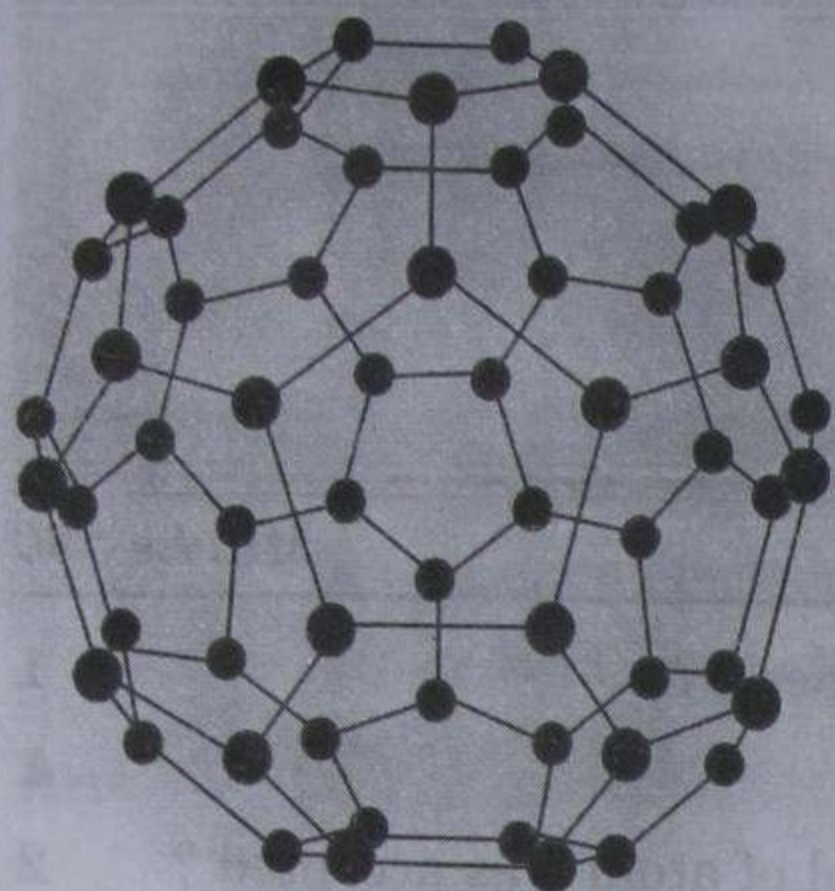




8

THE PERIODIC TABLE

SCOPE OF SYLLABUS

Dobereiner's Triads, Newland's law of Octaves, Mendeleev's contributions; Modern Periodic Law, the Modern Periodic Table. (groups and periods)

General idea of Dobereiner's triads, Newland's law of Octaves, Mendeleev's periodic law, Discovery of Atomic Number and its use as a basis for Modern Periodic Law, Modern Periodic Table (groups 1 to 18 and periods 1 to 7).

IMPORTANT POINTS TO REMEMBER

1. The **table** in which the **elements** are arranged in the **increasing order** of their **atomic number** is called the **periodic table**.
2. The **similar properties** which **recur** after a **regular interval** are called the **periodic properties**.
3. **Several attempts** were made to **classify** the **elements** so as to make their **study simple** and **systematic**.
4. **J.W. Dobereiner** arranged the **elements** in the **group of three** called **triads**. According to this, the **chemically similar elements** were **arranged** in the **increasing order** of their **atomic weights** in the **group of three** to make a **triad**. It was noted that the **atomic weight** of **middle element** present in **triad** is the **mean** of the **other two elements**.

(i) **Triad of alkali metals**—**lithium, sodium** and **potassium** have **atomic weights** 7, 23 and 39 respectively. By taking the **arithmetic mean** of **lithium** and **potassium** we get the **atomic**

weight of sodium, i.e., $\frac{7+39}{2} = \frac{46}{2} = 23$

(ii) **Triad of halogens** – **chlorine, bromine** and **iodine** have **atomic weights** 35.5, 80.4 and 126.5 respectively. By taking the arithmetic mean of **chlorine** and **iodine**, we get the **atomic weight**

of bromine, i.e., $\frac{35.5+126.5}{2} = 81$

(iii) **Triad of alkaline earth metals** – **calcium, strontium** and **barium** have **atomic weights** 40, 88 and 137 respectively. By taking the **arithmetic mean** of **calcium** and **barium**, we get the

atomic weight of strontium, i.e., $\frac{40+137}{2} = 88$

This classification was not accepted as **many elements** could **not** be **grouped** in **triads**.

