

# PERIODIC TABLE

## VERY SHORT ANSWER TYPE QUESTIONS

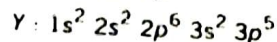
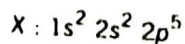
GPLUS EDUCATION

1. On what basis did Mendeleev classify the elements ?
2. How many periods and groups were present in Mendeleev's original periodic table ?
3. What are the modern names given to ekasilicon and ekaaluminium predicted by Mendeleev ?
4. Name two anomalous pairs of elements present in Mendeleev's periodic table.
5. Which is the most fundamental property of an atom ?
6. How many groups are present in the long form of the periodic table ?
7. Which periods are short and which are long in the periodic table and how many elements do they contain?
8. Name the orbitals which get filled in moving from left to right in fourth period.
9. What is the general electronic configuration of the elements of *f*-block ?
10. Which groups constitute the *d*-block in the periodic table ?
11. Define atomic radius of an atom.
12. Why is van der Waals' radius of an atom greater than its covalent radius ?
13. How do the atomic radii change across a period ?
14. Why is a cation smaller than the parent atom ?
15. Give the formula of one species positively charged and one negatively charged that will be isoelectronic with He.
16. Among  $IE_1$ ,  $IE_2$ ,  $IE_3$  of an element, which is the largest ? Arrange them in the increasing order.
17. Among *s*, *p*, *d* and *f* subshells of the same shell, which has the highest ionisation energy ?
18. How does ionisation energy vary in a group in the periodic table ?
19. Why is energy released when an electron is added to a neutral atom ?
20. Name the elements which possess most negative values of electron gain enthalpy in their periods.
21. Why does LiCl have a lower M.P. than NaCl ?
22. Which is more basic : LiOH or NaOH ?
23. Which is more stable :  $Na_2CO_3$  or  $CaCO_3$  ?
24. Which of the following are not representative elements ?  
Li, K, Al, Cu, Ne, Fe, S, Ce, Th
25. Which is more soluble in water :  $CaSO_4$  or  $SrSO_4$  ?

## SHORT ANSWER TYPE QUESTIONS

1. State and explain Mendeleev's periodic law.
2. State modern periodic law. How is this law helpful in the classification of elements ?
3. Mention the group, period and block to which each of the following elements belongs in the long form of periodic table.  
(a) X ( $Z = 9$ )  
(b) Y ( $Z = 28$ )  
(c) E ( $Z = 40$ )
4. An element possesses electronic configuration  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^1 5s^2$ . Place this element in the long form of the periodic table.
5. Mention the characteristic properties of *p*-block elements.
6. What are transition elements ? Mention their characteristic properties.
7. What is the cause of periodicity in the properties of elements ?
8. Explain why :  
(i) Crystal radius is larger than covalent radius.  
(ii) Size of atom decreases across a period.
9. Arrange with explanation the following ions in the increasing order of their sizes.  
 $Cl^-$ ,  $N^{3-}$ ,  $O^{2-}$ ,  $S^{2-}$ ,  $Al^{3+}$
10. Arrange the following ions in the decreasing order of their sizes and explain.  
 $Li^+$ ,  $K^+$ ,  $Mg^{2+}$ ,  $Al^{3+}$
11. Define ionisation energy and ionisation potential.
12. Why is an anion larger than the parent atom ?
13. Define valency. How does it change across a period and on going down a group ?
14. Why is the second ionisation energy of an element much greater than its first ionisation energy ?
15. Explain what do you understand by screening effect. How does this effect influence the values of ionisation energies ?
16. Arrange with explanation the following elements in the increasing order of their ionisation energies :  
Li, Be, B, Na, Mg
17. Why do the alkali metals possess minimum and the noble gases maximum ionisation energies in respective periods ?
18. Why is the ionisation energy of beryllium greater than that of Li and B ?
19. Why does the ionisation energy decrease on going down a group ?
20. Among the elements of second period pick out the element  
(i) with the most negative electron gain enthalpy;  
(ii) with the most positive electron gain enthalpy;  
(iii) with the largest atomic radius;  
(iv) that is the most reactive non-metal;  
(v) that is the most reactive metal.
21. Why does the fourth period have eighteen and not eight elements ?
22. The valency of a representative element is either equal to the number of valence electrons or eight minus the number. What is the basis of this rule ?

