



**CLASS X**  
**CHEMISTRY**  
**CHAPTER 1**  
**PERIODIC CLASSIFICATION OF ELEMENTS**

**SOLUTIONS**

Let's answer these (Page-3)

**Q. 1. What is Dobereiner's law of triads? Give one example.**

**Ans.** Dobereiner's law of triads is a law governing the classification of elements in which elements when arranged in a triad in the order of increasing atomic masses, the atomic mass of the middle element is approximately equal to the arithmetic mean of the atomic masses of the other two elements.

For example:

Atomic Mass	Element
40.1	Ca
87.6	Sr
137.3	Ba

Here,  
Average of the atomic masses of Ca & Ba

$$= \frac{40.1+137.3}{2} = \frac{177.4}{2} = 88.7 \text{ which is approximately equal to } 87.6, \text{ the atomic mass of Sr}$$

Hence (Ca, Sr, Ba) forms a Dobereiner's triad.

**Q. 2. A, B and C are the elements in Dobereiner's triad. If the atomic mass of A is 40 and that of C is 137. What could be the atomic mass of B?**

**Ans.** Element-A Atomic Mass = 40  
Element-C Atomic Mass = 137  
Atomic Mass of element B = Average of atomic masses of element A and C

$$= \frac{40+137}{2} = \frac{177}{2} = 88.5$$

$\therefore$  Atomic mass of B = 88.5



**Q. 3. What is Newlands' laws of octaves? Explain with an example?**

**Ans.** Newlands' laws of octaves is a law governing the classification of elements in which element when arranged in the increasing order of atomic masses, the properties of every eighth (8<sup>th</sup>) element resemble very closely the properties of the first one just like octaves in musical notes.

Example:

sa	re	ga	ma	pa	da	ni	Note of music
H	Li	Be	B	C	N	O	Element
1	7	9	11	12	14	16	Atomic mass
F	Na	Mg	Al	Si	P	S	Element
19	23	24	27	28	31	32	Atomic mass
Cl	K	Ca					Element
35.5	39	40					Atomic mass

Starting from Hydrogen (H), the eighth element came out to be Fluorine (F). The eighth element starting from Fluorine (F) was Chlorine (Cl). The properties of F and Cl were found similar.

**Q. 4. What were the limitations of Newlands' law of octaves?**

**Ans.** The law could not be applied to elements of higher atomic masses after Calcium.

Let us answer these (Page 6)

**Q. 1. What was Mendeleev's principle for the classification of elements?**

**Ans.** Mendeleev's principle for the classification of elements is the Mendeleev's Periodic Law which states that, *"the properties of elements are the periodic functions of their atomic masses"*.

**Q. 2. Using Mendeleev's Periodic Table, predict the formula for the oxides of the following elements: K, C, Al, Si, Ba.**

**Ans.**

Element	Oxide
K	K <sub>2</sub> O
C	CO <sub>2</sub>
Al	Al <sub>2</sub> O <sub>3</sub>
Si	SiO <sub>2</sub>
Ba	BaO

**Q. 3. Besides Gallium, which other elements have since been discovered that were left blank by Mendeleev in his periodic table? (any two).**

**Ans.** Scandium (Sc) and Germanium (Ge)



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**Q. 4. Give your reason why the noble gases are placed in a separate group.**

**Ans.** Noble gases are placed in a separate group because they were not discovered at the time of Mendeleev and possess exceptional properties.

**Let us answer these. Page 18-19**

**Q. 1. What name has given to the horizontal arrangement of elements in the periodic table? Is there any gradation in the properties of elements across these rows? Give two examples to illustrate.**

**Ans.** The horizontal arrangement of elements in the periodic table is called periods.

There is gradation in the properties of elements across these rows.

Examples,

- (i) The atomic radius decreases in moving from left to right along a period for normal elements.
- (ii) Metallic character decreases across a period.

