CHEMISTRY

The p-Block Elements (Group 13 & 14)

No. of Questions	Maximum Marks	Time
30	120	1 Hour

Speed TEST 40

Chapter-wise

GENERAL INSTRUCTIONS

- This test contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solutions provided at the end of this book.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

1. Boric acid is polymeric due to
(a) its acidic nature
(b) the presence of hydrogen bonds
(c) its monobasic nature
(d) its geometry

2. Which of the following statements about anhydrous aluminium chloride is correct?
(a) It exists as $AlCl_3$ molecules
(b) It is not easily hydrolysed
(c) It sublimes at 180ºC
(d) It is a strong Lewis base

3. The approximate percentage of silica in cement is:
(a) 5 – 10% (b) 15 – 20%
(c) 20 – 25% (d) 25 – 30%

4. An aqueous solution of potash alum gives :
(a) two types of ions (b) only one type of ion
(c) four types of ions (d) three types of ions

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

5. The $I.E_1$ among the group 13 member follows as

(a) $B > Al < Ga < Tl$ (b) $B > Al > Ga > Tl$

(c) $B > Ga > Al > Tl$ (d) $B > Ga < Al < Tl$

6. Non-oxide ceramics can be

(a) B_4C (b) SiC

(c) Si_3N_4 (d) All of these

7. Be_2C and Al_4C_3 are called –

(a) ethanides (b) methanides

(c) carbonides (d) acetylides

8. Anhydrous $AlCl_3$ cannot be obtained from which of the following reactions ?

(a) Heating $AlCl_3.6H_2O$

(b) By passing dry HCl over hot aluminium powder

(c) By passing dry Cl_2 over hot aluminium powder

(d) By passing dry Cl_2 over a hot mixture of alumina and coke

9. Aluminium is extracted from alumina (Al_2O_3) by electrolysis of a molten mixture of :

(a) $Al_2O_3 + HF + NaAlF_4$

(b) $Al_2O_3 + CaF_2 + NaAlF_4$

(c) $Al_2O_3 + Na_3AlF_6 + CaF_2$

(d) $Al_2O_3 + KF + Na_3AlF_6$

10. Alum helps in purifying water by

(a) forming Si complex with clay partiles

(b) sulphate part which combines with the dirt and removes it

(c) coagulaing the mud particles

(d) making mud water soluble.

11. Carbon and silicon belong to group 14. The maximum coordination number of carbon in commonly occurring compounds is 4, whereas that of silicon is 6. This is due to

(a) large size of silicon

(b) more electropositive nature of silicon

(c) availability of *d*-orbitals in silicon

(d) Both (a) and (b)

12. Soldiers of Napolean army while at alps during freezing winter suffered a serious problem as regards to the tin buttons of their uniforms. White metallic tin buttons got converted to grey powder. This transformation is related to

(a) a change in the partial pressure of oxygen in the air

(b) a change in the crystalline structure of tin

(c) an interaction with nitrogen of the air at very low temperatures

(d) an interaction with water vapours contained in the humid air

13. On adding ammonium hydroxide solution to $Al_2(SO_4)_3$ (aq) :

(a) A precipitate is formed which does not dissolve in excess of ammonium hydroxide

(b) A precipitate is formed which dissolves in excess of ammonia solution

(c) No precipitate is formed

(d) None of these

14. Gas A is bubbled through slaked lime when a white precipitate is formed. On prolonged bubbling the precipitate is dissolved. On heating the resultant solution, the white precipitate appears with evolution of gas B. The gases A and B respectively are

(a) CO and CO (b) CO_2 and CO

(c) CO and CO_2 (d) CO_2 and CO_2

RESPONSE GRID					
	5. ⓐⓑⓒⓓ	**6.** ⓐⓑⓒⓓ	**7.** ⓐⓑⓒⓓ	**8.** ⓐⓑⓒⓓ	**9.** ⓐⓑⓒⓓ
	10. ⓐⓑⓒⓓ	**11.** ⓐⓑⓒⓓ	**12.** ⓐⓑⓒⓓ	**13.** ⓐⓑⓒⓓ	**14.** ⓐⓑⓒⓓ