- \*23 Why do noble gases have positive electron gain enthalpies?  
 24 Two elements X and Y possess the following electronic configuration ?



Which out of these two elements does possess a negative electron gain enthalpy and why ?

25. Why do the melting points decrease in going from NaF  
 \* NaI ?

26.  $\text{Li}_2\text{CO}_3$  decomposes on heating but the carbonates of all alkali metals do not decompose easily on heating. Why ?

## ESSAY (LONG ANSWER) TYPE QUESTIONS

1. Give a brief account of the historical developments in the classification of elements.
2. State the law on the basis of which Mendeleev classified the elements. Mention the important features of his periodic table. What are the merits and defects of Mendeleev's periodic table ?
3. Compare the known properties of germanium with those predicted by Mendeleev for ekasilicon.
4. What is modern periodic law ? Mention the important features of the long form of the periodic table. Why is this periodic table supposed to be superior to other periodic tables ?
5. The long form of the periodic table is closely related to the electronic configuration of elements. Justify this statement with examples.
6. What is the basis of splitting the long form of the periodic table into s, p, d and f blocks ? Mention the characteristic properties of the elements of each block.
7. How can the elements be classified on the basis of their electronic configuration ? Mention the characteristic properties of each type of elements.
8. What do you understand by the term *periodicity* ? What is the main cause of periodicity ? How do the following properties vary in periodic table ?  
 (i) Atomic size                      (ii) Valency  
 (iii) Ionisation energy              (iv) Electron affinity
9. Define various types of atomic radii. (Why is covalent radius smaller than metallic and van der Waals' radii ?) How do atomic radii vary in a group and in a period.
10. What do you understand by first, second and third ionisation energies of an element ? Discuss the factors on which ionisation energy of an element depends.
11. Define electron gain enthalpy. Explain why electron gain enthalpies of some elements are positive. How does electron gain enthalpy vary in a group and in a period ?
12. Explain why :  
 \* (a) Electron gain enthalpies of the noble gases are positive.  
 \* (b) The electron affinities of Be and Mg are zero.  
 (c) NaOH is more basic than LiOH.  
 (d) The second ionisation energy of Li is very high.
13. Write short notes on the following : *with examples*  
 \* (a) Penetration effect      (b) Isoelectronic ions  
 (c) Periodic trends in melting and boiling points.
14. The electronic configuration of some elements are given below :  
 (i)  $1s^2 2s^2$   
 (ii)  $1s^2 2s^2 2p^6$   
 (iii)  $1s^2 2s^2 2p^6 3s^2 3p^5$   
 (iv)  $1s^2 2s^2 2p^1$   
 (a) Name the elements.  
 (b) Which is a halogen ?  
 (c) Which does belong to s-block ?  
 (d) Which does have the highest IE ?  
 (e) Which does have the highest EA ?  
 (f) Which does have valency three ?

## OBJECTIVE (MULTIPLE CHOICE) TYPE QUESTIONS

Choose the correct option in the following questions :

