

Chapter: 2

Q.1 Textbook activity question

30

- 1 Does this arrangement match with the pattern of the second period of the modern periodic table?

Element	O	B	C	N	Be	Li
Atomic radius (pm)	66	88	77	74	111	152

Ans Yes. The arrangement of the elements matches with the second period of the modern periodic table because the elements were arranged in the decreasing order of their atomic radius.

- 2 How many valence electrons are there in each of these elements?

Ans Number of valence electrons in each of these elements is 1.

- 3 Write the electronic configuration of the first four elements in this group.

Ans

Elements	Electronic configuration
Hydrogen	1
Lithium	2, 1
Sodium	2, 8, 1
Potassium	2, 8, 8, 1

- 4 What is the cause of nonmetallic character of elements?

Ans The tendency to form anion by accepting outside electrons into its valence shell or electronegativity is the cause of nonmetallic character of an element.

- 5 How is the problem regarding the position of cobalt (^{59}Co) and Nickel (^{59}Ni) in Mendeleev's periodic table resolved in modern periodic table?

Ans (i) According to Mendeleev's periodic law, elements are arranged in the order of their increasing atomic masses.
 (ii) When Co. and Ni were put in the group on the basis of their chemical properties it was found that Co having higher mass of 58.9 comes first and Nickel with slightly lower atomic mass of 58.7 comes later.
 (iii) Modern Periodic table resolved this problem. According to the Modern Periodic law, elements are arranged in their increasing order of atomic number.
 (iv) The atomic number of Cobalt is 27 comes first and Nickel with atomic number 28 comes next even if their atomic masses are in the reverse order.

- 6 Which similarity do you find in their configuration?

Ans From the above electronic configurations, we can say that the number of valence electrons of all the elements are same which is 1.

- 7 What is the difference between the molecules of elements and compounds?

Ans Molecules of elements contain atoms of the same element where as molecules of compounds contain atoms of two or more different elements.

- 8 By referring to the modern periodic table find out the periods to which the above elements belong.

Element	K	Na	Rb	Cs	Li
Atomic radius (pm)	231	186	244	262	152

Ans All the given elements belong to group 1 of the modern periodic table.

9 What would be the expected trend in the variation of nonmetallic character of elements down a group?

Ans The nonmetallic character decreases down a group.

10 What are the types of elements?

Ans metals, metalloids, and nonmetals

11 Write the molecular formulae of oxides of the following elements by referring to the Mendeleev's periodic table. Na, Si, Ca, C, Rb, P, Ba, Cl, Sn, Ca

Ans

Element	Molecular formula	Element	Molecular formula
Na	Na ₂ O	P	P ₂ O ₅
Si	SiO ₂	Ba	BaO
Ca	CaO	Cl	Cl ₂ O ₇
C	CO ₂	Sn	SnO ₂
Rb	Rb ₂ O		

12 What do you think? Should hydrogen be placed in the group 17 of halogens or group 1 of alkali metals in the modern periodic table?

Ans (i) Hydrogen fits in its current position in the periodic table (group 1) much better than in group 17 (though is not a perfect position). For example Hydrogen forms oxide (H₂O) just like oxides of alkali metals (Na₂O, K₂O). It has the same common charge (+ 1) as all alkali metals.

(ii) It resembles halogens in forming diatomic molecules
H₂, Cl₂, F₂, Br₂.

(iii) It does not behave like halogens, being mainly in the + 1 oxidation state. It does not happen to be like halogens, the most stable compounds of halogens have either -1 or a very high oxidation state like -7 or +5.)

(iv) Hydrogen has one electron in the outermost shell and it is placed in top of group/based on atomic number.

13 How did the position of ³⁵₁₇Cl and ³⁷₁₇Cl get fixed in the modern periodic table?

Ans (i) Modern Periodic table is based on atomic numbers, So, the position of isotopes of elements was decided by arranging the elements in the ascending order of their atomic numbers.

(ii) As isotopes have the same atomic number they do not need to be given different positions (slots).

14 Is the number of valence electrons same for all these elements?

Ans The number of valence electrons is different for all these elements.

15 Chlorine has two isotopes, viz, Cl-35 and Cl- 37. Their atomic masses are 35 and 37 respectively. Their chemical properties are same. Where should these be placed in Mendeleev's periodic table? In different places or in the same place?

Ans Mendeleev arranged the elements in increasing order of atomic mass. Since the atomic masses of the isotopes of chlorine are 35 and 37, they should be kept in different positions in the Mendeleev Periodic table.

