Exercise :4 C

How does the Modern atomic theory contradict and correlate with Dalton' s atomic theory?

Solution:

The latest research on the atom has proved that most of the postulates of Dalton's atomic theory contradict. However, Dalton was right that atoms take part in chemical reactions.
Comparisons of Dalton's atomic theory with the modern atomic theory.

Dalton's atomic theory:

- Atoms are indivisible.
- Atoms of the same element are similar in every respect.
- Atoms combine in a simple whole number ratio to form molecules.
- Atoms of different elements are different.
- Atoms can neither be created nor be destroyed.

Modern atomic theory:

- Atoms are divisible and consist of electrons, protons, neutrons and even more sub-particles.
- Atoms of the same element may differ from one another.
- Atoms of different elements may be similar called isobars.
- Atoms combine in a ratio which is not a simple whole number ratio; e.g. in sugar, the $C_{12}H_{22}O_{11}$ ratio is not a whole number ratio.

2. a) What are inert elements?
b) Why do they exist as monoatoms in molecules?
c) What are valence electron?

Solution:

a) Elements whose outermost orbital is completely filled are knows as inert elements.

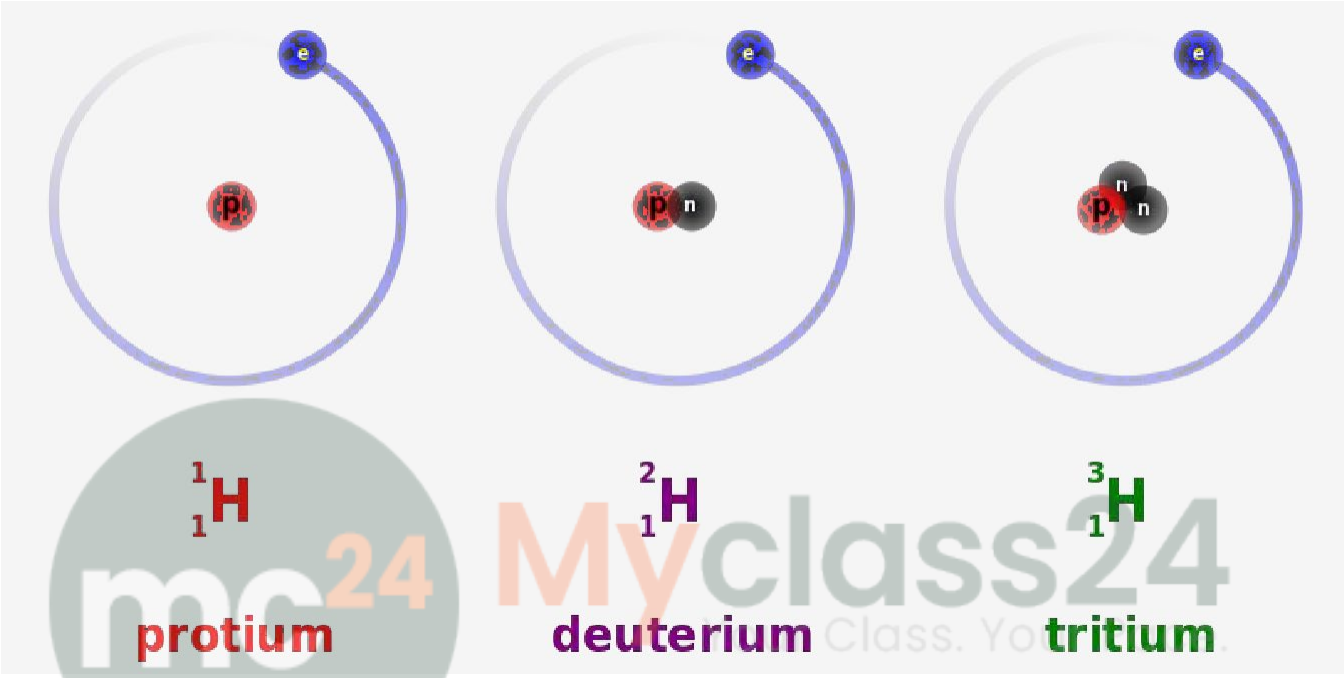
b) Inert elements exist as monoatoms because molecules of these elements contain only one atom.

c) Electron present in the outermost orbital os known as valence electrons.

