

VIII- 3.Periodic Classification of Elements

Exercise Solutions

Level 1

Sol 1: (d)

The periodic table makes the study of elements simpler by organizing them to study their relationship with each other. It also helps in correlating the properties of all states of matter.

Sol 2: J.W.Dobereiner gave the Law of Triads.

Sol 3: (a)

Li, Na and K are arranged according to the Law of Triads.

Sol 4: (b)

Mass of Br = (Mass of Cl + Mass of I) / 2
 $80 = (\text{Mass of Cl} + 127) / 2$
Mass of Cl = 33

Sol 4: (a)

Considering volume is same for all the three, then mass = density,
So, Density of As = (Density of P + Density of Sb) / 2
 $= (2 + 9) / 2 = 5.5$

Sol 5: (a)

Newland arranged the elements in the order of atomic masses.

Sol 6: (a)

It starts with hydrogen.

Sol 7: (b)

There was no place for noble gases in Newland's table.

Sol 8: (d)

Newlands arranged the known 56 elements in the order of increasing atomic masses.

Sol 9 : (b)

Every first and eighth element exhibit similar properties, according to Newland's classification.

Sol 10: (b)

Every first and eighth element exhibit similar properties, according to Newland's classification. So, fifth element will have similar properties as 12th element.

Sol 11: (a)

Every first and eighth element exhibit similar properties, according to Newland's classification. So, Mg resembles Ca.

Sol 12: (b)

All the other elements belong to same group except Al and Cr.

- Sol 13: (d)
Newland's law is valid upto calcium.
- Sol 14: (c)
Newland's law is valid upto calcium.
- Sol 15: (d)
Refer to limitations of law of octaves, P-50.
- Sol 16: (b)
Mendeleev arranged all 63 elements; which were discovered till his time; in the order of their increasing relative atomic masses.
- Sol 17: (a)
Mendeleev classified the elements in the order of increasing atomic masses.
- Sol 18: (c)
Mendeleev predicted the properties of the elements on the basis of their oxide formula.
- Sol 19: (a)
There are 8 groups in Mendeleev's table.
- Sol 20: (d)
Based on the valency of elements, the formula of oxide is R_2O_5
- Sol 21: (a)
Based on the valency of elements, the formula of hydride is RH_3 .
- Sol 22: (c)
Based on the valency of elements, the formula of oxide of silicon is Si_2O_4 or SiO_2 .
- Sol 23: (a)
Eka- aluminum is later predicted as gallium.
- Sol 24: (d)
Based on the valency of elements, the formula of oxide of gallium is Ga_2O_3
- Sol 25: (c)
Mendeleev divided the seven groups into subgroups making a total of 14 subgroups.
- Sol 26: (d)
The only common property between the elements of subgroups is their valency.
- Sol 27: (c)
All the other pair of elements belong to same period except Ar and K.
- Sol 28: (d)
Tellurium is placed before iodine in the Mendeleev's periodic table.
- Sol 29: (a)
The modern periodic law is based on atomic number or no of protons.

Sol 30: (b)

Modern periodic table consists of 18 groups.

Sol 31: (b)

14th group of modern periodic table is equivalent to IVA group of Mendeleev's table.

Sol 32: (a)

S, Se and Te will exhibit similar properties as they belong to same group.

Sol 33: (a)

14th group belongs to representative elements.

Sol 34: (b)

Last two shells of these elements namely outermost and penultimate shells are incomplete.

Sol 35: (b)

The picogens are the chemical elements in group 15 of the periodic table. This group is also known as the nitrogen family.

Sol 36: (b)

No. of shells is equal to the period number in which that element is present.

Sol 37: (c)

The alkali metals belong to group 1 and each period starts with an alkali metal.

Sol 38: (b)

8 elements are present in 3rd group.

Sol 39: (b)

14 elements ranging from atomic number 58-71 belongs to lanthanide series.

Sol 40: (b)

14 elements ranging from atomic number 58-71 i.e. from cerium to lutetium, belongs to lanthanide series.

Level – 2

Sol 1: (c)

No. of shells remains same on moving across the period.

Sol 2: (c)

No of valence electrons remains same on moving down the group.

Sol 3: (c)

Along the period, valency increases from 1 to 4 then decreases till 0.