16 Arrange the above elements vertically downwards in an increasing order of atomic radii.

Element	K	Na	Rb	Cs	Li
Atomic radius (pm)	231	186	244	262	151

Ans	Element	Li	Na	K	Rb	Cs
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17 Is the number of shells the same in these?

Ans Number of Shells is same in these elements i.e.2.

18 Look at the elements of the third period. Classify them into metals and nonmetals.

Ans The third period contains eight elements: sodium (Na), magnesium (Mg), aluminium (Al), silicon (Si), phosphorus (P), sulfur (S), chlorine (Cl), and argon (Ar).

Metals - (sodium, magnesium, aluminium),

Nonmetals - (phosphorous, sulfur, chlorine, argon) and one is metalloid (silicon).

19 What is the expected trend in the variation of nonmetallic character of elements from left to right in a period?

Ans Non-metallic character increases from left to right in a period.

20 What are the types of matter?

Ans i. **Solids** – relatively rigid, definite volume and shape. In a solid, the atoms and molecules are attached to each other. ...

ii. **Liquids** – definite volume but able to change shape by flowing. In a liquid, the atoms and molecules are loosely bonded. ...

iii. **Gases** – no definite volume or shape.

21 Due to uncertainty in the names of some of the elements, a question mark is indicated before the symbol in the Mendeleev's periodic table. What are such symbols?

Ans Mendeleev arranged the elements in the increasing order of atomic masses. In some places the atomic mass of elements would not be in right order to put them in the correct group. Tellurium is heavier than Iodine, but he put Iodine after Tellurium because Iodine has similar properties like F, Cl, Br. He placed the elements according to their properties and put a question mark to indicate that the atomic mass needs to be checked. for e.g.? Yt = 88 in Mendeleev's periodic table was corrected as Yt = 88.906 in Modern Periodic table.

22 Write the molecular formulae of the compounds of the following elements with hydrogen by referring to the Mendeleev's periodic table. C, S, Br, As, F, O, N, Cl

Ans	Elements	Compounds (with hydrogen)
	C	CH ₄ Methane
	S	H ₂ S Hydrogen sulphide
	Br	HBr Hydrogen bromide
	As	AsH ₃ Arsine
	F	HF Hydrogen fluoride
	O	H ₂ O Water
	N	NH ₃ Ammonia
	Cl	HCl Hydrogen chloride

23 On going through the modern periodic table it is seen that the elements Li, Be, B, C, N, O, F and Ne belong to the period-2. Write down electronic configuration of all of them.

Ans Electronic configuration of the elements :

Li	Be	B	C	N	O	F	Ne
2, 1	2, 2	2, 3	2, 4	2, 5	2, 6	2, 7	2, 8

24 There are some vacant places in the Mendeleev's periodic table. In some of these places the atomic masses are seen to be predicted. Enlist three of these predicted atomic masses along with their group and period.

Ans Three of these predicted atomic masses along with their group and period are:

- a. atomic mass = 44, group III and period 4
- b. Atomic mass = 68, group III and period 5
- c. Atomic mass = 72, group IV and period 5

25 On which side of the period are the metals? Left or right?

Ans Left side of the period are the metals.

26 Go through the modern periodic table and write the names one below the other of the elements of group 1.

Ans The modern periodic table is given below:

Four elements of group 1 :Hydrogen (H)
Lithium (Li)
Sodium (Na)
Potassium (K)

27 Can there be an element with atomic mass 53 or 54 in between the two elements, chromium $^{53}_{24}\text{Cr}$ and manganese $^{55}_{25}\text{Mn}$?

Ans It is not possible. Since their atomic numbers are continuous, there cannot be an element between Chromium and Manganese.

28 On which side of the period did you find the nonmetals?

Ans On the right side of the periodic table, we find non-metals.

29 Does this arrangement match with the pattern of the group 1 of the modern periodic table?

Element	K	Na	Rb	Cs	Li
Atomic radius (pm)	231	186	244	262	151

Ans Yes. The arrangement of the elements as per the increasing order of atomic radius matches with the group 1 of the modern periodic table.

30 What are the smallest particles of matter called?

Ans The smallest particles of matter are called atoms and molecules.

Q.2 Multiple Choice Questions

4

1 Alkaline earth metals have valency 2. This means that their position in the modern periodic table is in
a. Group 2 b. Group 16 c. Period 2 d. d-block

Ans Option a.

2 The number of electrons in the outermost shell of alkali metals is _____.
a) 1 b) 2 c) 3 d) 7

Ans option a

3 In which block of the modern periodic table are the nonmetals found?
a. s-block b. p-block c. d-block d. f-block

Ans Option b.

