

**1. What is the need for periodic classification of elements?**

When elements are classified such that they have the same properties, study of large number of elements is reduced to study of few groups of elements.

**2. Give reason: Classification of elements on the basis of states of matter cannot be justified.**

Classification on the basis of states of matter cannot be justified because for example bromine and mercury are liquids at room temperature, they cannot be placed in the same group.

**3. Give reason: Classification of elements as metals and non-metals is justified but not satisfactory.**

Classification of elements as metals and non-metals is justified because there are more common characteristics in both the groups but it is not satisfactory because each metal or non-metal have completely different properties.

**4. State Dobereiner's law of triads.**

According to Dobereiner's law of triads: When elements are arranged in the order of increasing atomic masses in groups of three elements, the atomic mass of the middle element of the triad is equal to the average atomic mass of the other two elements.

**5. What are triads?**

Elements arranged in group of three are called triads.

**6. Explain Dobereiner's law of triads with an example.**

According to Dobereiner's law of triads: When elements are arranged in the order of increasing atomic masses in groups of three elements, the atomic mass of the middle element of the triad is equal to the average atomic mass of the other two elements.

Example 1:

Atomic mass of chlorine = 35.5

Atomic mass of Iodine = 127

$$\text{Average atomic mass} = \frac{35.5 + 127}{2} = \frac{162.5}{2} = 81.25$$

The atomic mass of middle element Bromine = 80

Example 2:

Atomic mass of Calcium = 40

Atomic mass of Barium = 137

$$\text{Average atomic mass} = \frac{40 + 137}{2} = \frac{177}{2} = 88.5$$

The atomic mass of middle element Strontium = 88

7. In a triad A, B and C, the atomic masses of A and B are 80 and 120 respectively. What is the atomic mass of element C?

Atomic mass of A=80

Atomic mass of B=120

$$\text{Atomic mass of B} = \frac{A + C}{2}$$

$$120 = \frac{80 + C}{2}$$

$$120 \times 2 = 80 + C$$

$$240 = 80 + C$$

$$C = 240 - 80$$

$$C = 160$$

Therefore atomic mass of C = 160

8. In a triad X, Y and Z, the atomic masses of X and Y are 7 and 23 respectively. Find the atomic mass of element Z.

9. In a triad of A, B, C elements, if the atomic mass of B and C are 150 and 200 respectively. Find the atomic mass of A.

10. The atomic masses of three elements X, Y and Z having similar chemical properties are 7, 23 and 39 respectively.

a) Calculate the average atomic mass of elements X and Z.

b) How is the average atomic mass of elements X and Z compare with the atomic mass of element Y?

c) Which law of classification of elements is illustrated by this example?

d) Give another example of a set of elements which are classified according to this law.

a) The average atomic mass of X and Z =  $\frac{7 + 39}{2} = \frac{46}{2} = 23$

b) The average atomic mass of X and Z is equal to the atomic mass of Y

c) The law illustrated in this example is Dobereiner's law of triads.

d) Another example of Dobereiner's law is Calcium, Strontium and Barium.

11. What are the limitations of Dobereiner's law of triads?

Dobereiner's classification was not satisfactory, as he failed to arrange all of the then known elements in the form of triads. He could identify only three triads from the elements known at that time.

12. State Newland's law of Octaves.

New land law of octaves states that "When elements are arranged in the order of increasing atomic mass, the properties of the eighth element (starting from any given element) are a repetition of the properties of the first element".

13. What similarity was observed by Newland in the properties of elements and octaves of music?

When Newland arranged the elements, he found that the properties of eighth element resembled the properties of the first element, This repetition in the properties is just like the repetition of eighth note in an octave of music. (sarega ma pa da nisa)

14. X and Y are the two elements having similar properties which obey Newland's law of octaves. How many elements are there in-between X and Y?

There are 6 elements between X and Y

15. Why Newland law of octaves is called so?

As Newland law is similar to the octaves in music, he called the law as law of octaves.

16. What are the limitations of Newland law of Octaves?

Newland law of octaves could not be extended after 17 elements.

17. State Mendeleev's periodic law.

Mendeleev's periodic law states that "The properties of elements are periodic functions of their atomic mass".