For very **low mass** or for very **high mass elements**, the law was not holding good, *e.g.*, **F, Cl** and **Br**. **Atomic mass of Cl** is **not** the **arithmetic mean** of **atomic masses** of **F** and **Br**.

5. **Newland** arranged the **elements** in the **increasing order** of their **atomic weights**. He suggested that the **properties** of the **elements recur** after a **regular interval** after **every seven elements** just like the **repetition** of **musical notes**.

6. **Newland** arranged the **elements** known at that time in the following manner

Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl
K	Ca					

7. **Failure of Newland's law of octaves :**

(i) It was not valid for elements that had atomic masses higher than calcium.

(ii) When more elements were discovered like He, Ne etc., they could not be accommodated in this table.

8. In **periodic table** the **vertical lines** are called **groups** and the **horizontal lines** are called **periods**.

9. **Mendeleev** suggested the **periodic law**, *i.e.*, the **physical** and the **chemical properties** of **elements** are the **periodic functions** of their **atomic weights**.

10. **Mendeleev's periodic table** had certain **defects** :

(i) **Position of hydrogen** : Hydrogen had a controversial position, *i.e.*, it was placed in two groups, group 1 (alkali metals) and group 17 (halogens).

(ii) **Position of isotopes**.

(iii) **Position of transition elements**.

(iv) **Position of rare earth metals**.

11. (i) When Mendeleev presented his periodic table **inert gases** were **not discovered**, he easily placed these elements **at the end** of the **table** without disturbing the table.

(ii) The **elements** which were **discovered later** could be easily **placed** in the **gaps** provided in the table.

12. The **most accepted form** of **periodic table** is the **long form** of the **periodic table**. In 1913 **Moseley** **modified** the **previous periodic law** as it states that the **physical** and the **chemical properties** of the **elements** are the **periodic functions** of their **atomic number**. As Moseley found that the **atomic number** (*i.e.*, the number of protons) is more **fundamental property** of an atom **than** its **atomic weight**.

13. On the basis of the **modern periodic law** proposed by **Moseley**, the **long form** or **Modern** or **Bohr's periodic table** was **prepared**, which consists of **18 vertical lines (groups)** and **7 horizontal lines (periods)**.

14. In **long form** of **periodic table** the **elements** having **same number** of **valence electrons** are placed under the **same vertical columns** called **groups**.

15. The **different characteristics** of the **long form** of the **periodic table** are given below.

(i) The **highly metallic elements** are placed on the **left hand side** of the **periodic table**.

(ii) The **highly non-metallic elements** are placed on the **right hand side** of the **periodic table**.

(iii) The **transition elements** are accommodated between **metals** and **non-metals**.

(iv) The **noble gases** are placed in **group 18**.

(v) The elements present in the **left and right side** of the **vertical columns** are called **normal elements** or **representative elements**. The elements having **complete penultimate shells** are called **normal elements** or the **representative elements**.

(vi) **Lanthanides** and **Actinides** are placed **outside** the **main body** of the **periodic table**.

(vii) The **seventh period** is an **incomplete period**.

16. The elements present in **different groups** are given **specific names** like

Group number	Name
1	Alkali metals
2	Alkaline earth metals
17	Halogens
18	Inert gases or Noble gases

17. The **horizontal rows** are called **periods**.

(i) **First period** is the **shortest period** having only **2 elements**.

(ii) **Second period** is a **short period** consisting of **8 elements**.

(iii) **Third period** is a **short period** consisting of **8 elements**.

(iv) **Fourth period** is a **long period** consisting of **18 elements**. **Ten elements** are of **transition series** and **eight elements** are the **normal elements**.

(v) **Fifth period** is a **long period** consisting of **18 elements**. **Eight** are **normal elements** or **representative elements** and **ten** are **transition elements**.

(vi) **Sixth period** is a **very long period** consisting of **32 elements**. It includes **eight normal** or **representative elements**, **ten transition elements** and **fourteen inner transition elements** of **lanthanide series**.

(vii) **Seventh period** is an **incomplete period**.

18. As we move down the **group**, the **basic character** of oxides **increases**.

19. As we move across the **period**, the **acidic character** of oxides **increases**.

20. At **end** of every **period** there is a presence of an **inert gas** with **octet configuration**.

21. **Inert gases** have **zero valency** as they can neither lose electron nor they can gain electron as they have **complete octet**.