15. The straight chain polymer is formed by
(a) hydrolysis of CH_3SiCl_3 followed by condensation polymerisation
(b) hydrolysis of $(CH_3)_4Si$ by addition polymerisation
(c) hydrolysis of $(CH_3)_2SiCl_2$ followed by condensation polymerisation
(d) hydrolysis of $(CH_3)_3SiCl$ followed by condensation polymerisation

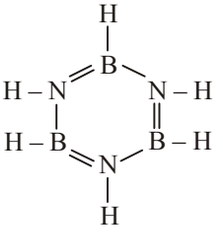
16. It is because of inability of ns^2 electrons of the valence shell to participate in bonding that:-
(a) Sn^{2+} is oxidising while Pb^{4+} is reducing
(b) Sn^{2+} and Pb^{2+} are both oxidising and reducing
(c) Sn^{4+} is reducing while Pb^{4+} is oxidising
(d) Sn^{2+} is reducing while Pb^{4+} is oxidising

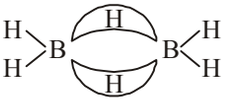
17. A group 14 element is oxidised to form corresponding oxide which is gaseous in nature, when dissolved in water pH of the water decreases further addition of group 2 hydroxides leads to precipitation. This oxide can be
(a) GeO_2 (b) CO
(c) CO_2 (d) SnO_2

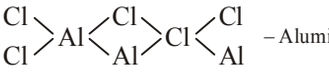
18. In borax bead test which compound is formed?
(a) Ortho-borate (b) Meta-borate
(c) Double oxide (d) Tetra-borate

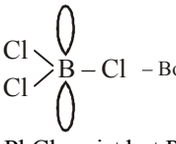
19. Orthoboric acid when heated to red hot gives
(a) metaboric acid (b) pyroboric acid
(c) boron and water (d) boric anhydride

20. Which of the following compounds is not matched correctly with its structure?

(a)  – Borazine

(b)  – Diborane

(c)  – Aluminium chloride

(d)  – Boron trichloride

21. PbF_4, $PbCl_4$ exist but $PbBr_4$ and PbI_4 do not exist because of
(a) large size of Br^- and I^-
(b) strong oxidising character of Pb^{4+}
(c) strong reducing character of Pb^{4+}
(d) low electronegativity of Br^- and I^-.

22. In silicon dioxide
(a) there are double bonds between silicon and oxygen atoms
(b) silicon atom is bonded to two oxygen atoms
(c) each silicon atom is surrounded by two oxygen atoms and each oxygen atom is bonded to two silicon atoms
(d) each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms.

23. Which one of the following is the correct statement?
(a) Boric acid is a protonic acid
(b) Beryllium exhibits coordination number of six
(c) Chlorides of both beryllium and aluminium have bridged structures in solid phase
(d) $B_2H_6.2NH_3$ is known as 'inorganic benzene'

24. Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behaviour is that graphite
(a) is an allotropic form of diamond
(b) has molecules of variable molecular masses like polymers
(c) has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interplate bonds
(d) is a non-crystalline substance

RESPONSE GRID					
	15. (a)(b)(c)(d)	**16.** (a)(b)(c)(d)	**17.** (a)(b)(c)(d)	**18.** (a)(b)(c)(d)	**19.** (a)(b)(c)(d)
	20. (a)(b)(c)(d)	**21.** (a)(b)(c)(d)	**22.** (a)(b)(c)(d)	**23.** (a)(b)(c)(d)	**24.** (a)(b)(c)(d)

25. The gas evolved on heating CaF_2 and SiO_2 with concentrated H_2SO_4, on hydrolysis gives a white gelatinous precipitate. The precipitate is:

(a) hydrofluosilicic acid (b) silica gel

(c) silicic acid (d) calciumfluorosilicate

26. Glass is a

(a) super-cooled liquid (b) gel

(c) polymeric mixture (d) micro-crystalline solid

27. Identify the incorrect statement :

(a) In $(Si_3O_9)^{6-}$, tetrahedral SiO_4 units share two oxygen atoms.