18. What was the Mendeleev's basis for classification of elements?

Mendeleev's classification is based on atomic mass.

**19. Mention the merits of Mendeleev's periodic law.**

Mendeleev left vacant spaces in the table for the elements that were to be discovered. He was able to predict the atomic mass and properties of elements even before their discovery.

His periodic table helped to discover new elements like germanium.

**20. State the characteristics of Mendeleev's periodic table.**

- 1) Mendeleev's periodic table consists of 7 periods (horizontal) and 9 groups (vertical).
- 2) Elements are arranged in the increasing order of their atomic weights.
- 3) The elements that have similar property were placed in vertical columns.

**21. Atomic mass is not useful to construct the periodic table. Give reasons with an example. OR Why is atomic number is more useful than atomic mass to classify the elements?**

Isotopes of an element have same atomic number but different atomic mass. They have to be placed in four places. This creates confusion because other elements occupied these positions.

**22. What is meant by isotope of an element?**

The meaning of isotope is iso-same, tope-place. Atoms having different atomic masses with the same atomic number. They are given the same place in the periodic table.

**23. State Modern periodic law.**

Modern periodic law states that "The properties of elements are a periodic function of their atomic number".

**24. Mention the characteristics of modern periodic table.**

When elements are arranged according to increasing atomic numbers, elements having similar properties are kept in the same group. There is a inter relation between electronic configuration and atomic number. The elements are arranged in 7 horizontal rows called periods and 18 vertical columns called groups.

**25. What is the significance of atomic number in the modern classification of elements?**

In the modern classification, elements are arranged in the increasing order of their atomic numbers.

**26. What are periods and groups in the modern periodic table?**

The horizontal rows in the periodic table are called periods. The vertical columns in the periodic table are called groups.

**27. How many periods and groups are there in the modern periodic table?**

In the modern periodic table there are 7 periods and 18 groups.

28. Compare the arrangement of elements in Mendeleev's and Modern periodic table.

Mendeleev's periodic table	Modern periodic table
1. Elements are arranged in the order of increasing atomic masses.	1. Elements are arranged in the order of increasing atomic numbers.
2. There are 8 groups	2. There are 18 groups

29. Consider the isotopes of carbon, C-12 and C-14. Would you place them in different slots because their atomic masses are different or would you place them in the same position because their chemical properties are the same?

Isotopes are not placed according to their atomic mass but they are all placed in the same position as they have the same atomic number.

30. Consider the following isotopes  $_{17}\text{Cl}^{35}$  and  $_{17}\text{Cl}^{37}$ . Explain why.

a) they have identical chemical properties.

b) they are placed in the same position in the modern periodic table,

a) They have same atomic number

b) All isotopes are placed in the same position in the modern periodic table.

31. Give reason: Elements of group 18 are called zero group elements.

Elements of group 18 have valency of zero. Hence they are called zero group elements.

32. Give reason: Elements of group 18 or group zero are called inert or noble gases.

Elements of group 18 do not form chemical bond on their own with other elements as they have completed shells of electrons. They have no tendency to gain or lose electrons. Hence they are most un-reactive.

33. Why do inert gases have zero valency?

Inert gases have zero valency because their octet is complete.

34. Why are noble gases chemically unreactive?

Noble gases do not form chemical bond on their own with other elements as they have completed shells of electrons.

35. Why are noble gases placed in a separate group?

Noble gases are very unreactive. So, they are placed in a separate group.

36. Give example of noble gases or inert elements.

Helium, Neon, Argon, Xenon, Krypton etc.

37. What is octet structure?

The electronic structure of elements having 8 electrons in the outermost shell is called octet structure.

38. Is it possible to have an element having atomic number 1.5?

Atomic number is always a whole number. It can either be 1 or 2. There can be no element with atomic number 1.5

39. List the short period, long period and incomplete periods in the modern periodic table.

Period number	Description	Number of elements
1st	Very short	2 (H & He)
2 <sup>nd</sup>	Short	8 elements (Li to Ne)
3rd	Short	8 elements (Na to Ar)
4 <sup>th</sup>	Long	18 elements (K to Kr)
5 <sup>th</sup>	Long	18 elements (Rb to Xe)
6 <sup>th</sup>	Very long	32 elements (Cs to Rn)
7th	incomplete	Rest of the elements (Fr onwards)

40. What are Lanthanides and Actinides?

The 14 elements coming after Lanthanum are called Lanthanides. 14 elements coming after actinium are called Actinides.