**Q. 2. How do the properties of group 1 elements differ from those of group 17 elements? Illustrate the difference in at least two properties?**

**Ans.** Group 1 elements are metals while group 17 elements are non-metals. For examples:

- (i) Group 1 elements have the tendency to lose electron while group 17 elements have tendency to gain electrons.
- (ii) Group 1 elements form basic oxides while group 17 elements form acidic oxides.

**Q. 3. From the standpoint of electronic configuration, determine which element will be the first and which will be last in a period of the periodic table?**

**Ans.** The elements having one electron in the same valence shell will be placed in the first period and the element having eight electrons in the valence shell will be placed in the last period.

**Q. 4. Accommodation of isotopic form of the same element was an upset in Mendeleev's periodic table. How could the Modern Periodic table remove the anomaly?**

**Ans.** The Modern Periodic table removes this anomaly in Mendeleev's periodic table by arranging elements in the increasing order of their atomic number.

**Q. 5. Name two elements you would expect to show chemical reactions similar to lithium. What is the basis of your choice?**

**Ans.** Sodium (Na) and Potassium (K)

They belong to the same group i.e. group 1 of the periodic table and have the same valence electron i.e. 1.



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**Q. 6. Name**

- (i) **three elements having one electron in their outermost shells.**
- (ii) **two elements having four electrons in their outermost shells.**
- (iii) **three elements with completely filled shells.**

**Ans.**

- i) Lithium (Li), Sodium (Na) and Potassium (K)
- ii) Carbon (C) and Silicon (Si)
- iii) Helium (He), Neon (Ne) and Argon (Ar).

**Q. 7. Fluorine, Chlorine and Bromine belong to group 17 of the periodic table. What similarity is there in the atoms of these elements?**

**Ans.** Fluorine, Chlorine and Bromine have the same valence electron i.e. 7.

**Q. 8. By considering their positions in the periodic table, which one of the following elements is expected to have maximum metallic character?**

**In, Sn, Sb, Te, I**

**Ans.** 'In' because metallic character decreases from left to right in a period.

**Q. 9. How would the tendency to gain electrons change as we go from left to right across a period?**

**Ans.** From left to right in a period, the effective nuclear charge increases due to gradual increase in the number of protons. As a result, the valence electrons are pulled in more strongly by the nucleus and the tendency to gain electrons increases across a period.

**Q. 10. How would be the tendency to gain electrons change as we go down a group?**

**Ans.** Down the group, the effective nuclear charge experienced by valence electrons is decreasing because the outermost electrons are farther away from the nucleus due to the addition of new shells. Hence, the tendency of an element to gain electrons decreases down a group.

**Q. 11. Why are non-metals found on the right-hand side of the periodic table towards the top?**

**Ans.** Non-metals have high tendency to gain electrons and the tendency to gain electrons (electronegative character) increases along a period and decreases down a group. That is why non-metals are found on the right-hand side of the periodic table towards the top.



**EXERCISES Page 20-21**

**Q. 1. Why is there a need to classify the elements? What differences are likely to arise if the classification is not made?**

**Ans.** Classification of elements is needed in order to make the study of elements and their properties easier.

If the classification is not made, it will be a difficult task to study and remember all the properties of elements and their compounds.

**Q. 2. Name the period and group to which the element with atomic number 15 belongs.**

**Ans.** Atomic no. 15:

Electronic configuration: 2, 8, 5

Period : 3<sup>rd</sup>

Group : 15

**Q. 3. State one reason for keeping Boron and Aluminium in the same group of the periodic table.**

**Ans.** They have similar outer configuration with 3 valence electrons each.

**Q. 4. Write the electronic configurations of the elements Na, Al, Ca, O and Si and justify their positions in the periodic table.**

**Ans.**

Elements	Electronic configuration	Period	Group
Na	2,8,1	3rd	1
Al	2,8,3	3rd	13
Ca	2,8,8,2	4th	2
O	2,6	2nd	16
Si	2,8,4	3rd	14

**Q. 5. Why is atomic number more important than atomic mass to know the properties of the elements?**

**Ans.** The properties of elements depend upon their electrons which is equal to number of protons or atomic number of that element. Therefore, atomic number is more important than its atomic mass.