(b) Trialkylchlorosilane on hydrolysis gives R_3SiOH.

(c) $SiCl_4$ undergoes hydrolysis to give H_4SiO_4.

(d) $(Si_3O_9)^{6-}$ has cyclic structure.

28. The catenation tendency of C, Si and Ge is in the order Ge < Si < C. The bond energies (in kJ mol^{-1}) of C – C, Si – Si and Ge –Ge bonds are respectively;

(a) 348, 297, 260 (b) 297, 348, 260

(c) 348, 260, 297 (d) 260, 297, 348

29. Example of a three-dimensional silicate is:

(a) Zeolites (b) Ultramarines

(c) Feldspars (d) Beryls

30. CO_2 and N_2 are non-supporters of combustion. However for putting out fires CO_2 is preferred over N_2 because CO_2

(a) does not burn

(b) forms non-combustible products with burning substances

(c) is denser than nitrogen

(d) is a more reactive gas

RESPONSE GRID	**25.** ⓐⓑⓒⓓ **26.** ⓐⓑⓒⓓ **27.** ⓐⓑⓒⓓ **28.** ⓐⓑⓒⓓ **29.** ⓐⓑⓒⓓ **30.** ⓐⓑⓒⓓ

CHEMISTRY CHAPTERWISE SPEED TEST-40			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	38	Qualifying Score	52
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Speed Test-40

1. (b) In Boric acid each B atom is sp^2 hybridized and contains BO_3^{3-} units which are held together by hydrogen bonds.

2. (c) $AlCl_3$ exists as a dimer (Al_2Cl_6). It is a strong Lewis acid as it has an incomplete octet and has a tendency to gain electrons. $AlCl_3$ undergoes hydrolysis easily and forms an acidic solution.

$AlCl_3 + 3H_2O \rightarrow Al(OH)_3 + 3HCl$

Option (c) is true that $AlCl_3$ sublimes at 180ºC.

3. (c) The approximate composition of cement is :

Lime (CaO) = 50 – 60%

Silica (SiO_2) = 20 – 25 %

Alumina (Al_2O_3) = 5 – 10 %

Magnesia (MgO) = 2 – 3%

Ferric oxide (Fe_2O_3) = 2 – 3%

4. (d) $K_2SO_4.Al_2(SO_4)_3.24H_2O \xrightarrow{\text{water}}$

$2K^+ + 4SO_4^{2-} + 2Al^{3+} + 24H_2O$

5. (c) The IE_1 of Ga is more than that of Al because of the small atomic size and greater effective nuclear charge of Ga.

6. (d) Ceramics are inorganic , non-metallic, solid minerals. They come in a variety of forms, including silicates (silica, SiO_2 with metal oxides), oxides (oxygen and metals), carbides (carbon and metals), aluminates (alumina, Al_2O_3 with metal oxides) and nitrides.

The given ceramics are B_4C (carbides), SiC (carbides), Si_3N_4 (nitrides) and thus, none of these is an oxide. *All of these are non-oxide ceramics.*

7. (b) Because they react with water to form methane gas

$$\underset{\text{Aluminium carbide}}{Al_4C_3} + 12H_2O \longrightarrow 4\,Al(OH)_3 + \underset{\text{Methane}}{3CH_4}$$

$$\underset{\text{Beryllium carbide}}{Be_2C} + 4H_2O \longrightarrow 2Be(OH)_2 + \underset{\text{Methane}}{CH_4}$$

8. (a) $2Al + 6HCl \xrightarrow{\Delta,\ air} 2AlCl_3 + 3H_2$

$2Al + 3Cl_2 \longrightarrow 2AlCl_3$

$Al_2O_3 + 3C + 3Cl_2 \xrightarrow{1000°C} \underset{\text{vapours}}{2AlCl_3} + 3CO$

$\downarrow$ Cooling

Anhydrous $AlCl_3$

$AlCl_3.6H_2O \xrightarrow{\Delta} Al(OH)_3 + 3HCl + 3H_2O$

Thus $AlCl_3$ cannot be obtained by this method

9. (c) Fused alumina (Al_2O_3) is a bad conductor of electricity. Therefore, cryolite (Na AlF) and fluorspar (CaF) are good conductor of electricity but also reduce the melting point of the mixture to around 1140 K.

