3.CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

Single Correct Answer Type

1. Which of the following has the electronic configuration $[Ar]3d^5$?
   a) Cr b) Fe^{3+} c) Mn d) V
2. Electron affinity is positive when
   a) O^- is formed from O b) O^{2-} is formed from O^- c) O^+ is formed from O d) Electron affinity is always a negative value
3. $(A), (B), (C)$ are elements in the third short period. Oxide of (A) is ionic, that of (B) is amphoteric and of (C) a giant molecule. $(A), (B)$ and (C) will have atomic number in the order
   a) $(A) < (B) < (C)$ b) $(C) < (B) < (A)$ c) $(A) < (C) < (B)$ d) $(B) < (A) < (C)$
4. First long period contains …….. elements
   a) 8 b) 18 c) 32 d) 2
5. Li resemble Mg. This is called diagonal relationship which is attributed to
   a) Same value of electron egativity b) Same value of electron affinity c) Penetration of sub-shells d) Identical effective nuclear charge
6. Which of the following does not represent the correct order of the properties indicated?
   a) $Ni^{2+} > Cr^{2+} > Fe^{2+} > Mn^{2+}$ (size) b) Sc > Ti > Cr > Mn (size) c) $Ni^{2+} < Co^{2+} < Fe^{2+} <$ Mn^{2+} (unpaired electron) d) $Fe^{2+} > Co^{2+} > Ni^{2+} > Cu^{2+}$ (unpaired electron)
7. If Aufbau and Hund's rule are not used, then incorrect statement is
   a) K^+ would be coloured ion b) Na will be in same s-block (if these rules are true) c) Cu would be s-block element d) Magnetic moment of Cr(24) would be zero
8. Representative elements belong to
   a) s- and p-block b) d-block c) d- and f-block d) f-block
9. Which of the following oxides is highly basic?
   a) Al_2O_3 b) Cr_2O_3 c) Na_2O d) BaO
10. If Aufbau rule is not followed, K-19 will be placed in ……. block
    a) s b) p c) d d) f
11. Which of the following metals forms a amphoteric oxide?
    a) Ca b) Ni c) Zn d) Fe
12. Catenation properties of C, Si, Ge, Sn, Pb are in order
    a) $C \gg Si > Ge \approx Sn \gg Pb$ b) $C < Si < Ge < Sn < Pb$ c) $C > Si > Sn > Ge > Pb$ d) None of the above is correct
13. Select the correct statement
    a) More active metals are on the left side of the Periodic Table b) Less active metals are on the left side of the Periodic Table c) Reducing power decreases moving down the group d) All the above are correct statements
14. The electronegativities of elements A and B are 1.2 and 3.4 units respectively. The type of bond connecting A and B in compound AB is
    a) Covalent b) Ionic c) Coordinate covalent d) Polar covalent
15. Which of the following will have maximum electron affinity?
    a) $1s^2 2s^2 2p$ b) $1s^2 2s^2 2p$ c) $1s^2 2s^2 2p$ d) $1s^2 2s^2 2p$
16. Select the correct alternate
    a) Due to lanthanide contraction Zr and Hf have almost equal size b) Due to completion of $3d$-subshell, the electronic charge density in this subshell becomes very high c) Both (a) & (b) are correct statements d) Both of the above are incorrect statements

which increases the inter-electronic repulsion hence, size increases

17. Point out the oxide which is amphoteric in nature
a) CO b) Bi_2O_3 c) PbO d) CO_2

18. Covalent radius of nitrogen is 70 pm. Hence, covalent radius of boron is about
a) 60 pm b) 110 pm c) 50 pm d) 40 pm

19. Melting points of NaCl, NaBr, NaI and NaF will be in order
a) $NaI < NaBr < NaCl < NaF$ b) $NaF < NaCl < NaBr < NaI$ c) $NaBr < NaF < NaCl < NaI$ d) $NaCl < NaI < NaF < NaBr$

20. Which pair is different from the others?
a) Li − Mg b) Na − K c) Ca − Mg d) B − Al

21. For the process
$X(g) + e^- \rightarrow X^-(g), \quad \Delta H = x$
and $X^-(g) \rightarrow X(g) + e^-, \quad \Delta H = y$
Select the correct alternate
a) Ionization energy of $X^-(g)$ is y b) Electron affinity of $X(g)$ is x c) Electron affinity of $X(g)$ is $-y$ d) All the above are correct statements

22. The atoms of the elements belonging to the same group of the Periodic Table will have
a) The same number of protons b) The same number of electrons in the valence-shell c) The same number of neutrons d) The same number of electrons

