Set – 1

Table 11.2 Atomic and Physical Properties of Group 13 Elements

Property	Element				
	Boron B	Aluminium Al	Gallium Ga	Indium In	Thallium Tl
Atomic number	5	13	31	49	81
Atomic mass(g mol^{-1})	10.81	26.98	69.72	114.82	204.38
Electronic Configuration	$[He]2s^2 2p^1$	$[Ne]3s^2 3p^1$	$[Ar]3d^{10} 4s^2 4p^1$	$[Kr]4d^{10} 5s^2 5p^1$	$[Xe]4f^{14} 5d^{10} 6s^2 6p^1$
Atomic radius/pm[a]	(88)	143	135	167	170
Ionic radius M^{3+}/pm[b]	(27)	53.5	62.0	80.0	88.5
Ionic radius M^+/pm	-	-	120	140	150
Ionization enthalpy ($\Delta_i H_1$) (kJ mol^{-1})	801	577	579	558	589
Ionization enthalpy ($\Delta_i H_2$) (kJ mol^{-1})	2427	1816	1979	1820	1971
Ionization enthalpy ($\Delta_i H_3$) (kJ mol^{-1})	3659	2744	2962	2704	2877
Electronegativity[c]	2.0	1.5	1.6	1.7	1.8
Density /g cm^{-3} at 298 K	2.35	2.70	5.90	7.31	11.85
Melting point / K	2453	933	303	430	576
Boiling point / K	3923	2740	2676	2353	1730
$E^{\ominus}$/ V for (M^{3+}/M)	-	–1.66	–0.56	–0.34	+1.26
$E^{\ominus}$ / V for (M^+/M)	-	+0.55	-0.79(acid) –1.39(alkali)	–0.18	–0.34

Q1. Which of the following is the correct atomic radii order of Group 13 elements?

A. B
B. Al
C. B
D. B

Ans. (C)

Q2. Which of the following is the correct ionic radii order of Group 13 elements?

A. B
B. B

C. Al
D. B

Ans. (D)

Q3. Which of the following has the lowest first Ionisation enthalpy?

A. B
B. Al
C. In
D. Tl

Ans. (C)

Q4. Which of the following has the highest first ionisation enthalpy?

A. B
B. Al
C. Ga
D. In

Ans. (A)

Q5. Which of the following has the lowest second Ionisation enthalpy?

A. Al
B. Ga
C. In
D. Tl

Ans. (A)

Q6. Which of the following is the correct first ionisation enthalpy order of Group 13 elements?

A. Tl>Ga>Al>B>In
B. B>Al>Ga>In>Tl
C. Tl>In>Ga>Al>B
D. B>Tl>Ga>Al>In

Ans. (D)

Q7. Which of the following is the correct Second ionisation enthalpy order of Group 13 elements?

A. B>Al>Ga>In>Tl
B. B>Ga>Tl>In>Al
C. B>Tl>Ga>Al>In
D. B>Al>Ga>In>Tl

Ans. (B)

Q8. Which of the following is the correct Third ionisation enthalpy order of Group 13 elements?

A. B>Ga>Tl>Al>In
B. B>Al>Ga>In>Tl
C. B>Al>Ga>In>Tl
D. B>Ga>Tl>In>Al

Ans. (A)

Q9. Which of the following is the correct Electronegativity order of Group 13 elements?

A. B>Al>Ga>In>Tl
B. B>Tl>In>Ga>Al
C. B>Tl>Ga>Al>In
D. B>Al>Ga>In>Tl

Ans. (B)

Q10. Which of the following is the correct density order of Group 13 elements?

A. B>Tl>Ga>Al>In
B. Tl>Ga>Al>B>In
C. Tl>In>Ga>Al>B
D. B>Ga>Tl>In>Al

Ans. (C)

Q11. Which of the following is the correct melting point order of Group 13 elements?

A. B>Al>Ga>In>Tl
B. B>Al>Tl>In>Ga
C. B>Ga>Tl>In>Al
D. B>Tl>Ga>Al>In

Ans. (B)

Q12. Which of the following is the correct melting point order of Group 13 elements?