**Q. 6. State how atomic size varies from left to right in a period and from top to bottom in a group.**

**Ans.** From left to right in a period atomic size decreases. This is because of the increase in the nuclear charge which pulls the electrons closer to the nucleus as electrons are added to the same shell and from top to bottom atomic size increases because of the addition of electrons to new shells.

**Q. 7. The atomic radii of the elements of second period are given below:**

2<sup>nd</sup> period elements: B      Be      O      N      Li      C  
Atomic radii (pm) : 80      90      74      75      123      77

- Arrange the elements in the decreasing order of their atomic radii, keeping the element with the largest atomic radius first.
- Find out whether the arrangement is in the pattern of a period or not?
- From this data, infer how the atomic size of the elements changed as one goes from left to right in a period.

**Ans.**

- $Li > Be > B > C > N > O$
- The arrangement is in the pattern of a period.
- Atomic size decreases as one goes from left to right in a period.

**Q. 8. By considering their position in the periodic table, which one of the following elements would you expect to have the maximum metallic character?**

Ga, Ge, As, Se, Br

**Ans.** Ga

**Q. 9. The position of three elements A, B and C in the periodic table are shown below.**

Group 16	Group 17
--	--
--	A
--	--
B	C

- State whether A is a metal or non-metal?
- State whether C will be more reactive or less reactive than A?
- Will C be larger or smaller in size than B?
- What type of ion (cation or anion) will be formed by A?



- Ans.** (a) A is a non-metal  
(b) C will be less reactive than A.  
(c) C will be smaller in size than B.  
(d) A will form anion.

**Q. 10.**Element X forms a chloride with the formula  $XCl_2$ . With which of the following elements, X would most likely be in the same group of the periodic table?

**Na, Mg, Al, C.**

**Ans.** Since the chloride of X has the formula  $XCl_2$ , the valency of X will be 2. Mg has valency 2 as it has 2 valence electrons. Hence, X will be in the same group of Mg in the periodic table.

**Q. 11.**Name two elements you would expect to show chemical properties similar to Li. What is the basis of your choice?

**Ans.** Sodium (Na) and Potassium (K)

Both, Na (atomic no.11) and K (atomic no.19) have one valence electron each similar to Li (atomic no.3).

**Q. 12.** What properties do all elements in the same group of boron in the periodic table have in common?

**Ans.** Boron has valence electrons 3 and its valency is 3. Similarly, all elements in the same group of boron in the periodic table have valence electrons 3 and their valency is 3.

**Q. 13.**An atom has electronic configuration 2, 8, 6.

- (a) What is the atomic number of this element?  
(b) Which of the following elements would it be similar in chemical properties?  
N (7), F (9), P (15), O (8), Ar (18)

**Ans.** (a) The atomic number of this element is 16.  
(b) O (8)

**Q. 14.**Nitrogen (at.no.7) and Phosphorus (at. no. 15) belong to group 15 of the periodic table. Which of them will be more electronegative and why?

**Ans.** Nitrogen will be more electronegative than Phosphorus. Because electro-negativity character decreases of down a group.



**Q. 15. In the modern periodic table, Calcium (at. no. 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38. Which of them have physical and chemical properties resembling Calcium?**

**Ans.** Elements with atomic number 12 and 38 will have physical and chemical properties resembling calcium because they have 2 valence electrons each and belong to the same group of the periodic table.

### **EXTRA QUESTIONS AND ANSWERS**

**Q. 1. What is the definition of element according to Robert Boyle?**

**Ans.** Robert Boyle defined an element as “any substance that cannot be decomposed into a simpler substance by a chemical reaction”.

**Q. 2. Why periodic classification of elements is necessary?**

**Ans.** When only a few elements were known, it was easy to study and remember their properties. But it has become difficult task when several new elements were discovered. In order to find regularities or trends in the properties of about 118 known elements, there is a need of periodic classification of elements.