23. EC of Gd (64) is written as
a) $[Xe]_{54}4f^7$ b) $[Xe]_{54}4f^8$ c) $[Xe]_{54}4f^9$ d) $[Xe]_{54}4f^{10}$

24. Numbering of groups as 1, 2,.....18 was adopted by IUPAC in
a) 1986 b) 1906 c) 1908 d) 1988

25. Which of the following forms a stable +4 oxidation state?
a) Lanthanum b) Cerium c) Europium d) Gadolinium

26. A molecule H − X will be 50% ionic if electronegativity difference of H and X is
a) 1.2 eV b) 1.4 eV c) 1.5 eV d) 1.7 eV

27. Most stable cation of element 113 will be
a) M^{3+} b) M^{2+} c) M^+ d) M_2^{2+}

28. Which is incorrect statement?
a) In solid state O^{2-} is stabilized by neighbouring cations b) Formation of O^{2-} from O^- is unfavourable in the gas phase c) Electron affinity of O > S d) All of the above are incorrect

29. With respect to oxygen maximum valency is shown by
a) Halogen family b) Oxygen family c) Nitrogen family d) Boron family

30. The dominant factor in determining the IE of the elements on moving down the groups is its
a) Atomic radius b) Effective nuclear charge c) Both (a) and (b) d) None of the above

31. Select the correct statement(s)
a) Across a transition series, there is only a small decrease in atomic radius from one element to another due to very small increase in effective b) The rate of decrease in the size across the lanthanide series is less than the across the first transition series c) Both (a) & (b) are correct statements d) None of the above statement is correct

nuclear charge

32. Which of the following statement is false?
a) Elements of IB and IIB groups are transition elements
b) Elements of VB group do not contain metalloids
c) Elements of IA and IIA groups are normal elements
d) Elements of IVB group are neither strongly electronegative nor strongly electropositive

33. Which has maximum ionization potential?
a) N b) O c) O^+ d) Na

34. Which has maximum IE?
a) Mg b) Mg^+ c) Mg^{2+} d) Equal

35. $M(g) \rightarrow M^+(g) + e^-, \Delta H = 100$ eV
$M(g) \rightarrow M^{2+}(g) + 2e^-, \Delta H = 250$ eV
Which is the incorrect statement?
a) I_1 of $M(g)$ is 100 eV
b) I_1 of $M^+(g)$ is 150 eV
c) I_2 of $M(g)$ is 250 eV
d) I_2 of $M(g)$ is 150 eV

36. Which is best oxidizing agent?
a) Ge^{4+} b) Pb^{4+} c) Sn^{4+} d) Sn^{2+}

37. Element with valence shell-electronic configuration as d^5s^1 is placed in
a) IA, s-block b) VIA, s-block c) VIB, s-block d) VIB, d-block

38. Which group of elements is analogous to the lanthanides?
a) Halides b) Actinides c) Chalcogenides d) Borides

39. Which will have graded property similar to EC $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$?
a) $[Ar]3d^{10}4s^1$ b) $[Kr]4d^{10}5s^1$ c) $[Kr]5s^1$ d) All of these

40. The separation of lanthanides in ion-exchange method is based on
a) Basicity of the hydroxides
b) Size of the hydrated ions
c) Size of the unhydrated ion
d) The solubility of their nitrates

41. Which of the following will have the most negative electron affinity and which the least negative?
a) F, Cl b) Cl, F c) Cl, S d) Cl, P

42. Select the correct statement about radius of an atom
a) Values of van der Waals' radii are larger than those of covalent radii because the van der Waals' forces are much weaker than the forces operating between atoms in a covalently bonded molecule
b) The metallic radii are smaller than the van der Waals' radii, since the bonding forces in the metallic crystal lattice are much stronger than the van der Waals' forces
c) Both (a) & (b) are correct
d) None of the above is correct

43. Sodium forms Na^+ ion but it does not form Na^{2+} because
a) Very low value of $(IE)_1$ and $(IE)_2$
b) Very high value of $(IE)_1$ and $(IE)_2$
c) Low value of $(IE)_1$ and low value of $(IE)_2$
d) Low value of $(IE)_1$ and high value of $(IE)_2$

44. The electronic configuration $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6 4d^{10}, 5s^2$ is for
a) f-block element b) d-block element c) p-block element d) s-block element

45. Which one of the following has the smallest atomic radius?
a) F b) Cl c) Cs d) Mg

46. Mixture containing aqueous Li^+, Na^+, K^+ ions are electrolysed. Cations are discharged at

cathode in the order: (easiest at the end)
$M^+(aq) + e^- \rightarrow M$

a) Li^+, Na^+, b) K^+, Na^+, c) Li^+, K^+, d) Na^+, K^+, I

47. Screening effect is not observed in

a) He^+ b) Li^{2+} c) Be^{3+} d) All of these cases

48. Which has maximum stability?

a) $AsCl_3$ b) $SbCl_3$ c) $BiCl_3$ d) Equal

49. In periodic Table, metallic elements appear

a) In the left-hand columns b) In the top rows c) In the right-hand columns d) In the bottom rows