3. In what respect do the three isotopes of hydrogen differ ? Give their structures.

Solution:

The three isotopes of hydrogen differ in mass numbers which are 1,2 and 3 respectively known as protium, deuterium and tritium.



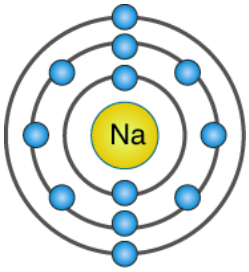
4. Match the atomic numbers 4. 14. 8. 15. and 19 with each of the following :
(a) A solid non-metal of valency 3.
(b) A gas of valency 2.
(c) A metal of valency 1.
(d) A non-metal of valency 4.

Solution:

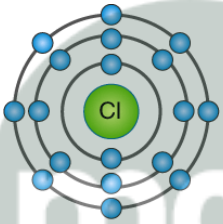
Name with valency	Atomic Number
(a) A solid non-metal of valency 3.	15
(b) A gas of valency 2.	8
(c) A metal of valency 1.	19
(d) A non-metal of valency 4.	14

5. Draw diagrams representing the atomic structures of the following
(a) Sodium atom (b) Chloride ion
(c) Carbon atom (d) Oxide ion.

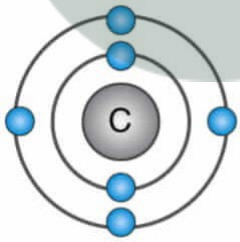
Solution:



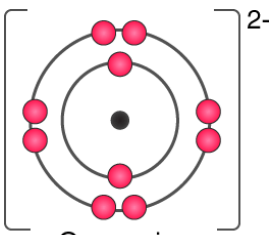
Sodium atom



Chlorine atom



CARBON ATOM



Oxygen ion
O^{2-} $[2,8]^{2-}$

6. What is the significance of the number of protons found in the atoms of different elements ?

Solution:

The number of protons in the nucleus of an atom determines the element type of the atom.

7. Elements X, Y and Z have atomic numbers 6, 9 and 12 respectively. Which one :
(a) forms an anion (b) forms a cation
(c) has four electrons in its valence shell?

Solution:

a) Y(2, 7) forms an anion.
b) Z(2, 8, 2) forms a cation.
c) X(2, 4) has four electrons in the valence shell.

8. Element X has electronic configuration 2, 8, 18, 8, 1. Without identifying X,

- **a) Predict the sign and charge on a simple ion of X.**
- **b) Write if X will be an oxidising agent or reducing agent. Why?**

Solution:

a) X^{1+}
b) Oxidising agent, because it can donate electrons.

9. Define the terms :
a) mass number (b) ion c) cation
d) anion (e) element f) orbit.

Solution:

a) The mass number is the sum of protons and neutrons present in the nucleus of an atom.

b) An ion is an atom carrying charge due to gaining or losing electrons

c) Positively charged ion which are formed after losing an electron is called cation.

d) Negaively charged ion formed after gaining an electron is called anion

e) An element is a substance which cannot be split up into two or more simple substances by usual chemical methods of applying heat, light or electric energy

f) The circular path around the nucleus in which electrons of the atom revolve.

10. From the symbol $_{2}^{4}He$ for the element helium, write down the mass number and the atomic number of the element

Solution:

Atomic number = 2
Mass number = 4

11. Five atoms are labelled A to E.

Atoms	Mass no	Atomic no
A	40	20
B	19	9
C	7	3
D	16	8
E	14	7

(a) Which one of these atoms :
(i) contains 7 protons
(ii) has electronic configuration 2 7.

