

## Structure of the Atom

### 1. OBJECTIVE QUESTIONS

1. Who discovered electron?  
 (a) E. Goldstein (b) Bohr  
 (c) J.J. Thomson (d) J. Chadwick

**Ans :** (c) J.J. Thomson

2. Maximum number of electrons present in ' $N$ ' shell is  
 (a) 18 (b) 32  
 (c) 2 (d) 8

**Ans :** (b) 32

$N$ -shell  $\Rightarrow n = 4$

We know that, maximum number of electrons present in an orbit =  $2n^2$

$$\begin{aligned} \text{No of electrons 'N' shell} &= 2 \times 4^2 \\ &= 2 \times 16 = 32 \end{aligned}$$

3. Mass of proton is  
 (a) equal to the mass of hydrogen atom  
 (b) less than the mass of hydrogen atom  
 (c) negligible  
 (d) more than the mass of hydrogen atom

**Ans :** (a) equal to the mass of hydrogen atom

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4. A neutral atom (atomic number  $> 1$ ) has  
 (a) electron and proton  
 (b) neutron and electron  
 (c) neutron, electron and proton  
 (d) neutron and proton

**Ans :** (c) neutron, electron and proton

5. Proton was discovered by  
 (a) Thomson (b) Rutherford

- (c) Chadwick (d) Goldstein

**Ans :** (d) Goldstein

E. Goldstein discovered the presence of new radiations in a gas discharge and called them canal rays. These rays were positively charged radiations which ultimately led to the discovery of sub-atomic particle-proton.

6. In 1932, J. Chadwick discovered another sub-atomic particle which had no charge and a mass nearly equal to that of a proton. It was eventually named as  
 (a) proton (b) neutron  
 (c) electron (d)  $\alpha$ -particle

**Ans :** (b) neutron

Neutrons have no charge and mass nearly equal to that of protons.

7. Which of the following is a property of isotopes?  
 (a) They have the same number of electrons.  
 (b) They have different numbers of protons.  
 (c) They have different chemical properties.  
 (d) They have the same mass number.

**Ans :** (a) They have the same number of electrons. They have the same number of protons. They have same chemical properties. They have different mass numbers.

8. Which of the following is not true for isotopes?  
 (a) They have the same atomic number.  
 (b) They have the same mass number.  
 (c) They have the same electronic configuration.  
 (d) They have the same chemical properties.

**Ans :** (b) They have the same mass number. They have different mass numbers.

9. The given table shows the number of protons, neutrons and electrons in atoms or ions. Which atom/ion in the table is an isotope of the atom with the composition of  $11p, 11e$  and  $14n$ ?

Atoms/ Ions	Number of protons ( $p$ )	Number of electrons ( $e$ )	Number of neutrons ( $n$ )
$P$	11	11	12
$Q$	18	18	22
$R$	15	18	16
$S$	11	10	14

- (a)  $P$  (b)  $Q$   
 (c)  $R$  (d)  $S$

**Ans :** (a)  $P$

Isotopes are the atoms of the same element with different mass numbers i.e., they have same number of protons but different number of neutrons.

Mass number = No. of protons + No. of neutrons

Mass number of the given atom =  $11 + 14 = 25$

Atoms/ Ions	<i>p</i>	<i>e</i>	<i>n</i>	Mass number
<i>P</i>	11	11	12	$11 + 12 = 23$
<i>Q</i>	18	18	22	$18 + 22 = 40$
<i>R</i>	15	18	16	$15 + 16 = 31$
<i>S</i>	11	10	14	$11 + 14 = 25$

10. *X* and *Y* are the two atomic species:

Atom	Number of protons	Number of neutrons
<i>X</i>	8	8
<i>Y</i>	8	10

Select the correct statement about *X* and *Y*.

- (a) *X* and *Y* are isobars
- (b) *X* and *Y* have different chemical properties
- (c) *X* and *Y* have different physical properties
- (d) *X* and *Y* are the atoms of different elements

**Ans :** (c) *X* and *Y* have different physical properties  
 ${}^{16}_8X$  and  ${}^{18}_8Y$

As *X* and *Y* have same atomic number but different mass numbers so they are isotopes. Isotopes have different physical properties but similar chemical properties. Isotopes are the atoms of same elements.