41. Why are Lanthanides and Actinides placed separately?

OR

**Give reason: 'f' block elements are kept separately in the periodic table.**

Lanthanides and Actinides are series of elements having similar properties and they are placed at the bottom of the periodic table so that the periodic table can fit on a single page for our convenience. They show more horizontal similarity rather than vertical similarity.

42. How does the electronic configuration of an atom relate to its position in the modern periodic table?

The group number of elements having up to two valence electrons is equal to the number of valence electrons.

For example: Group 1 elements have 1 valence electron.

Group 2 elements have 2 valence electrons.

Group 13 elements have 3 valence electrons.

43. How is the electronic configuration of an atom related to the period in the periodic table?

Periods are formed according to the way in which electrons get filled up in different shells and orbitals. For example first period of the table is completed when the first shell of the atom is completely filled up.

44. Give reason: In the first period, hydrogen and helium are not placed adjacent to each other

OR

**There is a big gap between hydrogen and helium in the periodic table.**

Because Hydrogen and Helium belong to different groups. The Hydrogen element belongs to the 'Hydrogen' group, whereas the Helium element belongs to the 'noble gas'

group. Helium should be next to hydrogen. But the 2nd group of elements are alkaline earth metals and Helium is a Noble gas, therefore it is decided that Helium be grouped with all the Noble gases.

**45. What are transition elements?**

Elements where electrons of their atoms occupy ultimate shells leaving penultimate (last but one) shells partially vacant are called transition elements.

Electrons of these elements fill normally upto 1s, 2s, 2p, 3s and 3p. After 3p electrons occupy 4s leaving 3d orbitals vacant.

**46. Why are 'd block' elements called outer transition elements?**

'd block' elements are called outer transition elements because they contain at most two electrons in their outer shell.

**47. Why 'f block' elements are called inner transition elements?**

The elements for which f sub shells are filling are called the inner transition elements.

**48. How elements are classified based on electronic configuration?**

Based on electronic configuration, all elements are grouped into four categories. They are 's block', 'p block', 'd block' and 'f block' elements.

**49. How is the block to which an element belongs determined?**

If we know the atomic number and electronic configuration of an element, we can find the block to which they belong. If the outermost sub energy level is 's' then it belongs to 's block'. If the outermost sub energy level is 'p' then it belongs to 'p block'.

Example: Atomic number of sodium is 11. Its electronic configuration is  $1s^2, 2s^2, 2p^6, 3s^1$ . The orbital occupied by the outermost electron is s. So sodium belongs to 's' block.

**50. Find the block to which the following elements belong.**

a) Aluminium (Atomic number: 13)

Electronic configuration of aluminium is  $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$

The orbital occupied by the ultimate electron is 'p'. So aluminium belongs to 'p' block.

b) Iron (Atomic number 26)

Electronic configuration of Iron is  $1s^2, 2s^2, 2p^6, 3s^2, 3d^10, 4s^2$

The orbital occupied by the penultimate shell is 'd'. So iron belongs to 'd' block.

c) Cerium (Atomic number 58)

Electronic configuration of Cerium is  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 4f^2, 5s^2, 5p^6, 6s^2$

The orbital occupied by the penultimate shell is 'f'. So Cerium belongs to 'f' block.

**51. How is the period to which an element belongs determined?**

If we know the atomic number and electronic configuration of an element, we can find the period to which it belongs by finding the number of shells. Total number of shells indicates period number.

Example: Atomic number of Calcium is 20. Its electronic configuration  $1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^2$ . Highest shell number is 4 so calcium belongs to the 4<sup>th</sup> period.

**52. To which period do the following elements belong?**

a) Manganese (Atomic number:25)

Atomic number of Manganese is 25

Its electronic configuration is  $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^2$

Highest shell number is 4 so it belongs to 4<sup>th</sup> period.

b) Zinc (Atomic number: 30)

Atomic number of zinc is 30.

Its electronic configuration is  $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2$

Highest shell number is 4, so it belongs to 4<sup>th</sup> period.