- The first attempt to classify elements was made by
  - Mendeleev
  - Newlands
  - Lothar Meyer
  - Dobereiner.
- The most important active step in the development of periodic table was taken by
  - Mendeleev
  - Dalton
  - Avogadro
  - Cavendish.
- In the modern periodic table, elements are arranged in
  - increasing mass
  - increasing volume
  - increasing atomic number
  - alphabetically.
- The statement that is false for the long form of the periodic table is
  - it reflects the sequence of filling of electrons in the order of sub energy levels  $s, p, d, f$
  - it helps to predict the stable valency states of the elements
  - it reflects trends in physical and chemical properties of the elements
  - it helps to predict the relative ionocity of the bond between any two elements.
- The tenth element in the periodic table resembles with the
  - first
  - second
  - fourth
  - ninth.
- In the periodic table, going down in fluorine group
  - reactivity will increase
  - electronegativity will increase
  - ionic radius will increase
  - ionisation potential will increase.
- Which of the following sets belong to the same period ?
  - Li, Na, K
  - Li, Mg, Ca
  - Cu, Ni, Zn
  - F, Cl, Br.
- Which of the following transitions involves maximum amount of energy ?
  - $M^-(g) \longrightarrow M(g)$
  - $M(g) \longrightarrow M^+(g)$
  - $M^+(g) \longrightarrow M^{2+}(g)$
  - $M^{2+}(g) \longrightarrow M^{3+}(g)$ .
- With reference to concept of ionisation potential, which one of the following sets is correct ?
  - $U > K > Cs$
  - $B > U > K$
  - $Cs > U > B$
  - $Cs < U < K$ .
- A sudden large jump between the values of second and third ionisation energies of an element would be associated with the electronic configuration
  - $1s^2 2s^2 2p^6 3s^1$
  - $1s^2 2s^2 2p^6 3s^2 3p^1$
  - $1s^2 2s^2 2p^6 3s^2 3p^2$
  - $1s^2 2s^2 2p^6 3s^2$ .
- Atomic radii of fluorine and neon in Angstrom units are respectively given by
  - 0.762, 1.60
  - 1.60, 1.60
  - 0.72, 0.72
  - None of these values.
- Which of the following is the largest ?
  - $Cl^-$
  - $S^{2-}$
  - $Na^+$
  - $F^-$ .
- If the valence shell electronic structure for an element is  $ns^2 np^5$ , this element will belong to the group of
  - alkali metals
  - inert metals
  - noble gases
  - halogens.
- The element californium belongs to a family of
  - actinide series
  - alkali metals
  - alkaline earth metals
  - lanthanide series.
- Which of the following represents the electronic configuration of  $d$ -block elements ?
  - $(n-1)s^2 d^{1-10}$
  - $(n-1)d^{1-10} ns^2$
  - $(n-1)d^{1-10} ns^2 p^4$
  - $(n-1)p^4 ns^2$ .
- Which one of the following is the smallest in size ?
  - $N^{3-}$
  - $O^{2-}$
  - $F^-$
  - $Na^+$ .
- Arrange in the increasing order of ionic radii the elements O, C, F, Cl, Br.
  - F, O, C, Cl, Br
  - F, C, O, Cl, Br
  - F, Cl, Br, O, C
  - C, O, F, Cl, Br.
- Which has the highest second ionisation potential ?
  - Nitrogen
  - Carbon
  - Oxygen
  - Fluorine.
- If the ionisation potential for hydrogen atom is 13.6 eV, then the ionisation potential for  $He^+$  ion should be
  - 27.2 eV
  - 54.4 eV
  - 6.8 eV
  - 13.6 eV.
- The correct order of second ionisation potentials of carbon, nitrogen, oxygen and fluoroine is
  - $C > N > O > F$
  - $O > N > F > C$
  - $O > F > N > C$
  - $F > O > N > C$ .
- The element with configuration  $1s^2 2s^2 2p^6 3s^2$  would be
  - a metal
  - a non-metal
  - an inert gas
  - a metalloid.
- Electron affinity is the
  - energy released when an electron is added to an isolated atom in the gaseous state
  - energy absorbed when an electron is added to an isolated atom in the gaseous state
  - energy required to take out an electron from an isolated gaseous atom
  - power of an atom to attract an electron to itself.