A. B>Al>Ga>In>Tl
B. B>Ga>Tl>In>Al
C. B>Tl>Ga>Al>In
D. B>Al>Tl>In>Ga

Ans. (A)

Set – 2

Table 11.3 Atomic and Physical Properties of Group 14 Elements

Property		Element				
		Carbon C	Silicon Si	Germanium Ge	Tin Sn	Lead Pb
Atomic Number		6	14	32	50	82
Atomic mass (g mol^{-1})		12.01	28.09	72.60	118.71	207.2
Electronic configuration		$[He]2s^2 2p^2$	$[Ne]3s^2 3p^2$	$[Ar]3d^{10} 4s^2 4p^2$	$[Kr]4d^{10} 5s^2 5p^2$	$[Xe]4f^{14} 5d^{10} 6s^2 6p^2$
Covalent radius/pm[a]		77	118	122	140	146
Ionic radius M^{4+}/pm[b]		–	40	53	69	78
Ionic radius M^{2+}/pm[b]		–	–	73	118	119
Ionization enthalpy/ kJ mol^{-1}	$\Delta_i H_1$	1086	786	761	708	715
	$\Delta_i H_2$	2352	1577	1537	1411	1450
	$\Delta_i H_3$	4620	3228	3300	2942	3081
	$\Delta_i H_4$	6220	4354	4409	3929	4082
Electronegativity[c]		2.5	1.8	1.8	1.8	1.9
Density[d]/g cm^{-3}		3.51[e]	2.34	5.32	7.26[f]	11.34
Melting point/K		4373	1693	1218	505	600
Boiling point/K		–	3550	3123	2896	2024
Electrical resistivity/ ohm cm (293 K)		10^{14}–10^{16}	50	50	10^{-5}	2×10^{-5}

Q1. Which of the following is the correct order of covalent radii of group 14 elements?

A. C
B. C
C. Si
D. pb

Ans. (A)

Q2. Which of the following is the correct order of first ionisation enthalpy order of group 14 elements?

A. C
B. pb
C. Sn
D. Ge

Ans. (C)

Q3. Which of the following is the correct order of second ionisation enthalpy order of group 14 elements?

A. Sn
B. Ge
C. C
D. pb

Ans. (A)

Q4. Which of the following is the correct order of third ionisation enthalpy order of group 14 elements?

A. Ge
B. C
C. pb
D. Sn

Ans. (D)

Q5. Which of the following is the correct order of fourth ionisation enthalpy order of group 14 elements?

A. Sn
B. pb
C. Ge
D. Sn

Ans. (A)

Q6. Which of the following is the correct melting point order of group 14 elements?

A. C
B. Sn
C. Ge
D. pb

Ans. (B)

Q7. Which of the following is the correct density order for group 14 elements?

A. C
B. Si
C. Ge
D. C

Ans. (B)

Q8. Which of the following is the correct boiling point order for group 14 elements?

A. Pb
B. Ge
C. pb
D. Si

Ans. (A)

Q9. Which of the following is the correct bond enthalpy order for group 14 elements?11

A. C-C
B. Si-
C. Sn-Sn< Ge-Ge
D. Sn-Sn

Ans. (C)

Set – 3

11.7.1 Diamond

It has a crystalline lattice. In diamond each carbon atom undergoes sp^3 hybridisation and linked to four other carbon atoms by using hybridised orbitals in tetrahedral fashion. The C–C bond length is 154 pm. The structure extends in space and produces a rigid three-dimensional network of carbon atoms. In this

Q1. What is the hybridisation of each C atom in diamond?

A. sp_2
B. sp_3
C. sp
D. sp_2d

Ans. (B)

Q2. What is the geometry of Diamond crystal?

A. Tetrahedral
B. Octahedral
C. hexagonal
D. planar

Ans. (A)

Q3. What is the bond length of each C-C ?

A. 340 pm
B. 141.5 pm
C. 154 pm
D. 250 pm

Ans. (C)

Set – 4

11.7.2 Graphite

Graphite has layered structure (Fig.11.4). Layers are held by van der Waals forces and distance between two layers is 340 pm. Each layer is composed of planar hexagonal rings of carbon atoms. C—C bond length within the layer is 141.5 pm. Each carbon atom in hexagonal ring undergoes sp^2 hybridisation and makes three sigma bonds with three neighbouring carbon atoms. Fourth electron

Q1. What is the hybridisation of each C atom in Graphite?

A. sp_2
B. sp_3
C. sp
D. sp_2d

Ans. (A)

Q2. What is the geometry of Graphite?

A. Tetrahedral
B. Octahedral
C. hexagonal
D. planar

Ans. (C)

Q3. What is the bond length of each C-C ?

A. 340 pm
B. 141.5 pm
C. 154 pm
D. 250 pm

Ans. (B)