4 Molecular formula of the chloride of an element X is XCl. This compound is a solid having high melting point. Which of the following elements be present in the same group as X.
a. Na b. Mg c. Al d. Si

Ans Option a.

Q.3 Match the pair

1

- 1 Rearrange the columns 2 and 3 so as to match with the column 1.

Column 1	Column 2	Column 3
i) Triad	a. Lightest & negatively charged particle in all the atoms	1. Mendeleev
ii) Octave	b. Concentrated mass and positive charge	2. Thomson
iii) Atomic number	c. Average of the first and the third atomic masses	3. Newlands
iv) Period	d. Properties of the eighth element similar to the first	4. Rutherford
v) Nucleus	e. Positive charge on the nucleus	5. Dobereiner
vi) Electron	f. Sequential change in molecular formulae	6. Moseley

Ans (i → c → 5), (ii → d → 3),
 (iii → e → 6), (iv → f → 1),
 (v → b → 4), (vi → a → 2).

Q.4 Name the following

14

- 1 The period with electrons in the shells K, L and M.

Ans Period 3.

- 2 Nonmetals in the third period.

Ans Phosphorous (P), Sulfur (S), Chlorine (Cl), and Argon (Ag).

- 3 Write the name and symbol of the element from the description.
 The most electronegative atom.

Ans Fluorine (F₂)

- 4 Metalloid found in group 13 and period 2.

Ans Boron

- 5 Write the name and symbol of the element from the description.
 The atom having the smallest size.

Ans Helium (He)

- 6 Two elements having valency 4.

Ans Carbon, Silicon

- 7 The family of metals having valency one.

Ans Alkali metals.

- 8 Write the name and symbol of the element from the description.
 The most reactive nonmetal.

Ans Fluorine (Fe).

- 9 The family of nonmetals having valency one.

Ans Halogens.

- 10 The group with valency zero.

Ans Group 18.

11 Write the name and symbol of the element from the description.
The noble gas with the smallest atomic nucleus.

Ans Helium (He)

12 Write the name and symbol of the element from the description.
The atom having the smallest atomic mass.

Ans Hydrogen (H₂)

13 The metalloids in the second and third periods.

Ans Boron (second period), Silicon (third period)

14 The family of metals having valency two.

Ans Alkaline earth metals.

Q.5 Give scientific reasons

10

1 The third period contains only eight elements even though the electron capacity of the third shell is 18.

Ans i. According to the law of electron octet, the last shell cannot have more than eight electrons.
ii. Hence, the third period contains only eight elements in the third shell even though the electron capacity of the third shell is 18.

2 Atomic radius goes on decreasing while going from left to right in a period.

Ans 1. Atomic radius is the distance between the nucleus of the atom and its outermost shell.
2. While going from left to right within a period, the number of shells remains the same, while the number of electrons increases by one at a time. However, the additional electron gets added to the same outermost shell.
3. At the same time, a proton is being added to the nucleus. This increases the positive charge in the nucleus and hence, the atomic number increases one by one, and the positive charge in the nucleus also increases by one unit at a time.
4. Due to the increased nuclear charge, the electrons are pulled towards the nucleus to a greater extent and therefore the size of the atom and hence, the radius of the atom decreases as we go from left to right in a period.

3 Elements belonging to the same group have the same valency.

Ans i. Elements fall in same group with similar properties.
ii. So, all the element that have same number of valence electrons belongs to the same group.
iii. Thus, Elements belonging to the same group have the same valency.

4 As we move down the group metallic character increases. OR
The atomic size increases as we move down the group.

Ans 1. Metals have a tendency to lose valence electrons to form a cation (positive ion).
2. As we go from left to right, the number of valence electrons in the outermost shell increases, but the number of shells remain the same.
3. The atomic radius decreases and the positive charge on the nucleus increases. As a result of this, the tendency of atom to lose valence electrons decreases within a period from left to right.
4. Hence, metallic character decreases from left to right in a period.

5 Metallic properties of the elements change to non metallic properties as one moves from left to right in a period of periodic table.

Ans i. If an element donates its valence electrons with ease so as to form positively charged ions, it is said to be metallic element.
ii. Conversely, if an element accepts electrons in its valence shell so as to form negatively charged ions, the element is said to be non metallic.
iii. On progressing from left to right, there is gradual increase in the nuclear charge due to increase in atomic number but this results in decrease in atomic size.
iv. Increased nuclear charge bounds the electrons in the valence shell more tightly and makes it difficult for atoms of elements to donate electrons.