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11. Isotopes have

- (a) same physical and chemical properties
- (b) same physical properties but different chemical properties
- (c) same chemical properties but different physical properties
- (d) different physical and chemical properties

**Ans :** (c) same chemical properties but different physical properties

Chemical properties of an element depend on its number of electrons, and the isotopes have same number of electrons. Thus, they show similar chemical properties.

Physical properties depends on mass number and isotopes have different mass numbers. Thus, they show different physical properties.

12. Rutherford's experiment on scattering of  $\alpha$ -particles showed for the first time that the atom has

- (a) nucleus
- (b) electron
- (c) proton
- (d) neutron

**Ans :** (a) nucleus

13. Valency of oxygen is

- (a) 1
- (b) 2
- (c) 3
- (d) 4

**Ans :** (b) 2

Electronic configuration is O is 2, 6.

Hence, The valency of oxygen =  $8 - 6 = 2$

14. The part of an atom where nearly whole mass is concentrated is called  
 (a) extra-nuclear part (b) nucleus  
 (c) atom (d) neutron

**Ans :** (b) nucleus

The entire mass of the atom is concentrated in the nucleus.

15. In the nucleus of  ${}^{40}_{20}\text{Ca}$ , there are

- (a) 40 protons and 20 electrons
- (b) 20 protons and 40 electrons
- (c) 20 protons and 20 neutrons
- (d) 20 protons and 40 neutrons

**Ans :** (c) 20 protons and 20 neutrons

Atomic number of calcium (*Z*) = 20

No. of protons = No. of electrons = 20

Mass number of calcium (*A*) = 40

No. of neutrons (*n*) =  $A - Z$

=  $40 - 20 = 20$

Therefore, there are 20 electrons, 20 protons and 20 neutrons in calcium.

16. Which of the following elements has same number of protons, electrons and neutrons?

- (a) Al
- (b) Mg
- (c) P
- (d) Cl

**Ans :** (b) Mg

Mg is represented as  ${}^{24}_{12}\text{Mg}$ . It has protons, electrons and neutrons equal to 12 (all are same).

17. The number of neutrons in the element  ${}^9_4\text{Be}$  is

- (a) 4
- (b) 5
- (c) 9
- (d) 13

**Ans :** (b) 5

Number of neutrons

= Mass number – Atomic number

=  $9 - 4 = 5$

18. Atom *X* and atom *Y* have similar chemical properties. If the proton number of atom *X* is 12, What is the likely proton number of atom *Y*?

- (a) 5
- (b) 10
- (c) 14
- (d) 20

**Ans :** (d) 20

Electronic configuration of atom *X* is 2, 8, 2. Since atom *X* and atom *Y* have similar chemical properties, atom *Y* must have same number of valence electrons as atom *X*. So, the proton number of atom *Y* is 10 and electronic configuration is 2, 8, 8, 2.

19. Which of the following elements contains only two electrons in the outermost shell?

- (a) Helium
- (b) Beryllium

- (c) Magnesium (d) All of these

**Ans :** (d) All of these

All have two electrons in valence shell.

20. The ion of an element has 2 positive charge. Mass number of the atom is 24 and the number of neutrons is 12. What is the number of electrons in the ion?

- (a) 8 (b) 10  
(c) 12 (d) 24

**Ans :** (b) 10

The ion of an element has 2 positive charges.

$A = 24, n = 12, p = 24 - 12 = 12, e = 12 - 2 = 10$   
So, the number of electrons in the ion = 10.

21. The charge on the atom having 17 protons, 18 electrons is

- (a) +1 (b) -1  
(c) -2 (d) zero

**Ans :** (b) -1

No. of electrons > No. of protons

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22. The formula of a molecule is  $X_2$ . One molecule of  $X_2$  contains 18 protons. If the nucleon number of  $X$  is 19, how many neutrons are there in one atom of  $X$ ?