(b) Write down the formula of the compound forme: between C and D.
(c) Predict : (i) metals (ii) non-metals.

Solution:

a.
Atom E contains 7 protons.
Atom B has an electronic configuration 2, 7.
b. Atom C stands for $_{7}Li^{3}$, Atom D stands for $_{8}O^{16}$.
Hence, compound formula is Li_2O.
c. Metals: A and C, Non-metals: B, D, E

12. An atom of an element has two electrons in the M she What is the (a) atomic number (b) number of protons in this element?

Solution:

Number of electrons in the M shell = 2
hence, the number of electrons in the K and L shells will be = 2, 8
Hence, atomic number = 2 + 8 + 2 = 12
Number of protons = 12

13. $^{24}_{12}Mg$ and $^{26}_{12}Mg$ are symbols of two isotopes of magnesium

(a) Compare the atoms of these isotopes with respect to :
(i) the composition of their nuclei.
(ii) their electronic configurations.

(b) Give reasons why the two isotopes of magnesium have different mass numbers.

Solution:

a)
i)

	$^{24}_{12}Mg$	$^{26}_{12}Mg$
No. of electrons	12	12
No. of protons	12	12
No. of neutrons	24 - 12 = 12	26-12 = 14

Hence, composition of nuclei

$12Mg^{24} \rightarrow \begin{bmatrix} p & n \\ 12 & + \ 12 \end{bmatrix} {}_{12}Mg^{26} \longrightarrow \begin{bmatrix} p & n \\ 12 & + \ 14 \end{bmatrix}$

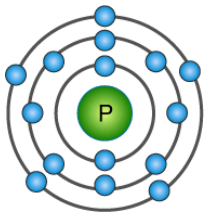
ii). Electronic configuration = 2, 8, 2

b) Mass numbers of isotopes of Magnesium are different because of the different number of neutrons, i.e. 12 and 14, respectively.

14. What are nucleons? How many nucleons are present in phosphorus ? Draw its structure.

Solution:

Constituents of the nucleus are called nucleons, i.e. protons and neutrons.
Atomic mass of phosphorus = 31
Atomic number = 15



15. What are isotopes ? With reference to which fundamental particle do isotopes differ ? Give two uses of isotopes.

Solution:

Isotopes are the elements having the same atomic number but different mass numbers. Isotopes differ concerning neutrons.

Uses of isotopes

- Some isotopes are radio active, and they are used to treat cancer Ex: cobalt isotopes
- An isotope of 235U is used as a fuel in a nuclear reactor.

16. Why do $_{1}^{35}Cl$ and $_{1}^{37}Cl$ have the same chemical properties? In what respect do these atoms differ?

Solution:

Electrons are the particles which take place in reaction. Chemical properties depend on the electronic configuration. In isotopes of $_{1}^{35}Cl$ and $_{1}^{37}Cl$ the atomic numbers are the same; hence, their electronic configuration remains the same, and so are their chemical properties.

These differ only in physical contents and weights because neutrons contribute to the mass of an atom which is 35 and 37 in this case.

17. Explain fractional atomic mass. What is the fractional mass of chlorine?

Solution:
Fractional atomic mass is the weighted average of all the naturally occurring isotopes of that element. Fractional mass of chlorine is 35.5.

18. a) What is meant by " atomic number of an element"?
b) Complete the table given below:

	No of protons	No of electrons	No of neutrons	Atomic number	Mass number
$_{17}^{35}Cl$					
$_{17}^{37}Cl$					

Write down the electronic configuration of i) Chlorine atom ii) Chloride ion

Solution:

a) The number of protons in the nucleus of an atom represents atomic number of an element.

b)

	No of protons	No of electrons	No of neutrons	Atomic number	Mass number
$^{35}_{17}Cl$	17	17	18	17	35
$^{37}_{17}Cl$	17	17	20	17	37

c) i. Electronic configuration of chlorine = 2, 8, 7
ii. Electronic configuration of chlorine ion = 2, 8, 8

19. Name the following :
(a) The element which does not contain any neutron in its nucleus.
(b) An element having valency `zero'.
(c) Metal with valency
(d) Two atoms having the same number of protons and electrons but different number of neutrons.
(e) The shell closest to the nucleus of an atom.

