element.

Solution

$$\text{Mass Number} = \text{Atomic number} + \text{Number of neutrons}$$

$$\begin{aligned} \text{Atomic Number} &= \text{Mass number} - \text{Number of neutrons} \\ &= 39 - 20 \end{aligned}$$

$$\text{Atomic Number} = 19$$

Element having atomic number 19 is Potassium (K)

23. Match the following

- | | | |
|------|---------|-------|
| I. | N Shell | 1. 32 |
| II. | K Shell | 2. 8 |
| III. | M Shell | 3. 18 |
| IV. | L Shell | 4. 2 |
- a) 3, 1, 2, 4
b) 2, 1, 4, 3
c) 1, 4, 3, 2
d) 1, 2, 4, 3

Explanation

Shell	Value of (n)	Maximum number of electrons ($2n^2$)
K	1	$2 \times 1^2 = 2$
L	2	$2 \times 2^2 = 8$
M	3	$2 \times 3^2 = 18$
N	4	$2 \times 4^2 = 32$

24. How many electrons are there in M shell of Aluminium?

- a) 8
b) 18
c) 3
d) 2

Explanation

Problem 2

What is the Electronic configuration of Aluminium?

Solution

Electronic configuration of Aluminium atom:
($Z = 13$) **K shell = 2 , L shell = 8 and M shell = 3 electron.**

So its electronic configuration is 2, 8, 3

25. What is the forces between the protons and the neutrons in the nucleus?

- a) EM forces
- b) **Yukawa forces**
- c) Gravitational forces
- d) GM forces

Explanation

The forces between the protons and the neutrons in the nucleus are of special kind called Yukawa forces. This strong force is more powerful than gravity.

26. What is the electronic configuration of Oxygen?

- a) 2, 8
- b) **2, 6**
- c) 2, 8, 18
- d) 2, 8, 6

Explanation

Geometric Representation of oxygen atom $^{16}_8\text{O}$

Mass number $A = 16$

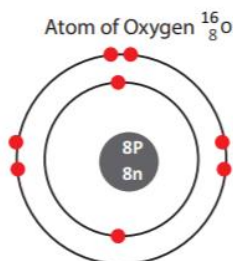
Atomic number $Z = 8$

Number of neutrons $= A - Z = 16 - 8 = 8$

Number of protons $= 8$

Number of electron $= 8$

Electronic configuration $= 2, 6$



27. Size of an atom can be measured in_____

- a) Milli-meter
- b) Nano-meter**
- c) Micro- meter
- d) Fermi-meter

Explanation

Atoms are so tiny their mass number cannot be expressed in grams but expressed in amu (atomic mass unit). New unit is U. Size of an atom can be measured in nano metre ($1 \text{ nm} = 10^{-9} \text{ m}$) Even though atom is an invisible tiny particle now-a-days atoms can be viewed through SEM that is Scanning Electron Microscope.

28. Which of the following statement is correct?

- 1) The outermost shell of an atom is called valence shell
 - 2) The electrons present in the valence shell are known as valence electrons
 - 3) The chemical properties of elements are decided by these valence electrons
- a) 1, 2
 - b) 1, 3
 - c) 2, 3
 - d) All the above**

Explanation

The outermost shell of an atom is called valence shell and the electrons present in the valence shell are known as valence electrons. The chemical properties of elements are decided by these valence electrons, since they are the ones that take part in chemical reactions.

29. Assertion(A): The elements with same number of electrons in the valence shell show similar Properties

Reason (R): Elements with 4 to 7 electrons in their valence shell are non-metals.

- a) Both (A) and (R) are correct, but (R) does not explain (A)**
- b) Both (A) and (R) are wrong
- c) Both (A) and (R) are correct and (R) explains (A)
- d) (A) is Correct and (R) is wrong

Explanation

The elements with same number of electrons in the valence shell show similar properties and those with different number of valence electrons show different chemical properties. Elements,

which have 1 or 2 or 3 valence electrons (except Hydrogen) are metals. Elements with 4 to 7 electrons in their valence shell are non-metals.