**53. What is meant by the term periodicity?**

When the elements are arranged in order of increasing atomic numbers, elements with similar chemical properties are repeated at definite intervals. This is known as periodicity.

The cause of periodicity is the recurrence of similar electronic configuration.

**54. What are the factors that decide the chemical behaviour of elements?**

a) Periodicity of chemical properties

b) Atomic size

c) Ionisation energy

d) Electro chemical nature

e) Metallic nature

**55. What is atomic size? How does it affect the chemical properties of an element?**

The distance between the centre of the nucleus and the outermost electron shell of an atom is called atomic size. It refers to the radius of the atom.

Size of an atom decides ionization energy and electron affinity. Electron affinity decides electro-negativity and electro-positivity.

**56. What happens to the atomic size as we move**

**a) Horizontally from left to right in a period of the periodic table?**

**b) Down the group of the periodic table?**

a) Atomic size decreases as we move from left to right along a period.

b) Atomic size increases as we go down a group.

**57. Why does atomic size (radius) decrease across a period?**

The atomic radius decreases along a period because the atomic number increases by one, but the additional electron goes to the same shell. There is no change in the number of shells but more electrons make the nucleus to exert greater inward pull on the electrons. As a result, outer electrons are pulled in closer to the nucleus which leads to contraction of the atom and thus decrease in atomic size.



Atomic size (radius)  $\xrightarrow{\text{Decreases}}$  Across a period (left to right)

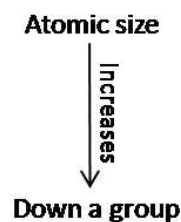
Ex: Atomic size of Lithium (Li) > Beryllium (Be) > Boron (B) > Carbon (C) > Nitrogen (N) > Oxygen (O) > Fluorine (F)

**58. Give reason: Atomic size of sodium atom is greater than that of chlorine atom.**

Sodium is in the 1<sup>st</sup> group where as chlorine is in 17<sup>th</sup> group. We know that the atomic size decreases down the group. Hence sodium atom has larger atomic size than that of chlorine atom.

**59. Why does atomic size of an atom increase down the group?**

In moving down a group, new shell is added to the atom. There is an increase in the energy level. The distance of the outermost electron from the nucleus increases. This increases the size of the atom down the group.



**60. Arrange the following elements in increasing order of their atomic size.**

a) Li, Be, F, N    b) Cl, At, Br, I

a) F < N < Be < Li

b) Cl < Br < I < At

**61. What is meant by ionisation energy?**

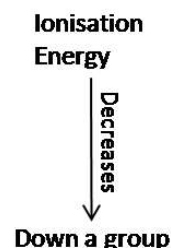
Ionisation energy is the energy required to remove the electron from the outermost shell from a free and isolated atom of the element.

**62. How does ionisation energy vary across a period and down a group?**

Ionisation energy increases along a period and decreases down a group.

Ionisation energy decreases with increase in the atomic size.

Ionisation energy  $\xrightarrow{\text{Increases}}$  Across a period (Left to right)



**63. Give reason: Sodium atom has lower ionisation energy than chlorine atom.**

Sodium is in the 1<sup>st</sup> group whereas chlorine is in 17<sup>th</sup> group. Atomic size decreases down the group. We know that ionisation energy increases with decrease in atomic size. Hence sodium atom has lower ionisation energy than that of chlorine atom.

**64. What is meant by electro-positive?**

Atoms which give up electrons easily are called electro-positive. Ex: Sodium atom.

**65. What is meant by electro negative?**

Atoms which accept electrons easily are called electro negative. Ex; Chlorine.

**66. How does electro positivity and electro negativity vary across a period and down a group?**

Electro positivity decreases along a period and increases down the group.

Electro negativity increases a period and decreases down the group.

Electro positivity  $\xrightarrow{\text{Decreases}}$  Across a period (Left to right)

Electro negativity  $\xrightarrow{\text{Increases}}$  Across a period (Left to right)

67. **Electro positivity**  $\downarrow$  **Increases** **Down a group**
- Electro negativity**  $\downarrow$  **Decreases** **Down a group**
- Periodic table are given – Boron, Aluminium, Gallium, Indium, Thallium (the first member of the group and Thallium is the last)]**
- Which element has the highest electro negativity?**

Boron would have the highest electro negativity as it decreases down the group.