- (a) 1 (b) 9  
(c) 10 (d) 18

**Ans :** (c) 10

Number of protons in one  $X_2$  is 18.

$$\text{Number of protons in } X = 18 \div 2 = 9$$

$$\text{Nucleon number} = p + n$$

$$19 = 9 + n$$

$$n = 19 - 9 = 10$$

23. Which of the following statements are part of Bohr's model of hydrogen atom?

- (a) Energy of the electrons in the orbit is quantized.  
(b) The electron in the orbit nearest to the nucleus has the lowest energy.  
(c) Electrons revolve in different orbits around the nucleus.  
(d) All of these

**Ans :** (d) All of these

24. Which pair of atom contains the same number of neutrons?

- (a)  $^{114}_{48}\text{Cd}$  and  $^{119}_{50}\text{Sn}$  (b)  $^{59}_{27}\text{Co}$  and  $^{59}_{28}\text{Ni}$   
(c)  $^{133}_{55}\text{Cs}$  and  $^{132}_{54}\text{Xe}$  (d)  $^{63}_{29}\text{Cu}$  and  $^{65}_{29}\text{Cu}$

**Ans :** (c)  $^{133}_{55}\text{Cs}$  and  $^{132}_{54}\text{Xe}$

Number of neutrons = Mass number - Atomic number

$$^{114}_{48}\text{Cd} : 56 \quad ^{119}_{50}\text{Sn} : 69 \quad ^{59}_{27}\text{Co} : 32 \quad ^{59}_{28}\text{Ni} : 31$$

$$^{133}_{55}\text{Cs} : 78 \quad ^{132}_{54}\text{Xe} : 78 \quad ^{63}_{29}\text{Cu} : 34 \quad ^{65}_{29}\text{Cu} : 36$$

25. Isotopes of the same elements have the same number of

- (a) neutrons  
(b) protons

- (c) protons and neutrons  
(d) protons, neutrons and electrons

**Ans :** (b) protons

Isotopes have the same atomic number, but different mass numbers. Thus, isotopes of the same element have the same number of protons.

26. Which of the following electronic configurations is wrong?

- (a) Li (3) = 2, 1 (b) O (3) = 2, 6  
(c) S (16) = 2, 6, 8 (d) P (15) = 2, 8, 5

**Ans :** (c) S (16) = 2, 6, 8

27. The mass number  $A$ , atomic number  $Z$  and number of neutrons  $n$  are related as

- (a)  $n = A - Z$  (b)  $n = A + Z$   
(c)  $n = A \times Z$  (d) none of these

**Ans :** (a)  $n = A - Z$

$$\text{Mass number } (A) = \text{Atomic number } (Z) + \text{Number of neutrons } (n)$$

$$\text{Number of neutrons } (n) = \text{Mass number } (A) - \text{Atomic number } (Z)$$

28. Maximum number of electrons which can be filled in the third shell of an atom is

- (a) 8 (b) 18  
(c) 10 (d) 32

**Ans :** (b) 18

The maximum number of electrons present in a shell is given by  $2n^2$ , where  $n = 1, 2, 3, \dots$

Maximum number of electrons which can be filled in third shell of an atom is  $2 \times (3)^2 = 18$ .

29. Cathode rays are made up of

- (a) positively charged particles  
(b) negatively charged particles  
(c) neutral particles  
(d) none of these

**Ans :** (b) negatively charged particles

30. Which of the following has a charge of +1 and a mass of 1 amu?

- (a) A neutron (b) A proton  
(c) An electron (d) A helium nucleus

**Ans :** (b) A proton

The mass of a proton is taken as one unit and its charge as plus one.

31. Rutherford's experiment which established the nuclear model of the atom used a beam of

- (a)  $\beta$ -particles which impinged on the metal foil and got absorbed  
(b)  $\gamma$ -rays which impinged on a metal foil and ejected electrons  
(c) hydrogen atoms, which impinged on a metal foil and got scattered  
(d)  $\alpha$ -particles nuclei, which impinged on a metal foil

and got scattered

**Ans :** (d)  $\alpha$ -particles nuclei, which impinged on a metal foil and got scattered

Rutherford conducted the experiment with  $\alpha$ -rays, whose composition is equal to  ${}^4_2\text{He}$  i.e., helium nucleus.