10. (c) Alum furnishes Al^{3+} ions which bring about coagulation of negatively charged clay particles, bacteria etc.

11. (c) Due to non-availability of vacant *d*-orbitals, it cannot exceed its coordination number more than four. Thus carbon never forms complexes e.g., $[CCl_6]^{2-}$ deos not exist but $[SiCl_6]^{2-}$ exists.

12. (b) $\underset{\text{(Grey)}}{\alpha\text{-tin}} \overset{15.2°C}{\rightleftharpoons} \underset{\text{(White)}}{\beta\text{-Sn}} \overset{164°C}{\rightleftharpoons} \underset{\text{(Britle)}}{\gamma\text{-Sn}} \overset{232°C}{\rightleftharpoons} \text{Liquid tin}$

(most common and stable) (Rhombic)

Although transitions of white to grey tin occurs at any temperature below 15.2°C, it becomes rapid only at –50°C, unless a catalyst is present. During the conversion of white tin to grey tin (in cold countries) volume increases. Grey Sn is very brittle easily crumbles down to powder. This phenomenon is called tin diseases, tin past or tin plague.

13. (a) $Al_2(SO_4)_3 + 6NH_4OH \rightarrow 2Al(OH)_3 + 3(NH_4)_2SO_4$

$Al(OH)_3 + NaOH \rightarrow Na^+[Al(OH)_4]^-$ Soluble complex it

is insoluble in NH_4OH

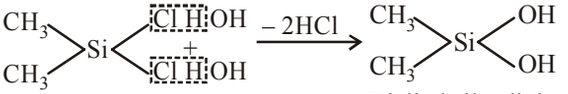
14. (d) $\underset{\text{(A)}}{CO_2} + Ca(OH)_2 \longrightarrow \underset{\text{white ppt}}{CaCO_3\downarrow} + H_2O$

$$CaCO_3 + CO_2 + H_2O \longrightarrow \underset{\substack{\text{Calcium bicarbonat e}\\ \text{(Souble in water)}}}{Ca(HCO_3)_2}$$

$$Ca(HCO_3)_2 \xrightarrow{\text{Heat}} CaCO_3 + \underset{\text{(B)}}{CO_2} + H_2O$$

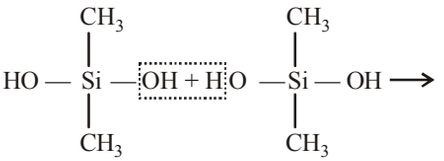
A and B are CO_2 and CO_2.

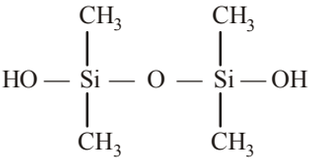
15. (c) Hydrolysis of substituted chlorosilanes yield corresponding silanols which undergo polymerisation.



Dialkyl silandiol

Polymerisation of dialkyl silandiol yields linear thermoplastic polymer.





16. (d) Inertness of ns^2 electrons of the valence shell to participate in bonding on moving down the group in heavier p-block elements is called inert pair effect.

As a result, Pb(II) is more stable than Pb(IV)

Sn(IV) is more stable than Sn(II)

$\therefore$ Pb(IV) is easily reduced to Pb(II) and can acts as an oxidising agent whereas Sn(II) is easily oxidised to Sn(IV) and can acts as a reducing agent.

17. (c) CO_2 forms carbonic acid H_2CO_3, when dissolved in water, CO is neutral, whereas other two GeO_2 and SnO_2 are solids.