68. **Nitrogen (atomic number 7) and Phosphorous (atomic number 15) belong to group 15 of the periodic table. Which of these will be more electro negative? Why?**

Nitrogen will be more electro negative as it decreases down the group.

69. **In period 2, element 'A' is to the right of element 'B'.**

a) The element 'A' would have a \_\_\_\_\_ atomic size than 'B'.

b) The element 'B' would have a \_\_\_\_\_ ionisation potential than 'A'.

a) Lower

b) Lower

70. **Arrange the following elements as given in the brackets:**

a) Na, Cl, Mg, P [in decreasing order of atomic size]

b) Cl, Al, Na, S [in increasing order of ionisation energy]

c) Ar, He, Ne [in increasing order of number of electronic shells]

a) Cl, P, Mg, Na

71. **Give reason: sodium has lower electron affinity than chlorine atom.**

As electron affinity increases across a period (from left to right)

72. **How does metallic nature vary along a period and down a group?**

Metallic nature decreases along a period and increases down the group. Example: In the 14<sup>th</sup> group there are elements carbon, silicon, germanium, tin and lead. Carbon and silicon are non-metals, tin and leads are metals.

73. **In which part of the periodic table do we find mostly metals and non-metals?**

Most metals are found on the extreme left side of a period. Most non-metals are found on the right side of a period.

74. **Which of the following elements have maximum metallic characteristics?**

Ga, Ge, As, Se, Be

Maximum metallic character is found in elements on the extreme left side of the periodic table. Out of the given elements Beryllium will have maximum metallic character as it is on the extreme left side in the periodic table.

**75. What are metalloids? Give example.**

Elements which are not distinctively metals and possess some physical properties of non-metals are called metalloids.

**76. What is the name of those elements which divide metals and non-metals in the periodic table?**

Metalloids

**77. List the elements of 15<sup>th</sup> group of the periodic table. Name the distinct metals and non-metals of the group.**

The elements of 15<sup>th</sup> group are Nitrogen, Phosphorous, Arsenic, Antimony and Bismuth. Nitrogen and phosphorous are non-metals. Arsenic and Antimony are metalloids, Bismuth is a metal.

**78. Taking first period and 17<sup>th</sup> group of the periodic table, write gradation of properties with respect to the following: a) atomic size b) Ionisation energy c) electro positivity and electro negativity.**

The elements of 1<sup>st</sup> period are hydrogen and helium.

a) Atomic size of hydrogen is larger than that of helium because atomic size decreases across a period.

b) Ionisation energy of helium is larger than that of hydrogen because ionisation increases across a period.

c) Electro positivity of hydrogen is higher than that of helium because it decreases across the period. Electro negativity of helium is higher than that of hydrogen because it increases across the period.

The elements of 17<sup>th</sup> group are Fluorine, Chlorine, Bromine, Iodine and Astatine.

a) Atomic size of Astatine is larger because it increases down the group.

b) Ionisation energy of Fluorine is higher because it decreases down the group.

c) Electro positivity of Astatine is higher as it increases down the group. Electro negativity of fluorine as it decreases down the group.

**79. Mention the advantages of the periodic table.**

a) Study of chemistry is simplified and organized leading to easy access of data of the elements.

b) It was possible to predict the atomic mass, some properties and other details of elements which are yet to be discovered during the time of Mendeleev.

c) There is striking similarity between the periodic table constructed empirically by Mendeleev and the modern periodic table based on electronic configuration and nature of chemical bond.

d) Interpretation of trends and periodicities of properties of elements provide a clear understanding and proof for atomic behavior.

e) It is possible to predict the properties of elements by considering the position of elements in the periodic table. On the other hand properties of element helps us to predict the position of an element in the periodic table.

80. The following shows a part of the periodic table containing first three periods in which five elements have been represented by the letters a, b, c, d and e.

- a) Select the letter which represents a metal.  
 b) Select the letter which represents a noble gas.  
 a) d  
 b) c

81. The position of three elements A, B and C in the periodic table shown below:

- a) State whether A is a metal or non-metal.  
 b) State whether C is more reactive or less reactive than A.  
 c) Will C be larger or smaller in size than B?