23. The process requiring the absorption of energy is  
 (a)  $F \rightarrow F^-$  (b)  $Cl \rightarrow Cl^-$   
 (c)  $O \rightarrow O^{2-}$  (d)  $H \rightarrow H^-$
24. Which of the following sets has the strongest tendency to form anions?  
 (a) V, Cr, Mn (b) Ga, In, Tl  
 (c) Na, Mg, Al (d) N, O, F
25. Elements which generally exhibit multiple oxidation states and whose ions are usually coloured are:  
 (a) metalloids (b) transition elements  
 (c) non-metals (d) gases
26. The electronic configuration of an element is  $1s^2 2s^2 2p^6 3s^2 3p^3$ . What is the atomic number of the element which is just below the above element in the periodic table?  
 (a) 49 (b) 31  
 (c) 34 (d) 33
27. Elements upto atomic number 105 have been discovered till now. If an element with atomic number 106 were ever discovered, which of the following electronic configuration will it possess?  
 (a)  $[Rn]5f^{14} 6d^4 7s^2$  (b)  $[Rn]5f^{14} 6d^5 7s^1$   
 (c)  $[Rn]5f^{14} 6d^6 7s^0$  (d)  $[Rn]5f^{14} 6d^1 7s^2 7p^3$
28. Which is the weakest base among NaOH,  $Ca(OH)_2$ , KOH and  $Zn(OH)_2$ ?  
 (a) NaOH (b) KOH  
 (c)  $Ca(OH)_2$  (d)  $Zn(OH)_2$
29. Which pair of atomic numbers represents s-block elements?  
 (a) 7, 15 (b) 6, 12  
 (c) 9, 17 (d) 3, 12
30. Which pair of elements has similar properties?  
 (a) 13, 31 (b) 11, 20  
 (c) 12, 10 (d) 21, 33
31. The values of  $IE_1$ ,  $IE_2$ ,  $IE_3$ ,  $IE_4$  and  $IE_5$  of an element are 7.1, 14.3, 34.5, 46.8 and 162.2 eV respectively. The element is likely to be  
 (a) Na (b) Si  
 (c) F (d) Ca
32. The incorrect statement among the following is  
 (a) The first ionisation potential of Al is less than the first ionisation potential of Mg.  
 (b) The second ionisation potential of Mg is greater than the second ionisation potential of Na.  
 (c) The first ionisation potential of Na is less than the first ionisation potential of Mg.  
 (d) The third ionisation potential of Mg is greater than the third ionisation potential of Al. (I.I.T., 1997)
33. Ionic radii of  
 (a)  $Ti^{4+} < Mn^{7+}$  (b)  $^{35}Cl^- < ^{37}Cl^-$   
 (c)  $K^+ > Cl^-$  (d)  $P^{3+} > P^{5+}$  (I.I.T., 1999)
34. The correct order of radii is  
 (a)  $Ne < Be < B$  (b)  $F^- < O^{2-} < N^{3-}$   
 (c)  $Na < Li < K$  (d)  $Fe^{3+} < Fe^{2+} < Fe^{4+}$   
 (I.I.T. Screening, 2000)
35. The correct order of first ionisation potential is  
 (a)  $K > Na > Li$  (b)  $Be > Mg > Ca$
36. Among the following complex ions, the species whose central metal atom does not have 'd' electron is  
 (a)  $[MnO_4]^-$  (b)  $[CO(NH_3)_6]^{3+}$   
 (c)  $[Fe(CN)_6]^{3-}$  (d)  $[Cr(H_2O)_6]^{3+}$   
 (I.I.T. Screening, 2001)
37. According to the periodic law of elements, the variation in properties of elements is related to their  
 (a) atomic masses  
 (b) nuclear masses  
 (c) atomic numbers  
 (d) nuclear neutron-proton number ratios. (I.I.T. Screening, 2001)
38. The atomic numbers of vanadium (V), chromium (Cr), manganese (Mn) and iron (Fe) are respectively 23, 24, 25 and 26. Which one of these may be expected to have the highest second ionisation enthalpy?  
 (a) V (b) Cr  
 (c) Mn (d) Fe. (A.I.E.E.E., 2002)
39. Which one of the following ions has the highest value of ionic radius?  
 (a)  $Li^+$  (b)  $B^{3+}$   
 (c)  $O^{2-}$  (d)  $F^-$  (A.I.E.E.E., 2002)
40. The formation of the oxide ion  $O^{2-}$  (g) requires first an exothermic and then an endothermic step as shown below  
 $O(g) + e^- = O^-(g); \Delta H^\circ = -142 \text{ kJ mol}^{-1}$   
 $O^-(g) + e^- \rightarrow O^{2-}(g); \Delta H^\circ = 844 \text{ kJ mol}^{-1}$   
 This is because  
 (a) oxygen is more electronegative  
 (b) oxygen has high electron affinity  
 (c)  $O^-$  ion will tend to resist the addition of another electron  
 (d)  $O^-$  ion has comparatively larger size than oxygen atom. (A.I.E.E.E., 2004)
41. Which among the following factors is the most important in making fluorine the strongest oxidising agent?  
 (a) Electron affinity (b) Ionisation enthalpy  
 (c) Hydration enthalpy (d) Bond dissociation energy (A.I.E.E.E., 2004)
42. The increasing order of the first ionisation enthalpies of the elements B, P, S and F (lowest first) is  
 (a)  $F < S < P < B$  (b)  $P < S < B < F$   
 (c)  $B < P < S < F$  (d)  $B < S < P < F$  (A.I.E.E.E., 2006)
43. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are given. Which of these statements gives the correct picture?  
 (a) The reactivity decreases in the alkali metals but increases in the halogens with increase in atomic number down the group.  
 (b) In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group.  
 (c) Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens.  
 (d) In alkali metals the reactivity increases but in the halogens it decreases with increase in atomic number down the group. (A.I.E.E.E., 2006)