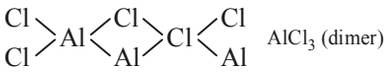
18. (b) $Na_2B_4O_7.10\,H_2O \xrightarrow[-10H_2O]{\Delta} Na_2B_4O_7$

$$\underset{\text{anhydrous}}{Na_2B_4O_7} \xrightarrow{\Delta} \underset{\text{sod. metaborate}}{2\,NaBO_2} + \underset{\text{Boric anhydride}}{B_2O_3}$$

$$CuO + B_2O_3 \longrightarrow \underset{\text{cupric meta borate(Blue beed)}}{Cu(BO_2)_2}$$

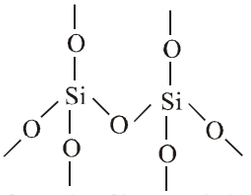
19. (b) $H_3BO_3 \xrightarrow{100°C} HBO_2 \xrightarrow{160°C}$

$$H_2B_4O_7 + H_2O \longrightarrow 2B_2O_3 + H_2O$$

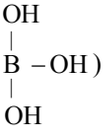
20. (c)  $AlCl_3$ (dimer)

21. (b) F and Cl are more oxidising in nature and can achieve Pb in (IV) O.S. but Br_2 and I_2 can not achieve Pb in (IV) O.S. secondly Pb^{4+} is strong in oxidising nature and in its presence, Br^- and I^- can not exist.

22. (d) In SiO_2 (quartz), each of O-atom is shared between two SiO_4^{4-} tetrahedra.

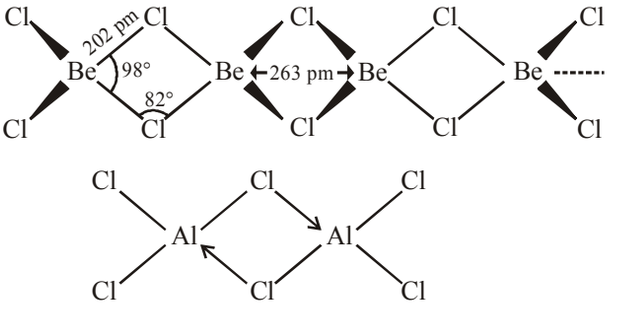


23. (c) The correct formula of inorganic benzene is $B_3N_3H_6$ so (d) is incorrect statement

Boric acid (H_3BO_3 or ) is a lewis acid so (a) is incorrect statement.

The coordination number exhibited by beryllium is 4 and not 6 so statement (b) is incorrect.

Both $BeCl_2$ and $AlCl_3$ exhibit bridged structures in solid state so (c) is correct statement.



24. (c) In graphite, carbon is sp^2 hybridized. Each carbon is thus linked to three other carbon atoms forming hexagonal rings. Since only three electrons of each carbon are used in making hexagonal ring, fourth electron of each carbon is free to move. This makes graphite a good conductors of heat and electricity.

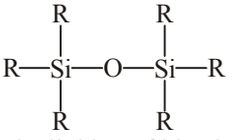
Further graphite has a two dimensional sheet like structure. These various sheets are held together by weak van der Waal's force of attraction. Due to these weak forces of attraction, one layer can slip over the other. This makes graphite soft and a good lubricating agent.

25. (d) $2CaF_2 + SiO_2 + H_2SO_4 \longrightarrow$

$$SiF_4 + H_2O + CaSO_4 \xrightarrow{\text{hydrolysis}} CaSiF_6$$

26. (a) Glass is a translucent or transparent amorphous supercooled solid solution or we can say super cooled liquid of silicates and borats having a general formula $R_2O.MO.6\,SiO_2$. where R = Na or K and M = Ca, Ba, Zn or Pb.

27. (b) The hydrolysis of Trialkylchlorosilane R_3SiCl yields dimer :



28. (a) The linking of identical atoms with each other to form long chains is called catenation. However, this property decreases from carbon to lead. Decrease of this property is associated with M-M bond energy which decreases from carbon to lead.

29. (c) The feldspars are most abundant aluminosilicate minerals in the Earth surface. The silicon atoms and aluminium atoms occupy the centres of interlinked tetrahedra of SiO_4^{4-} and AlO_4^{5-}. These tetrahedra connect at each corner to other tetrahedra forming an intricate, three dimesional, negatively charged framework. The sodium cations sit within the voids in this structure.

30. (c) CO_2 being more dense covers the igniting material more effectively than N_2.