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

a) Metals lie on the left side where as non-metals are placed on the right side of the periodic table. Group 17 is on the right side of the periodic table, thus element A is non-metal.

b) The chemical reactivity of non-metals decrease down the group, so element C is less reactive than A

c) The atomic size decreases moving from left to right along a period. So atom C will be smaller in size than B.

82. What are the periodic trends in a period?

- a) The number of valence electrons increases from left to right.  
 b) The atomic size decreases.  
 c) The non-metallic character increases.  
 d) The ionisation energy increases.

Moving Left → Right • Atomic Radius Decreases • Ionization Energy Increases  
 • Electro negativity Increases

Moving Top → Bottom • Atomic Radius Increases • Ionization Energy Decreases  
 • Electro negativity Decreases

83. Give reason: In the construction of periodic table, the periodic law is broken in some places.

Hydrogen resembles both the alkali metals and halogens. But it has been placed with the alkalis.

The lanthanides and actinides have not been placed in the main body of the table.

1. The person in 1815 who suggested in that elements can be classified on the basis of atomic mass was William Prout.

2. First attempt of classification of elements was made by **Dobereiner**.
3. The German chemist who pointed out that many of the known elements could be arranged in groups of three similar elements was **Dobereiner**.
4. Elements arranged in group of three are called **triads**.
5. The periodicity of repetition of properties in Newland's law was **eight**.
6. The contribution of Newland in the classification of element is the word **periodic**.
7. According to Newland's classification of elements, the properties of sulphur are similar to those of oxygen because sulphur is the **eighth** element starting from oxygen.
8. Mendeleev arranged the elements in his periodic table on the basis of **atomic mass**.
9. The Russian chemist who said that the properties of elements are periodic function of their atomic mass is **Dmitri Mendeleev**.
10. The modern periodic table was adopted by IUPAC in **1984**.
11. The full form of IUPAC is International Union of Pure and Applied Chemistry.
12. The horizontal rows of periodic table are called **periods**.
13. The cause of periodicity is the recurrence of similar **electronic configuration**.
14. The vertical columns of periodic table are called **groups**.
15. There are **18** groups and **7** periods in the modern periodic table.
16. The group **eighteen** elements are called **zero group** or **inert** or **noble gas**.
17. The group which has completely filled valence shell is **eighteen**.
18. Elements with eight electrons in their outermost shell are called **noble gases**.
19. The element which is the most reactive of all elements in the periodic table is **fluorine**.
20. The element which is referred to as "the element that consumes everything" is **fluorine**.
21. In the modern periodic table, the elements are arranged in the ascending order of their **atomic number**.
22. The shortest period in the periodic table is **first period**.
23. The longest period in the periodic table is **sixth period**.
24. The incomplete period in the periodic table is **seventh period**.
25. The group number of the element neon is **18**.
26. The period number of the element aluminium is **3**.
27. Horizontal similarity can be observed in the period number **6 & 7**.
28. The similarity in the properties of a group of elements is because they have same **number of outer electrons**.
29. The distance between the centre of the nucleus and the outermost electron shell of an atom is called **atomic size**.
30. The atomic size **decreases** as we move from left to right across the period.
31. The elements below sodium in the same group would have **lower** electro negativity.
32. The elements above chlorine would have **higher** ionisation energy.
33. The element from the elements Li, Na, K, having the least number of electron shells is **Li**.
34. The element with the least atomic size from Carbon, Nitrogen, Boron and Beryllium is **Nitrogen**.
35. The element with highest ionisation energy from the elements of period 1, 2, 3 is **period 1**.
36. The first element of 14<sup>th</sup> group is carbon, which is a non-metal. The metallic members of this group are **tin and lead**.
37. On going down in a group in the periodic table, the metallic nature of element **increases**.

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38. Elements which are not distinctively metals and possess some physical properties of non-metals are called **metalloids**.
  39. Atoms which give up electrons easily are called **electro-positive**.
  40. Atoms which receive electrons easily are called electro **negative**.
  41. The energy required to remove the electron from the outermost shell from a free and isolated atom of the element is called **ionisation energy**.
  42. Elements in which electrons of their atoms occupy ultimate shells leaving penultimate shells partially vacant are called **transition elements**.

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