44. The increasing order of the ionic radii of the given isoelectronic species is  
 (a)  $\text{Cl}^-$ ,  $\text{Ca}^{2+}$ ,  $\text{K}^+$ ,  $\text{S}^{2-}$  (b)  $\text{S}^{2-}$ ,  $\text{Cl}^-$ ,  $\text{Ca}^{2+}$ ,  $\text{K}^+$   
 (c)  $\text{Ca}^{2+}$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ ,  $\text{S}^{2-}$  (d)  $\text{K}^+$ ,  $\text{S}^{2-}$ ,  $\text{Ca}^{2+}$ ,  $\text{Cl}^-$ .

(A.I.E.E.E., 2012)

45. The correct order of electron gain enthalpy with negative sign of F, Cl, Br and I, having atomic number 9, 17, 35 and 53 respectively, is

- (a)  $\text{I} > \text{Br} > \text{Cl} > \text{F}$  (b)  $\text{F} > \text{Cl} > \text{Br} > \text{I}$   
 (c)  $\text{Cl} > \text{F} > \text{Br} > \text{I}$  (d)  $\text{Br} > \text{Cl} > \text{I} > \text{F}$ .

(A.I.E.E.E., 2011)

46. The correct sequence which shows decreasing order of the ionic radii of the elements is

- (a)  $\text{Al}^{3+} > \text{Mg}^{2+} > \text{Na}^+ > \text{F}^- > \text{O}^{2-}$   
 (b)  $\text{Na}^+ > \text{Mg}^{2+} > \text{Al}^{3+} > \text{O}^{2-} > \text{F}^-$   
 (c)  $\text{Na}^+ > \text{F}^- > \text{Mg}^{2+} > \text{O}^{2-} > \text{Al}^{3+}$   
 (d)  $\text{O}^{2-} > \text{F}^- > \text{Na}^+ > \text{Mg}^{2+} > \text{Al}^{3+}$ .

(A.I.E.E.E., 2010)

47. The correct order of the decreasing ionic radii among the following isoelectronic species is

- (a)  $\text{Ca}^{2+} > \text{K}^+ > \text{S}^{2-} > \text{Cl}^-$   
 (b)  $\text{Cl}^- > \text{S}^{2-} > \text{Ca}^{2+} > \text{K}^+$   
 (c)  $\text{S}^{2-} > \text{Cl}^- > \text{K}^+ > \text{Ca}^{2+}$   
 (d)  $\text{K}^+ > \text{Ca}^{2+} > \text{Cl}^- > \text{S}^{2-}$ .

(A.I.P.M.T., 2010)

48. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar?

- (a)  $\text{Ca} < \text{S} < \text{Ba} < \text{Se} < \text{Ar}$   
 (b)  $\text{S} < \text{Se} < \text{Ca} < \text{Ba} < \text{Ar}$   
 (c)  $\text{Ba} < \text{Ca} < \text{Se} < \text{S} < \text{Ar}$   
 (d)  $\text{Ca} < \text{Ba} < \text{S} < \text{Se} < \text{Ar}$ .

(J.E.E. Main, 2013)

49. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of  $\text{Na}^+$  will be

- (a) -2.55 eV (b) -5.1 eV  
 (c) -10.2 eV (d) +2.55 eV.