Thus the character of elements gradually changes from metallic to non metallic.

Q.6 Write Short Notes on

6

1 Position of isotopes in Mendeleev's periodic table and the modern periodic table.

Ans 1. Isotopes were discovered long after Mendeleev put forth the periodic table.
2. Mendeleev arranged the elements in an increasing order of atomic masses.
3. As isotopes have the same chemical properties but different atomic masses, no fixed positions could be given to the isotopes.
4. However, the modern periodic table is based on atomic numbers of elements. As isotopes of an element have the same atomic number, all the isotopes of an element are assigned the same position in the modern periodic table.

2 Mendeleev's periodic law.

Ans i. Mendeleev organized the period table on the basis of the chemical and physical properties of the elements.
ii. For this purpose, he considered the molecular formulae of hydrides and oxides of the elements, melting points, boiling points and densities of the elements and their hydrides and oxides.
iii. When he arranged the 63 elements known at that time in the increasing order of their atomic masses, he found that the chemical and physical properties of elements showed repetition after certain fixed interval.
iv. On the basis of this finding, he stated that 'properties of elements are a periodic function of their atomic masses'. This is known as Mendeleev's periodic law.

3 Structure of the modern periodic table.

Ans i. The modern periodic table consists of seven horizontal rows called the periods and eighteen vertical columns called the groups.
ii. The arrangement of the periods and groups results in the formation of boxes, where each box corresponds to the position of an element.
iii. In addition to these seven rows, lanthanide and actinide series are shown separately at the bottom of the periodic table. The first row is lanthanide series and the second row is actinide series.
iv. The entire periodic table is divided into four blocks: s-block, p-block, d-block and f-block.
v. A zig-zag line is drawn in the p-block of the periodic table. Metals lie on the left side while nonmetals lie on the right side of this line. Metalloids lie along the border of this line.

Q.7 Chemical reactions with equations.

2

1 Write down the electronic configuration of the following elements from the given atomic numbers. Answer the following question with explanation.

a. $_{13}\text{Al}$, $_{14}\text{Si}$, $_{11}\text{Na}$, $_{12}\text{Mg}$, $_{16}\text{S}$

Which of the above elements has the highest metallic character?

b. $_{6}\text{C}$, $_{3}\text{Li}$, $_{9}\text{F}$, $_{7}\text{N}$, $_{8}\text{O}$

Which of the above elements has the highest nonmetallic character?

Ans

	Element	Electronic configuration
i.	$_{13}\text{Al}$	2, 8, 3
	$_{14}\text{Si}$	2, 8, 4
	$_{11}\text{Na}$	2, 8, 1
	$_{12}\text{Mg}$	2, 8, 2
	$_{16}\text{S}$	2, 8, 6

The element with the highest metallic character is $_{11}\text{Na}$.

	Element	Electronic configuration
ii.	${}_6\text{C}$	2, 4
	${}_3\text{Li}$	2, 1
	${}_9\text{F}$	2, 7
	${}_7\text{N}$	2, 5
	${}_8\text{O}$	2, 6

The element with the highest nonmetallic character is ${}_9\text{F}$.

Q.8 Answer the following.

8

- 1 Metallic character goes on decreasing while going from left to right in a period.

OR

The non-metallic character goes on increasing while going from left to right in a period

Ans Metallic character goes on decreasing while going from left to right in a period because the tendency of atoms of the elements to lose electrons (or gain electrons) changes in a period. As we move from left to right in a period, the nuclear charge increases due to a gradual increase in the number of protons. Due to the increase in nuclear charge, the valence electrons are pulled strongly by the nucleus and it becomes difficult for the atoms to lose electrons. Hence, the metallic character decreases.

- 2 An element has its electron configuration as 2,8,8,2. Now answer the following questions.

- What is the atomic number of this element?
- What is the group of this element?
- To which period does this element belong?

Ans i. The atomic number of this element is 20.
ii. The group of this element 2.
iii. This element belongs to fourth period.

- 3 An element has its electronic configuration as 2,8,2. Now answer the following questions.

- What is the atomic number of this element ?
- What is the group of this element ?
- To which period does this element belong ?
- With which of the following elements would this element resemble N(7), Be(4), Ar(18), Cl(17)

Ans i. 12

ii. 2

iii. 3rd

iv. Be(4) as they belong to the same group.

- 4 Atomic radius goes on decreasing while going from left to right within a period.