**Q. 3. What led the Lavoisier to classify elements into metals and non-metals?**

**Ans.** Elements like Copper, Silver and Gold have characteristic lustre, malleability and ductility while elements like graphite (Carbon), Sulphur and Phosphorus do not have lustre, are non-malleable and non-ductile. These important differences in the properties of elements led Lavoisier to classify elements into metals and non-metals.

**Q. 4. What are the drawbacks or demerits of Lavoisier classification of elements?**

**Ans.** Drawbacks or demerits of Lavoisier classification of elements:

- (i) Grouping of metals and non-metals was too board and unbalanced as there are only a few non-metals (about 10%) in one group and a large number of metals (90%) in the other group.
- (ii) There was no place for elements with properties resembling those of metals and non-metals.

**Q. 5. How many elements were known at the time of Mendeleev?**

**Ans.** At the time of Mendeleev only 63 elements were known.





**Q. 6. State Mendeleev's periodic law.**

**Ans.** Mendeleev's periodic law states that "the properties of elements are the periodic functions of their atomic masses".

**Q. 7. What does Mendeleev's periodic law mean?**

**Ans.** Mendeleev's periodic law means that when the elements are arranged in order of increasing atomic masses then those with similar properties are repeated at regular intervals.

**Q. 8. In the Mendeleev's periodic classification, what were treated as one of the basic property of an element?**

**Ans.** The formula of the oxides and hydrides formed by an element were treated as one of the basic properties of an element for its classification into groups.

**Q. 9. In which journal Mendeleev's Periodic Table was published?**

**Ans.** Mendeleev's Periodic Table was published in a German Journal in 1872.

**Q. 10. What are vertical columns and horizontal rows of the Mendeleev's periodic table called?**

**Ans.** In periodic table, vertical columns are called 'groups'. They are eight in numbers and designated as I, II, III, IV, V, VI, VII, VIII.

Horizontal rows are called 'periods'. They are six in numbers and numbered as 1, 2, 3, 4, 5, 6.

**Q. 11. Why is Mendeleev's classification appreciated?**

**Ans.** Mendeleev classified the elements on the basis of their atomic masses and it brought some order in the properties exhibited by the elements and their compounds. By knowing the properties of an element in a group, the properties of other elements in the group can be easily guessed.

**Q. 12. Mention one of the achievements of Mendeleev's periodic table.**

**Ans.** One of the achievements of Mendeleev's periodic table was that when noble gases were discovered they could be placed in a new group called the zero group without disturbing the existing order.

**Q. 13. What are the limitations of Mendeleev's periodic table?**

**Ans.** Limitations of Mendeleev's periodic table:

- i) There is no place for isotopes.
- ii) Atomic mass does not increase in a regular manner.
- iii) Position of hydrogen is defective.
- iv) Defect regarding grouping of elements.



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**Q. 14. State Modern Periodic Table.**

**Ans.** Modern Periodic Table states that “the properties of elements are the periodic functions of their atomic numbers”.

**Q. 15. How many periods and groups are present in the modern periodic table?**

**Ans.** The modern periodic table has 7 periods (horizontal rows) and 18 groups (vertical columns).

**Q. 16. What are inner transition elements?**

**Ans.** Two series of elements, 14 in each series which are placed at the bottom of the main periodic table are called inner-transition elements.

**Q. 17. What is Lanthanide series?**

**Ans.** The first series of 14 elements from atomic numbers 58 to 71 (Ce to Lu) is called Lanthanide series.

**Q. 18. What is Actinide series?**

**Ans.** The second series of 14 elements from atomic numbers 90 to 103 (Th to Lr) is called Actinide series.

**Q. 19. What is known as zero group elements in the Modern periodic table? Why are they so called?**

**Ans.** Group 18 elements are known as zero group elements. This is because they have 0 valency combining capacity and are very un-reactive elements.