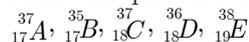
32. Rutherford's alpha particle scattering experiment eventually led to the conclusion that
- mass and energy are related
  - nucleus is present in the centre of the atom
  - neutrons are buried deep in the nucleus
  - the point of impact with matter can be precisely determined.

**Ans :** (b) nucleus is present in the centre of the atom

33. .... was the first one to propose a model for the structure of an atom.
- J. Chadwick
  - E. Rutherford
  - Neils Bohr
  - J.J. Thomson

**Ans :** (d) J.J. Thomson

34. Select the pair of isobars from the following species.



- A and B
- A and C
- C and E
- C and D

**Ans :** (b) A and C

Isobars have same mass number but different atomic numbers.

35. Neutrons are present in the nucleus of all atoms, except
- hydrogen
  - helium
  - lithium
  - boron

**Ans :** (a) hydrogen

Hydrogen contains only one proton in the nucleus and no neutron.

36. Which of the following shows the electronic configuration of  $\text{Ca}^{2+}$ ?
- He
  - Ne
  - Ar
  - $\text{F}^-$

**Ans :** (c) Ar

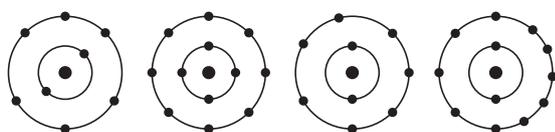
Electronic configuration of  $\text{Ca}^{2+}$

$$= 2, 8, 8$$

Electronic configuration of Ar

$$= 2, 8, 8$$

37. Which of the following do not represent Bohr's model of an atom correctly?



- 
- 
- 
- 

- 1 and 2
- 2 and 3

- 2 and 4
- 1 and 4

**Ans :** (c) 2 and 4

First shell can accommodate maximum of two electrons and second shell can accommodate maximum of eight electrons.

38. Which of the following particles is not deflected by a magnetic field?
- Proton
  - Neutron
  - Electron
  - All of these

**Ans :** (b) Neutron

There is no charge on neutron.

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39. The element with the atomic number 3 is likely to have similar chemical properties to the element with the atomic number
- 5
  - 11
  - 8
  - 20

**Ans :** (b) 11

Electronic configuration of the element with the atomic number 3 = 2, 1.

Electronic configuration of the element with the atomic number 11 = 2, 8, 1.

Both have same number of electrons in the valence shell hence show similar chemical properties.

40. Which of the following has the same number of electrons as an oxide ion ( $\text{O}^{2-}$ )?
- $\text{K}^+$
  - $\text{Mg}^{2+}$
  - $\text{Cl}^-$
  - $\text{S}^{2-}$

**Ans :** (b)  $\text{Mg}^{2+}$

$\text{O}^{2-}$  has 10 electrons.

$\text{K}^+$  has 18 electrons.

$\text{Mg}^{2+}$  has 10 electrons.

$\text{Cl}^-$  has 18 electrons.

$\text{S}^{2-}$  has 18 electrons.

41. Maximum number of electrons in any orbit is
- $n^2$
  - $2n^2$
  - $1/2n^2$
  - none of these

**Ans :** (b)  $2n^2$

42. An atom X achieves a stable electron structure by becoming an ion with formula  $\text{X}^{2-}$ . What is a possible electronic configuration of ion  $\text{X}^{2-}$ ?
- 2
  - 2, 2

- (c) 2, 6 (d) 2, 8, 8

**Ans :** (d) 2, 8, 8

An atom is stable if it has a duplet or octet configuration. A duplet or octet configuration is also known as a noble gas configuration.