30. Assertion(A): Valency of the elements having valence electrons 1, 2, 3, 4 is 1, 2, 3, 4 respectively

Reason(R): Valency of an element is the combining capacity of the element with other elements and is equal to the number of electrons that take part in a chemical reaction

- a) Both (A) and (R) are correct, but (R) does not explain (A)
- b) Both (A) and (R) are wrong
- c) **Both (A) and (R) are correct and (R) explains (A)**
- d) (A) is Correct and (R) is wrong

Explanation

Valency of an element is the combining capacity of the element with other elements and is equal to the number of electrons that take part in a chemical reaction. Valency of the elements having valence electrons 1, 2, 3, 4 is 1, 2, 3, 4 respectively. Valency of an element with 5, 6 and 7 valence electrons is 3, 2 and 1 (8–valence electrons) respectively. Because 8 is the number of electrons required by an element to attain stable electronic configuration. **Elements having completely filled outermost shell show Zero valency.** For example: The electronic configuration of Neon is 2,8 (completely filled). So, valency is 0.

31. What is the valency of Magnesium?

- a) 2
- b) 7
- c) 0
- d) 1

Explanation

Electronic configuration of magnesium is 2, 8, 2. So valency is 2.

Electronic configuration of sulphur is 2, 8, 6. So valency is 2 i.e. (8 – 6).

32. Match the following:

- | | |
|-------------------|---------------|
| I. Phosphorus | 1. Noble gas |
| II. Neon | 2. Non- metal |
| III. Potassium | 3. Metal |
| a) 1, 3, 2 | |
| b) 1, 2, 3 | |
| c) 2, 1, 3 | |

d) 2, 3, 1

Explanation

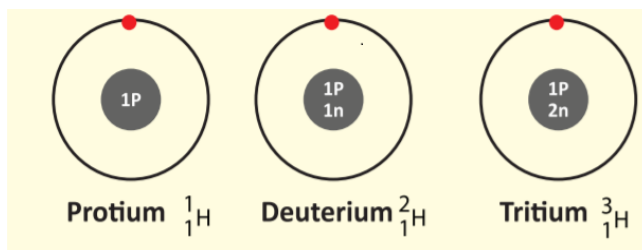
Elements	Symbol	Atomic No (Z) No. of protons/ No. of electrons	Mass No. (A) No. of protons + neutrons	No. of neutrons (A - Z)	Electronic configuration				Valency	Metal/ non-metal/ noble gas
					1st or K-shell	2nd or L-shell	3rd or M-shell	4th or N-shell		
Hydrogen	H	1	1	-	1				1	Non-metal
Helium	He	2	4	2	2				0	Noble gas
Lithium	Li	3	7	4	2	1			1	Metal
Beryllium	Be	4	9	5	2	2			2	Metal
Boron	B	5	11	6	2	3			3	Non-metal
Carbon	C	6	12	6	2	4			4	Non-metal
Nitrogen	N	7	14	7	2	5			3	Non-metal
Oxygen	O	8	16	8	2	6			2	Non-metal
Fluorine	F	9	19	10	2	7			1	Non-metal
Neon	Ne	10	20	10	2	8			0	Noble gas
Sodium	Na	11	23	12	2	8	1		1	Metal
Magnesium	Mg	12	24	12	2	8	2		2	Metal
Aluminium	Al	13	27	14	2	8	3		3	Metal
Silicon	Si	14	28	14	2	8	4		4	Non-metal
Phosphorus	P	15	31	16	2	8	5		3	Non-metal
Sulphur	S	16	32	16	2	8	6		2	Non-metal
Chlorine	Cl	17	35, 37	18, 20	2	8	7		1	Non-metal
Argon	Ar	18	40	22	2	8	8		0	Noble gas
Potassium	K	19	39	20	2	8	8	1	1	Metal
Calcium	Ca	20	40	20	2	8	8	2	2	Metal

33. Which of the following are Isotopes of Hydrogen?

- 1) Protium
- 2) Deuterium
- 3) Tritium
- a) 1, 3
- b) 2, 3
- c) 1, 3
- d) All the above

Explanation

In nature, a number of atoms of elements have been identified, which have the same atomic number but different mass numbers. For example, take the case of hydrogen atom, it has three atomic species as shown below:



The atomic number of all the three isotopes is 1, but the mass number is 1, 2 and 3, respectively.