50. For the element (X), student (A) measured its radius as 102 nm, student (B) as 103 nm and (C) as 100 nm using same apparatus. Their teacher explained that measurements were correct by saying that recorded values by (A), (B) and (C) are

a) Crystal, van der Waals and covalent radii b) Covalent, crystal and van der Waals radii c) Van der Waals, ionic and covalent d) None is correct

51. The hydration energy of lithium ion is -544 kJ mol^{-1} which is higher than that of other alkali metal ions. This is explained in terms of

a) Small size of lithium b) Higher IP c) Element of lowest atomic weight d) More reactive than other alkali metals

52. The ionic radii of O^{2-}, F^-, Na^+ and Mg^{2+} are 1.35, 1.34, 0.95 and 0.66 Å respectively. The radius of the Ne atom is

a) 1.39 Å b) 1.12 Å c) 0.85 Å d) 0.50 Å

53. Metallic nature increases moving down the group because

a) Nuclear charge increases b) Shielding increases c) Both (a) and (b) d) None of the above

54. Which reaction has most negative $\Delta G°$ value?

a) $+ 2e^- \rightarrow Ga^+$ b) $+ 2e^- \rightarrow In^+$ c) $+ 2e^- \rightarrow Tl^+$ d) Cannot be predicte d

55. Fluorine has the highest electronegativity among the ns^2np^5 group on the Pauling scale, but the electron affinity of fluorine is less than that of chlorine because

a) The atomic number of fluorine is less than that of chlorine b) Fluorine being the first member of the family behaves in an unusual manner c) Chlorine can accommodate an electron better than fluorine by utilizing its vacant $3d$-orbital d) Small size, high electron density and an increased electron repulsion makes addition of an electron to fluorine less favourable than that in the case of chlorine

56. Fluorine does not form any polyhalide as other halogens because

a) It has maximum ionic character b) It has low $F - F$ bond energy (38.5 kcal mol^{-1}) c) Of the absence of d-orbitals in the valence shell of fluorine d) It brings about maximum coordination number in other elements

57. Among the following, the number of elements showing only one non-zero oxidation state is
O, Cl, F, N, P, Sn, Tl, Na, Ti

a) 1 b) 2 c) 3 d) 4

58. Select the correct statement

a) Ionic hydrides are better reducing agents b) Covalent nature of hydrides increases across a period c) $LiAlH_4$ can reduce carbonyl compounds to d) All the above are correct statements

	and decreases down the group	alcohols	

59. The following acids have been arranged in the order of decreasing acid strength. Identify the correct order

ClOH (I) BrOH (II) IOH (III)

a) I > II > III b) II > I > III c) III > II > I d) I > III > II

60. Gd (64) has ..... unpaired electrons with sum of spin.....

a) 7, 3.5 b) 8, 3 c) 6, 3 d) 8, 4

61. For Cu^+, effective nuclear charge felt by a $3d$-electron is

a) 14.25 b) 13.95 c) 14.65 d) 29.0

62. The relative thermal stabilities of alkali metal halides are such that

a) CsCl > RbCl > KCl > NaCl > LiCl	b) LiCl > NaCl > RbCl > KCl > CsCl	c) CsCl > RbCl > NaCl > KCl < LiCl	d) CsCl < RbCl > KCl < NaCl > LiCl

63. Which of the following order is wrong?

a) NH_3 < PH_3 < AsH_3 – acidic	b) Li < Be < B < C – $(IE)_1$	c) Al_2O_3 < MgO < Na_2O < K_2O – basic	d) Li^{2+} < Na^+ < K^+ < Cs^+ – ionic radius

64. The statement is not true for the long form of the Periodic Table

a) It reflects the sequence of filling the electrons in the order of the sub-energy shells s, p, d and f	b) It helps to predict the stable valency states of the elements	c) It reflects trends in physical and chemical properties of the elements	d) It helps to predict the relative ionicity of the bond between any two elements

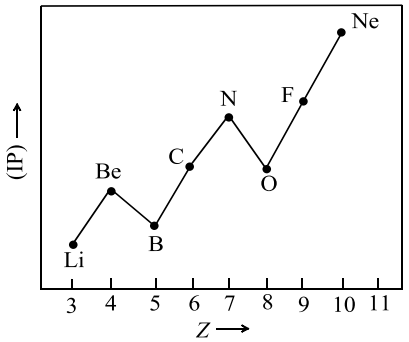
65. Element with atomic number 115 has configuration as ..... and with most stable cation as .....