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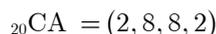
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43. The number of electrons in the valence shell of calcium is

- (a) 6 (b) 8
- 
- (c) 2 (d) 4

**Ans :** (c) 2

Two electrons in the valence shell of calcium



44. The electronic structure of an ion  $Z^{2-}$  is 2, 8. The number of neutrons is 11. The nucleon number of  $Z$  is
- (a) 16 (b) 19  
(c) 20 (d) 21

**Ans :** (b) 19Nucleon number = number of  $p$  + number of  $n$ Number of proton ( $p$ ) = 8Number of neutron ( $n$ ) = 11

$$8 + 11 = 19$$

45.  $\text{Na}^+$  ion is isoelectronic with
- (a)  $\text{Li}^+$  (b)  $\text{Mg}^{2+}$   
(c)  $\text{Ca}^{2+}$  (d)  $\text{Ba}^{2+}$

**Ans :** (b)  $\text{Mg}^{2+}$ 

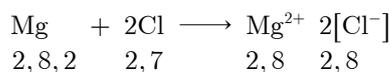
$\text{Na}^+$  is isoelectronic with  $\text{Mg}^{2+}$  as both have same number of electrons, i.e., 10.

46. The valency of an element is
- (a) the mass of the element displacing 1 part by the mass of hydrogen
- (b) the mass of the element combining with 8 parts by the mass of oxygen
- (c) the number of atoms of hydrogen combining with 1 atom of the given element
- (d) the number of atoms in 1 molecule of the given statement.

**Ans :** (c) the mass of the element combining with 8 parts by the mass of oxygen

The number of hydrogen atoms which combine with one atom of an element is called its valency.

47.  $\text{MgCl}_2$  is the formula for an ionic compound of magnesium and chlorine. If the charge on Cl is  $-1$ , then the charge on Mg must be
- (a)  $+2$  (b)  $+3$   
(c)  $-2$  (d)  $-3$

**Ans :** (a)  $+2$ 

48. A cation has a positive charge because
- (a) there are more protons than neutrons
- (b) the neutrons in the nucleus are charged
- (c) there are fewer electrons than protons
- (d) there are more electrons than protons

**Ans :** (c) there are fewer electrons than protons

Cation is formed by the loss of one or more electrons by an atom. Therefore, cation has a positive charge because there are fewer electrons than protons.

**2. FILL IN THE BLANK**

1. The subatomic particle not present in a hydrogen atom is .....

**Ans :** Neutron

2. An atom of an element has 11 protons, 11 electrons and 12 neutrons. The atomic mass of the atom is .....

**Ans :** 23

3. Almost all the mass of an atom is concentrated in a small region of space called the .....

**Ans :** Nucleus

4. Cathode rays are a beam of fast moving .....

**Ans :** electrons

5. The number of neutrons in the nucleus of an atom can be calculated by ..... the atomic number ..... its mass number.

**Ans :** eightFor more files visit [www.cbse.online](http://www.cbse.online)

6. According to Maharishi Kanad, the tiniest to tiny particle of a pure substance is called .....

**Ans :** anu

7. An atom is the smallest unit of an element which takes part in a .....

**Ans :** chemical reaction

8. The isotopes of an element do not differ in the number of ..... but do differ in the number of .....

**Ans :** subtracting, from

9. The K-shell of any atom cannot have more than ..... electrons.

**Ans :** two



**Ans :** (d) P – 4, Q – 3, R – 1, S – 2

5.

List-I (Atom)		List-II (Atomic mass)	
(P)	Electrons	(1)	Number of positively charged particles in nucleus
(Q)	Carbon dating	(2)	Negatively charged particles
(R)	Valence electrons	(3)	Technique to know age of fossils
(S)	Atomic number	(4)	Number of electrons in outermost shell

	P	Q	R	S
(a)	1	2	3	4
(b)	4	3	2	1
(c)	2	4	3	1
(d)	2	3	4	1

**Ans :** (d) P – 2, Q – 3, R – 4, S – 1

## 5. ASSERTION AND REASON

**DIRECTION :** In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- Assertion (A) is true but reason (R) is false.
- Assertion (A) is false but reason (R) is true.

1. **Assertion :** Atom is electrically neutral.