Ans While going from left to right within a period, the atomic number increases one by one, the positive charge on the nucleus increases by one unit at a time. However, the additional electron gets added to the same outermost shell. Due to the increased nuclear charge, The electrons are pulled towards the nucleus to a greater extent and there by the size of atom decreases. Hence atomic radius is goes on decreasing while going from left to right within a period.

Q.9 Answer the following

9

- 1 Write down the electronic configuration of the following elements from the given atomic numbers. Answer the following question with explanation.

a. ${}_4\text{Be}$, ${}_6\text{C}$, ${}_8\text{O}$, ${}_5\text{B}$, ${}_{13}\text{Al}$

Which is the most electropositive element among these?

b. ${}_{11}\text{Na}$, ${}_{15}\text{P}$, ${}_{17}\text{Cl}$, ${}_{14}\text{Si}$, ${}_{12}\text{Mg}$

Which of these has largest atoms?

c. ${}_{19}\text{K}$, ${}_3\text{Li}$, ${}_{11}\text{Na}$, ${}_4\text{Be}$

Which of these atoms has smallest atomic radius?

Ans

a.	Element	Electronic configuration
	${}_4\text{Be}$	2, 2
	${}_6\text{C}$	2, 4
	${}_8\text{O}$	2, 6
	${}_5\text{B}$	2, 3
	${}_{13}\text{Al}$	2, 8, 3

The most electropositive element is ${}_{13}\text{Al}$.

b.	Element	Electronic configuration
	${}_{11}\text{Na}$	2, 8, 1
	${}_{15}\text{P}$	2, 8, 5
	${}_{17}\text{Cl}$	2, 8, 7
	${}_{14}\text{Si}$	2, 8, 4
	${}_{12}\text{Mg}$	2, 8, 2

The element which has the largest atom is ${}_{11}\text{Na}$.

c.	Element	Electronic configuration
	${}_{19}\text{K}$	2, 8, 8, 1
	${}_3\text{Li}$	2, 1
	${}_{11}\text{Na}$	2, 8, 1
	${}_4\text{Be}$	2, 2

The element with the smallest atomic radius is ${}_4\text{Be}$.

2 An element has its electron configuration as 2,8,2. Now answer the following questions.

- What is the atomic number of this element?
- What is the valency of this element?
- What is the group of this element?
- To which period does this element belong?

With which of the following elements would this element resemble?(Atomic numbers are given in the brackets)

N(7), Be(4), Ar(18), Cl(17)

Ans i. Atomic number 12

ii. Valency 2

iii. Group 2

iv. Period 3

The element would resemble (Chemically similar) beryllium (Be) with electronic configuration (2, 2). As both possess same number of valence electrons, both would lie in the same group and display similar chemical properties.

3 Write down the electronic configuration of the following elements from the given atomic numbers. Answer the following question with explanation.

a. ${}_3\text{Li}$, ${}_{14}\text{Si}$, ${}_2\text{He}$, ${}_{11}\text{Na}$, ${}_{15}\text{P}$

Which of these elements belong to be period 3?

b. ${}_1\text{H}$, ${}_7\text{N}$, ${}_{20}\text{Ca}$, ${}_{16}\text{S}$, ${}_4\text{Be}$, ${}_{18}\text{Ar}$

Which of these elements belong to the second group?

c. ${}_7\text{N}$, ${}_6\text{C}$, ${}_8\text{O}$, ${}_5\text{B}$, ${}_{13}\text{Al}$

Which is the most electronegative element among these?

Ans

	Element	Electronic configuration
i.	${}_3\text{Li}$	2, 1
	${}_{14}\text{Si}$	2, 8, 4
	${}_2\text{He}$	2
	${}_{11}\text{Na}$	2, 8, 1
	${}_{15}\text{P}$	2, 8, 5

The elements ${}_{14}\text{Si}$, ${}_{11}\text{Na}$ and ${}_{15}\text{P}$ belong to period 3

	Element	Electronic configuration
ii.	${}_1\text{H}$	1
	${}_7\text{N}$	2, 5
	${}_{20}\text{Ca}$	2, 8, 8, 2
	${}_{16}\text{S}$	2, 8, 6
	${}_4\text{Be}$	2, 2
	${}_{18}\text{Ar}$	2, 8, 8

The elements ${}_{20}\text{Ca}$ and ${}_4\text{Be}$ belong to second group as they have two valence electrons.

	Element	Electronic configuration
iii.	${}_7\text{N}$	2, 5
	${}_6\text{C}$	2, 4
	${}_8\text{O}$	2, 6
	${}_5\text{B}$	2, 3
	${}_{13}\text{Al}$	2, 8, 3

The most electronegative element is ${}_8\text{O}$.