34. Which of the following is a radio-isotope?

- a) U-235
- b) Cobalt- 60
- c) Ar- 40
- d) **Both a and b**

Explanation

On the basis of these examples, isotopes are defined as the different atoms of the same element, having same atomic number but different mass numbers. There are two types of isotopes: stable and unstable. The isotopes which are unstable, as a result of the extra neutrons in their nuclei are radioactive and are called radioisotopes. For example, **uranium-235, which is a source of nuclear reactors, and cobalt-60, which is used in radiotherapy treatment are both radioisotopes.**

35. Which of the following are same in Isobars?

- a) Electrons
- b) Protons
- c) Neutrons
- d) **Nucleons**

Explanation

Let us consider two elements – calcium (atomic number 20), and argon (atomic number 18). They have different number of protons and electrons. But, the mass number of both these elements is 40. It follows that the **total number of nucleons in both the atoms are the same**. They are called **isobars**. Atoms of different elements with different atomic numbers, and same mass number are known as isobars.

36. Which of the following are same in case of isotones?

- a) Electrons
- b) Protons
- c) **Neutrons**
- d) Nucleons

Explanation

No of neutrons in boron = $11 - 5 = 6$

No of neutrons in carbon = $12 - 6 = 6$

The above pair of elements Boron and Carbon has the same number of neutrons but different number of protons and hence different atomic numbers. Atoms of different elements with different atomic numbers and different mass numbers, but with **same number of neutrons are called isotones**.

37. Who proposed Law of multiple proportions?

- a) Jeremias Ritcher
- b) **John Dalton**
- c) Gay Lussac
- d) Marie Curie

Explanation

Law of multiple proportions was proposed by **John Dalton** in 1804. It states that, "When two elements A and B combine together to form more than one compound, then different masses of A which separately combine with a fixed mass of B are in simple ratio".

38. What is the ratio of masses of oxygen in CO and CO₂?

- a) 1: 3
- b) 1: 4
- c) 1: 1
- d) **1: 2**

Explanation

Carbon combines with oxygen to form two different oxides, carbon monoxide (CO) and carbon dioxide (CO₂). **The ratio of masses of oxygen in CO and CO₂ for fixed mass of carbon is 1: 2.**

39. What is the ratio of masses of Sulphur in SO₂ and SO₃?

- a) 1: 3
- b) 2: 3
- c) 3: 2
- d) **1: 1**

Explanation

Let us take one more example, Sulphur combines with oxygen to form sulphur dioxide and sulphur trioxide. The ratio of masses of oxygen in SO₂ and SO₃ for fixed mass of Sulphur is 2:3. The ratio of masses of sulphur is 1: 1

40. Who proposed law of reciprocal proportions?

- a) Jeremias Ritcher
- b) John Dalton
- c) Gay Lussac
- d) Marie Curie

Explanation

The law of reciprocal proportions was proposed by Jeremias Ritcher in 1792. It 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 same or a simple multiple of the mass ratio in which they combine among themselves."

41. Match the following:

- | | |
|------------------------------|------|
| I. Principal quantum number | 1. m |
| II. Azimuthal quantum number | 2. l |
| III. spin quantum number | 3. s |
| IV. Magnetic quantum number | 4. n |
- a) 2, 1, 4, 3
 - b) 1, 4, 2, 3
 - c) 4, 2, 1, 3
 - d) 3, 1, 2, 4

Explanation

Quantum Number	Symbol	Information conveyed
Principal quantum number	<i>n</i>	Main energy level
Azimuthal quantum number	<i>l</i>	Sub shell/ shape of orbital
Magnetic quantum number	<i>m</i>	Orientation of orbitals
Spin quantum number	<i>s</i>	Spin of the electron

42. How many ways are there for defining the properties of an electron?

- a) 3
- b) 4**
- c) 1
- d) 5

Explanation

we have four ways of defining the properties of an electron, i.e. **four quantum numbers**. Thus, the numbers which designate and distinguish various atomic orbitals and electrons present in an atom are called quantum numbers.

43. Who proposed the Law of Combining Volumes?

- a) Jeremias Ritcher
- b) John Dalton
- c) Gay Lussac**
- d) Marie Curie

Explanation

According to Gay Lussac's Law, whenever gases react together, the volumes of the reacting gases bear a simple ratio, and the ratio is extended to the product when the product is also in gaseous state, provided all the volumes are measured under similar conditions of temperature and pressure.