Sol 4: (a)

Valency = 8 – No of valence electrons = 8 - 7 = 1

Sol 5: (c)

Valency = 8 – No of valence electrons = 8 - 5 = 3

- Sol 6: (a)
The atomic radius decreases along the period because of increase in effective nuclear charge, which results in greater attraction for the outermost shell thus resulting in decrease in radius.
- Sol 7: (c)
The nuclear charge increases across a period because of the increase in the no of electrons by one.
- Sol 8: (d)
Atomic size decreases along the period.
- Sol 9: (c)
All the elements belong to same group and size increases down the group.
- Sol 10: (c)
Na⁺ is formed by removing one electron from sodium atom having 11 electrons.
- Sol 11: (a)
The metallic character increases on moving down the group because of the lesser pull of nuclear charge for the outermost electrons.
- Sol 12: (d)
The metallic character increases on moving down the group.
- Sol 13: (c)
Silicon is a metalloid present in 3rd period.
- Sol 14: (d)
Non-metallic character increases along the period.
- Sol 15: (d)
Non-metallic character increases along the period. So Cl is the most reactive non-metal among the four.

Subjective

- Sol 1: Mass of B = (Mass of A + Mass of C) / 2
= (9+39) / 2 = 24
- Sol 2: Newland found that every eight element had properties similar that of the first. He compared this to the octaves found in music. Therefore, he called it the "Law of Octaves". It is known as "Newland's Law of Octaves".
- Sol 3: Mendeleev left gaps in his periodic table because the properties of known elements predicted other, as-yet-undiscovered, elements in these locations. As Mendeleev organized his periodic table, he recognized that these gaps would be filled as future scientists identified new elements.
- Sol 4: The modern periodic law states that the physical and chemical properties of the elements are the periodic functions of their atomic numbers.
Mendeleev's period law is based on atomic mass and modern periodic law is based on atomic number.
- Sol 5: Elements of group 1 have 1 electron in their valence shell. Ex: Li, Na K.

- Sol 6: A period in the periodic table is a row of chemical elements. All elements in a row have the same number of electron shells
- Sol 7: a) Na, Mg and Al belong to same period.
 b) K, Rb and Cs belong to same group.
 a) N, O and F belong to same period.
 a) Ne, Ar and Kr belong to same group.
- Sol 8: They are once called inert gases because they are unable to form compounds. The noble gases have a complete octet, making them very stable and unlikely to gain or lose any electrons.
- Sol 9: As we move from left to right in a period, the atomic no. of elements increases i.e. the number of protons and electrons in the atoms increases. Due to large positive charge on nucleus, the electrons are pulled in more close to the nucleus and thus the size of the atom decreases from Na to Cl.
- Sol 10: All the elements belong to group 2 and have two electrons in their valence shell.
- Sol 11: Refer page-56: Merits and Limitations of modern periodic table.
- Sol 12: a) Atomic configuration : 2, 6
 b) It is placed in 2nd period and 16th group.
 c) Because of 6 valence electrons, it is non-metallic.
 d) Valency = 8 – 6 = 2
 e) Based on the valency, the formula of hydride is H₂X.
- Sol 13: a) Atomic configuration of Y = 2, 1
 Valency of Y = 1
 Atomic configuration of A = 2, 8, 7
 Valency of A = 1
 Based on the valency of two elements, the formula of their compound is YA.
- b) Configuration = 2, 8
 Valency = 0
- Sol 14: i) K(19) = 2,8,8,1
 ii) Be and Ca belongs to same group as they both will have same no of valence electrons.
 iii) Be and F belong to same group and Be is bigger than F because size decreases along the period.
- Sol 15: i) As we move from left to right in a period, the atomic no. of elements increases i.e. the number of protons and electrons in the atoms increases. Due to large positive charge on nucleus, the electrons are pulled in more close to the nucleus and thus the size of the atom decreases.
- ii) Atomic numbers, not weights, determine the factor of chemical properties. As per Mendeleev's table, argon weights more than potassium (39.9 vs. 39.1, respectively), yet argon is in front of potassium. Thus, we can see that elements are arranged based on their atomic number. The periodic law is found to help determine many patterns of many different properties of elements; melting and boiling points, densities.
- iii) Atomic size of an element depends on the nuclear charge of that element. This is because, more nuclear charge means more protons, and more protons can hold more electrons of opposite charge. If there are more electrons in the atom of an element, its atomic size increases.