**Q. 20. Name the zero group elements.**

**Ans.** He, Ne, Ar, Kr, Xe & Rn.

**Q.21. What are normal or representative elements? Why are they so called?**

**Ans.** Elements of groups 1, 2 and 13 to 18 are called normal representative elements. This is because each group have their own characteristic properties and valence electron of elements can represent their respective groups.

**Q. 22. What are transition elements? Why are they so called?**

**Ans.** Elements of groups 3 to 12 are called transition elements. This is because they show transition in properties from metals to non-metals.

**Q. 23. To which group of Modern Periodic Table does the element with atomic number 20 belong?**

**Ans.** The element with atomic number 20 belongs to 4<sup>th</sup> period and group 2 of the Modern Periodic Table.



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**Q. 24. How does the basis of classification of elements in Modern Periodic Table differ from that of Mendeleev's table?**

**Ans.** In the Modern Periodic Table, elements are classified on the basis of atomic number but in Mendeleev's Periodic Table classification was done on the basis of atomic mass of the elements.

**Q. 25. The third period of the modern periodic table has the elements Al and Cl as members. To which group do they belong? Compare their atomic sizes and electro-negativity values. State the nature of their oxides.**

**Ans.** The elements Al and Cl belong to group 13 and 17 respectively.

Comparison of atomic sizes- Atomic size of Al is larger than that of Cl.

Comparison of electro negativity values – Cl is more electronegative than Al.

Nature of their oxides -  $\text{Al}_2\text{O}_3$  is amphoteric in nature and  $\text{Cl}_2\text{O}_7$  is highly acidic in nature.

**Q. 26. "X" is an element of group 2 of the periodic table. How many electrons are there in the valence shell of the element?**

**Ans.** Two electrons

**Q. 27. What is metallic character?**

**Ans.** The tendency of an element to lose electrons and form positive ions (cations) is called metallic character.

**Q. 28. Atoms of the elements A, B, C and D have 3, 11, 17 and 20 protons respectively in their nuclei. Identify-**

(i) elements belonging to the same group

(ii) elements that belong to the same period

(iii) heaviest atom among them.

**Ans.** Electronic configuration of the elements are-

A (3):2,1

B (11):2, 8, 1

C (17) : 2, 8, 7

D (20):2,8,8, 2

(i) A and B are in the same group 1 as they have the same valence electron i.e. 1

(ii) B and C are in the same period (3<sup>rd</sup>) as they have the same number of shells.

(iii) D is the heaviest as it has the largest number of protons.

**Q. 29. Why is modern periodic table considered to be an improvement over Mendeleev's table?**

**Ans.** Modern periodic table is based on the atomic number instead of atomic mass of Mendeleev's. Also it removes some of the anomalies of Mendeleev's periodic table.



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**Q. 30. An atom of an element Z has 22 neutrons and 18 protons in its nucleus. What are the (i) mass number (ii) valence electron and (iii) group number of Z.**

**Ans.**

i) Mass number = Number of protons + Number of neutrons  
= 18 + 22 = 40 u

ii) Since the element has 18 protons, it has 18 electrons.

Its electronic configuration is 2,8,8. Therefore, its valence electron is 8.

iii) Since the element has 8 valence electrons, it belongs to group 18 of the periodic table.

**Q. 31. Show the classification of the first twenty elements (atomic number 1 to 20) in accordance with the Modern Periodic Table.**

**Ans.**

Period	Group							
	1	2	13	14	15	16	17	18
1 <sup>st</sup> period	H (1)							He (2)
2 <sup>nd</sup> period	Li (3)	Be (4)	B (5)	C (6)	N (7)	O (8)	F (9)	Ne(10)
3 <sup>rd</sup> period	Na (11)	Mg(12)	Al(13)	Si(14)	P (15)	S (16)	Cl (17)	Ar(18)
4 <sup>th</sup> period	K (19)	Ca (20)						

**Q. 32. Why are the atomic sizes of Group 18 elements larger than that of Group 17 elements?**

Ans. This is due to the increase of inter electronic repulsions in the completely filled outer shells in the atoms of Group 18 elements.



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