22. **Metals** have **1, 2 or 3 electrons** in their **valence shell**.

23. **Metals** can easily **lose** their **outermost 1, 2 or 3 electrons** to **complete** their **outermost octet** hence they act as **reducing agents**.

24. **Non-metals** have **5, 6 or 7 electrons** in their **valence shell**.

25. **Non-metals** can easily **gain electrons** to **complete** their **outermost octet**, hence they act as **oxidizing agents**.

26. **Metals** **lose electrons** to form **positively charged particles** called **cations** whereas **non-metals** **gain electrons** to form **negatively charged particles** called **anions**.

27. The **long form** of the **periodic table** gives a **clear demarcation** of **different kinds of elements**. The **similar elements** are **placed together** and their properties are discussed and studied separately.

IMPORTANT QUESTIONS

Q1. The following questions are related with the long form of periodic table.

- (i) State Modern Periodic law.
- (ii) In which group halogens are placed in long form of periodic table?
- (iii) In the long form of periodic table the elements are arranged in the ascending order of _____.
- (iv) The number of shells are equal to the number of _____.
- (v) _____ metals are present in group 1 of the periodic table.
- (vi) The _____ metals are placed in group 2 of the periodic table.
- (vii) The first period has _____ elements. The elements are _____ and _____.
- (viii) At the end of every period _____ gases are present.

- Ans.**
- (i) The physical and the chemical properties of the elements are the periodic functions of their atomic numbers.
 - (ii) Group 17.
 - (iii) Atomic number
 - (iv) Periods.
 - (v) Alkali
 - (vi) Alkaline earth
 - (vii) Two, hydrogen and helium.
 - (viii) Inert

Q2. Table given below shows the mass number and atomic number of five elements A, B, C, D and E.

Element	Mass number	Atomic number
A	35	17
B	23	11
C	12	6
D	16	8
E	40	18

- (i) To which group and period elements A, B, C, D and E belong?

- (ii) Choose from A, B, C, D and E, metal, non-metal and inert gas.

- (iii) Give the electronic configurations of elements A, B, C, D and E.

Ans.

Element	Group	Period	Electronic configuration		
			K	L	M
A	17	3	2	8	7
B	1	3	2	8	1
C	14	2	2	4	
D	16	2	2	6	
E	18	3	2	8	8

Metal	Non-metal	Inert gas
B	A C D	E

Element	Electronic configuration		
	K	L	M
A	2	8	7
B	2	8	1
C	2	4	
D	2	6	
E	2	8	8

Q3. Choose the odd one in the following list of elements.

- (i) F, Cl, Br, Na
- (ii) Li, Na, K, Ca
- (iii) C, B, Be, Sn
- (iv) Sc, Ti, U, He
- (v) Ne, Ar, Kr, Fr

Ans.

- (i) Na
- (ii) Ca
- (iii) Sn
- (iv) He
- (v) Fr.

Q4.	1																2																		
	3												4A		5												6	B7	8	9	C10				
	11D		12														13		14		15		16E		17		18								
	19		20		21F		22		23		24		25G		26		27		28		29		30		31		32		33		34		35H		36I

Which of the lettered element is

- (i) an inert gas
- (iii) alkali metal
- (v) halogen
- (ii) transition element
- (iv) alkaline earth metal
- (vi) forms diatomic molecule.

Ans. (i) C, I
(iii) D
(v) H
(ii) F, G
(iv) A
(vi) B and H.

Q5. Elements A, B and C are the members of triad. Element 'A' has atomic weight 40 and element 'C' has atomic weight 137.6.

- (i) What is the atomic weight of 'B' ?
- (ii) Identify A, B and C.

Ans. (i) $\frac{40 + 137.6}{2} = 88.8$
(ii) A = Calcium
B = Strontium
C = Barium.

Q6. Identify the element present in the following groups and periods.

- (i) 5th period, group 1.
- (ii) 4th period, group 11.
- (iii) 2nd period, group 16.
- (iv) 3rd period, group 17.
- (v) 4th period, group 18.

Ans. (i) Rubidium
(ii) Copper
(iii) Oxygen
(iv) Chlorine
(v) Krypton.

Q7. In a group where do you expect to find the most metallic element ?

Ans. At the bottom.

Q8. In a group where do you expect to find the element having maximum size ?

Ans. At the bottom.

Q9. In which group Lanthanoids and Actinoids are present ?

Ans. Group 3.

Q10. How many elements are present in

- (i) First period ?
- (ii) Second period ?
- (iii) Third period ?