Solution:

a) Hydrogen
b) Helium
c) Magnesium
d) Hydrogen and carbon
e) K

20. Give reasons
(a) Physical properties of isotopes are different
(b) Argon does not react.
(c) Actual atomic mass is greater than mass number.
(d) $^{35}_{17}Cl$ and $^{37}_{17}Cl$ do not differ in their chemical reactions.

Solution:

a) Physical properties are dependent atomic mass of an element. Isotopes has different atomic mass hence they differ in their physical properties.

b) Arong outermost orbital is cimpletly filled with 8 electrons. Hence it does not react.

c) Actual atomic mass is greater than the mass number because the mass number is a whole number approximation of atomic mass unit.

d) $^{35}_{17}Cl$ and $^{37}_{17}Cl$ do not differ in their chemical reactions their atomic mass determines the chemical reactivity. Here chlorine isotose have same mass number.

21. An element A atomic number 7 mass number 14
B electronic configuration 2, 8, 8
C electrons 13, neutrons 14
D Protons 18 neutrons
E electronic configuration 2, 8, 8, 1

State (i) valency of each element (ii) which one is a metal (iii) which is a non-metal (iv) which is an inert gas.

Solution:

(i)
Element A
Atomic number = 7 = Number of electrons = 2, 5
Valency of A = 8 - 5 = 3

Element B
Electronic configuration 2, 8, 8
Valency of B = Zero

Element C has 13 electrons
Electronic configuration = 2, 8, 3
Valency of C = 3

Element D
Protons = 18 = Electrons = 2, 8, 8
Valency of D = Zero

Element E
Electronic configuration = 2, 8, 8, 1
Valency of E = 1

(ii) C and E are metals.
(iii) A is a non-metal.
(iv) A, C and E are not inert gases.

22. Choose the correct option
(a) Rutherford's alpha-particle scattering experiment discovered
A. Electron
B. Proton
C. Atomic nucleus
D. Neutron

(b) Number of valence electrons in 0^{-2} is :
A. 6
B. 8
C. 10
D. 4

(c) Which of the following is the correct electronic configuration of potassium ?

A. 2, 8, 9
B. 8, 2, 9
C. 2, 8, 8, 1
D. 1, 2, 8, 8

(d) The mass number of an atom whose unipositive ion has 10 electrons and 12 neutrons is :
A. 23
B. 22
C. 20
D. 21 23.

Solution:

a) C.Atomic nucleus
b) A.6
c) C.[2, 8, 8, 1]
d) D. A.23

23. Explain : (a) octet rule for formation of a chemical compund. (b) duplet rule for formation of hydrogen.

Solution:

a) Atoms of all noble gases have eight electrons in their outermost shell. This arrangement is called an Octet configuration. Each element tends to combine to attain electronic compounds either by obtaining or donating and sharing of electrons present in their outermost shell. This rule of attaining octet configuration is called as octet rule.

b) Hydrogen atom has one electron in the valence shell which it shares with another hydrogen atom having one electron to complete its duplet state, i.e. two electrons in the valence shell and resulting in the formation of hydrogen.

24. Complete the following table relating to the atomic structure of some elements.

Element Symbol	Atomic Number	Mass Number	Number of neutrons	Number of electrons	Number of protons
Li	**3**	**6**			
Cl	**17**		**20**		
Na			**12**		**11**
Al		**27**			**13**
S		**32**	**16**		

Solution:

Element Symbol	Atomic Number	Mass Number	Number of neutrons	Number of electrons	Number of protons
Li	3	6	4	3	3
Cl	17	37	20	17	17
Na	11	23	12	11	11
Al	13	27	14	13	13
S	16	32	16	16	16