(J.E.E. Main, 2013)

Answers

1. (a)	2. (a)	3. (c)	4. (b)	5. (b)	6. (c)	7. (c)	8. (d)	9. (b)	10. (d)
11. (a)	12. (b)	13. (d)	14. (a)	15. (b)	16. (d)	17. (a)	18. (c)	19. (b)	20. (c)
21. (a)	22. (a)	23. (c)	24. (d)	25. (b)	26. (d)	27. (b)	28. (d)	29. (d)	30. (a)
31. (b)	32. (b)	33. (d)	34. (b)	35. (b)	36. (a)	37. (c)	38. (b)	39. (c)	40. (c)
41. (c)	42. (d)	43. (d)	44. (c)	45. (c)	46. (d)	47. (c)	48. (c)	49. (b).	

'TRUE OR FALSE' TYPE QUESTIONS

State whether the following statements are True (T) or False (F) :

- The physical and chemical properties of elements are the periodic functions of their atomic weights.
- Noble gases were placed in the zero group in the Mendeleev's original periodic table.
- All groups were subdivided into A and B sub groups in Mendeleev's periodic table.
- Mendeleev's periodic table helped in correct determination of atomic masses of elements.
- Modern periodic table contains 18 groups.
- The elements of d-block are called representative elements.
- The third period contains 8 elements only.
- In the fifth period 5s, 5p and 5d shells are filled.
- Isotopes of an element are placed at the same place in the long form of the periodic table.
- The element with Z = 11 is present in the third period.
- All lanthanides are supposed to be present in group 3 of the periodic table.
- Atomic radius of F is greater than that of Ne.
- The electron affinity increases in going down a group.
- Melting and boiling points increase regularly in going across the second period.
- Melting point of LiCl is less than that of NaCl.
- CsOH is more basic than  $\text{Ba}(\text{OH})_2$ .
- $\text{Al}^{3+}$  is smaller than  $\text{Ca}^{2+}$ .
- The second ionisation energy of Li is much higher than that of He.
- np electrons are more penetrating than ns electrons.
- The electron affinity of nitrogen is zero.

Answers

1. F	2. F	3. F	4. T	5. T	6. F	7. T	8. F	9. T	10. T
11. T	12. F	13. T	14. T	15. F	16. F	17. F	18. F	19. T	20. T.

**'FILL IN THE BLANKS' TYPE QUESTIONS**

1. The element ekasilicon predicted by ..... was discovered by ..... who named it as .....
2. .... and not the ..... is the most fundamental property of an element.
3. Hydrogen may be placed at the top in group ..... as well as in group ..... of the periodic table.
4. The vertical columns in the periodic table are called ..... These are ..... in all.
5. The sixth period contains in all ..... elements among which ..... are lanthanides.
6. The elements of *p*-block possess electronic configuration of the type .....
7. The long form of the periodic table is closely associated with the ..... of the elements.
- \*8. The ions of transition elements are generally ..... and ..... in nature.
9. Covalent radius is defined as ..... of the distance between the centres of the ..... of two similar atoms bonded together by a ..... covalent bond.
- \*10.  $\text{Ca}^{2+}$  has a smaller ionic radius than  $\text{K}^+$  because it has .....
11. The atomic radii ..... on moving down a group
- \*12. A cation is ..... than the parent atom while an anion is ..... than the parent atom.
13. The larger screening effect ..... the ionisation energy of the atom.
14. Noble gases possess ..... values of ionisation energies due to the presence of .....
15. The energy released when electron is added to a neutral gaseous atom is called ..... of the atom.
- \*16. The electron affinities of noble gases are equal to ..... due to their .....
- \*17. Second electron affinity of oxygen is .....
18. The melting and boiling points ..... in going down group 17.

**Answers**

- |   |                               |   |               |
|---|-------------------------------|---|---------------|
| 1. Mendeleev, Winkler, germanium        | 2. Atomic number, atomic mass | 3. 1, 17                                  | 4. groups, 18 |
| 5. 32, 14                               | 6. $ns^2 np^{1-6}$            | 7. electronic configurations              |               |
| 8. coloured paramagnetic                | 9. half, nuclei, single       | 10. higher effective nuclear charge       |               |
| 11. increase                            | 12. smaller, larger           | 13. decreases                             |               |
| 14. very high, completely filled shells | 15. electron affinity         | 16. zero, stable electronic configuration |               |
| 17. negative                            | 18. increase                  |   |               |