Ans. (i) 2 elements
(ii) 8 elements
(iii) 8 elements.



LET'S RECALL

Fill Your Answer in the Space Given for Each Question.

Q1. Match the following :

A. Column I

- (i) Argon
- (ii) Bromine
- (iii) Potassium
- (iv) Oxygen
- (v) Calcium

Column II

- (a) Halogen
- (b) Alkali metal
- (c) Alkaline earth metal
- (d) Inert gas
- (e) Chalcogen

Ans. (i) ☐ (ii) ☐ (iii) ☐

B. Column I

- (i) First period
- (ii) Second period
- (iii) Fourth period
- (iv) Sixth period
- (v) Seventh period

Column II

- (a) 8 elements
- (b) 32 elements
- (c) 2 elements
- (d) Incomplete period
- (e) 18 elements

Ans. (i) ☐ (ii) ☐ (iii) ☐ (iv) ☐ (v) ☐

Q2. Fill in the blanks.

- (i) Representative elements have _____ penultimate shells.
- (ii) Transition elements have _____ penultimate shells.
- (iii) Vertical lines are called _____.
- (iv) Horizontal lines are called _____.
- (v) There are _____ vertical lines in the periodic table.
- (vi) Modern periodic law is given by _____.
- (vii) Inert gases have _____ valency.
- (viii) The elements of group 17 are called _____.
- (ix) Inert gases are present in group _____.
- (x) The highly non-metallic elements are present on _____ side of the periodic table.

Q3. Choose the odd one out in each case and write it in the box given below :

- (i) He, Ne, H, Kr
- (ii) Na, Rb, Fr, Ca
- (iii) F, At, Cl, Si
- (iv) Si, C, Al, Ge
- (v) K, Zr, Hf, Ti

Q4. Each question has four options out of which only one option is correct. Dark the bubble for correct answer.

(i) The transition elements starts from

(a) 1st period

(b) 2nd period

(c) 3rd period

(d) 4th period

Ans.

(a)

(b)

(c)

(d)

(ii) The element present in second period and group 18 is

(a) helium

(b) neon

(c) argon

(d) xenon

Ans.

(a)

(b)

(c)

(d)

(iii) The elements present in first two groups of the periodic table are

(a) highly non-metallic

(b) highly metallic

(c) inert gases

(d) metalloids

Ans.

(a)

(b)

(c)

(d)

(iv) The radioactive element in group 1 is

(a) sodium

(b) rubidium

(c) francium

(d) caesium

Ans.

(a)

(b)

(c)

(d)

(v) The radioactive element in group 2 is

(a) radium

(b) calcium

(c) magnesium

(d) beryllium

Ans.

(a)

(b)

(c)

(d)

Answers

1. A. (i) d	(ii) a	(iii) b	(iv) e	(v) c
B. (i) c	(ii) a	(iii) e	(iv) b	(v) d
2. (i) complete	(ii) incomplete	(iii) groups	(iv) periods	(v) 18
(vi) Moseley	(vii) zero	(viii) halogens	(ix) 18	(x) right
3. (i) H	(ii) Ca	(iii) Si	(iv) Al	(v) K
4. (i) d	(ii) b	(iii) b	(iv) c	(v) a

SELF EVALUATION TEST

Time : 30 minutes

Marks : 30

- Q1. State modern periodic law. 1
- Q2. Define group and period. 2
- Q3. What are representative elements ? In which groups these elements are present ? 2
- Q4. Choose odd one out from the following lists. 4

(i) Ra, Fr, Li

(ii) Cu, Ag, Au, He

(iii) N, P, S, Sb

(iv) He, Ne, Cu, Kr

- Q5. Name the elements occupying the following positions in the periodic table 5

S. No.	Group	Period
(i)	17	3
(ii)	16	2
(iii)	2	4
(iv)	1	6
(v)	14	3

- Q6. Name all the elements sequentially present in 5
- (i) Group 1 (ii) Group 2 (iii) Period 3
- (iv) Period 4 (v) Group 17

- Q7. Answer the following question related to the periodic table. 5

1 Groups	2											13	14	15	16	17	18
1																	2
3	4A											5	6	7	8B	9	10
11C	12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
19	20	21D	22	23	24	25	26	27	28E	29	30	31	32	33	34	35	36

Identify A, B, C, D and E.

- Q8. How many elements are present in 6
- (i) First period (ii) Second period (iii) Third period
- (iv) Fourth period (v) Fifth period (vi) Sixth period