**Reason :** A neutral particle, neutron is present in the nucleus of atom.

**Ans :** (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

Atom is electrically neutral because the number of protons (positively charged particle) is equal to the number of electrons (negatively charged particle).

2. **Assertion :** The size of the nucleus is very small as compared to the size of the atom.

**Reason :** The electrons revolve around the nucleus of the atom.

**Ans :** (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

3. **Assertion :** Thomson's atomic model is known as

'raisin pudding' model.

**Reason :** The atom is visualized as a pudding of positive charge with electrons (raisins) embedded in it.

**Ans :** (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

4. **Assertion :** Electrons moving in the same orbit will lose or gain energy.

**Reason :** On jumping from higher to lower energy level, the electron will gain energy.

**Ans :** (d) Assertion (A) is false but reason (R) is true. Electrons moving in the same orbit will not lose or gain energy. On jumping from higher to lower energy level, the electron will lose energy.

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5. **Assertion :** A few positively charged  $\alpha$ -particles are deflected in Rutherford's experiment.

**Reason :** Most of the space in the atom is empty.

**Ans :** (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

The positive charge has to be concentrated in a very small volume (nucleus) that repelled and deflected the positively charged  $\alpha$ -particles.

6. **Assertion :** Isotopes are electrically neutral.

**Reason :** Isotopes are species with same mass number but different atomic numbers.

**Ans :** (c) Assertion (A) is true but reason (R) is false. Isotopes are species with same atomic number but different mass numbers.

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7. **Assertion :** Isotopes are electrically neutral.

**Reason :** Isotopes of an element have equal number of protons and electrons.

**Ans :** (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

8. **Assertion :** In Rutherford's gold foil experiment, very few  $\alpha$ -particles are deflected back.

**Reason :** Nucleus present inside the atom is heavy.

**Ans :** (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

Nucleus present inside the atom is heavy but small.

**9. Assertion :** Isobars are identical in chemical properties.

**Reason :** Isobars have same atomic number.

**Ans :** (d) Assertion (A) is false but reason (R) is true. Isobars are not identical in chemical properties because they have same mass number and different atomic numbers.

**10. Assertion :** Anions are larger in size than the parent atom.

**Reason :** In an anion, the number of protons in the nucleus is less than the number of electrons moving around it.

**Ans :** (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

**11. Assertion :** Isotopes of an element show different valencies.

**Reason :** Isotopes have different atomic numbers.

**Ans :** (d) Assertion (A) is false but reason (R) is true. Isotopes of an element show same valency. They have same atomic number but different mass numbers.

**12. Assertion :** The atoms of different elements having same mass number but different atomic numbers are known as isobars.

**Reason :** The sum of protons and neutrons, in the isobars is always different.

**Ans :** (c) Assertion (A) is true but reason (R) is false. Sum of protons and neutrons is known as mass number which is same for isobars.

**13. Assertion :** For noble gases, valency is zero.

**Reason :** Noble gases have 8 valence electrons.

**Ans :** (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

**14. Assertion :** Cathode rays travel in straight lines.

**Reason :** Cathode rays do not penetrate through thin sheets.

**Ans :** (c) Assertion (A) is true but reason (R) is false. Cathode rays can penetrate through thin sheets.

**15. Assertion :** Cathode rays get deflected towards the positive plate of electric field.

**Reason :** Cathode rays consist of negatively charged particles known as electrons.

**16. Assertion :** Bohr's orbits are called stationary orbits.

**Reason :** Electrons remain stationary in these orbits for sometime.

**Ans :** (c) Assertion (A) is true but reason (R) is false. Electrons in different orbits have fixed energies.

**17. Assertion :** The mass of the total number of protons and neutrons is a measure of the approximate mass of an atom.

**Reason :** The mass of an electron is negligible.

**Ans :** (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of

assertion (A).

Since the mass of an electron is negligible, the mass of the total number of neutrons and protons (nucleons) is a measure of the approximate mass of an atom.

**Ans :** (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

In electric field, negatively charged particles always move towards positive plate and vice-versa.

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