a) $[Rn]7s^25$ M^{3+} b) $[Rn]7s^25$ M^{5+} c) $[Rn]7s^25$ M^+ d) $[Rn]5d^{10}$ M^{5+}

66. In which case effective nuclear charge is minimum?

a) Be b) Be^{2+} c) Be^{3+} d) Equal

67. Following graph shows variation of ionization potential (IP) with atomic number in second period (Li – Ne). Value of ionization potential (IP) of Na (11) will be



a) Above Ne b) Below Ne but above O c) Below Li d) Between N and O

68. Recently (in Aug 2003) two new elements have been discovered with atomic numbers

a) 113, 114 b) 114, 115 c) 115, 116 d) 113, 115

69. AB is predominantly ionic as A^+B^- if (IP stands for ionization potential, EA for electron affinity and EN for electronegativity)

a) $(IP)_A < (IP)_B$ b) $(EA)_A < (EA)_B$ c) $(EN)_A < (EN)_B$ d) $(IP)_B < (IP)_A$

70. M^{3+} has electronic configuration as $[Ar]3d^{10}4s^2$, hence it lies in

a) s-block b) p-block c) d-block d) f-block

71. Transition elements have vacant

a) s-orbital b) p-orbital c) d-orbital d) f-orbital

72. When the following five anions are arranged in order of decreasing ionic radius, the correct sequence is

a) $Se^{2-}, I^-,$ b) $I^-, Se^{2-},$ (c) $Se^{2-}, I^-,$ d) I^-, Se^{2-}, I

73. Match Column I (atomic number of elements) with Column II (position of elements in Periodic Table) and select the correct answer using the codes given below the Columns

	Column I		Column II
A	19	1.	p-block
B	22	2.	f-block
C	32	3.	d-block
D	64	4.	s-block

Codes

A B C D

a) 1 2 3 4 b) 4 3 1 2 c) 4 1 3 2 d) 2 1 3 4

74. Ionic radii of:
a) $Ti^{4+} < Mn^{7+}$ b) $^{35}Cl^{-} < {}^{37}Cl^{-}$ c) $K^{+} > Cl^{-}$ d) $P^{3+} > P^{5+}$

75. Covalency is favoured in the following cases
a) A smaller cation b) A larger anion c) Large charges on cation or anion d) In all the above cases

76. Main group elements constitute
a) s-and p-block b) p-and d-block c) s-and d-block d) d-and f-block

77. Oxidation energy of Li(s) to $Li^{+}(aq)$ is least in group IA elements. This is because of
a) Maximum heat of sublimation of Li(s) b) Maximum heat of hydration of Li^{+} c) Less negative heat of hydration of Li^{+} d) Maximum ionization energy of Li

78. Select the correct statement
a) Electron affinity of nitrogen is much lower than that of its neighbouring elements carbon and oxygen b) Electron affinity of F is higher than that of chlorine c) Both (a) & (b) are correct d) None of the above is correct

79. Chalcogens are elements of
a) Group 16 b) p-block c) ns^2np^4 configuration d) All are correct

80. The electron affinities of N, O, S and Cl are such that
a) $N < O < S < Cl$ b) $O < N < Cl < S$ c) $O \approx Cl < N \approx S$ d) $O < S < Cl < N$

81. Ionic radii are
a) Inversely proportional to effective nuclear charge b) Inversely proportional to square of effective nuclear charge c) Directly proportional to effective nuclear charge d) Directly proportional to square of effective nuclear charge

82. Out of BeH_2, CuH_2, CrH_2 and NaH, covalent hydrides are
a) BeH_2, NaH b) CuH_2, CrH c) BeH_2, CuH d) All of these

83. Which of the following is a transition element?
a) Al b) As c) Ni d) Rb

84. Elements X and Y have valence shell electron configuration as
$X: ns^2np^1$; $Y: ns^2np^3$
Which compound is likely formed from X and Y?
a) X_3Y_5 b) Y_3X_5 c) XY d) YX

85. Higher values of ionization energies of the $5d$-transition elements are consistent with the
a) Relatively smaller effective nuclear charge b) Relatively smaller size of their atoms c) Relatively smaller penetration d) All of the above are correct

86. Tendency of I^-, Br^-, Cl^- and F^- to be oxidized is in order
a) $I^- > Br^- > Cl^- > F^-$ b) $I^- < Br^- < Cl^- < F^-$ c) $I^- < Cl^- < F^- < Br^-$ d) $I^- = Br^- < Cl^- = F^-$

87. For which of the following crystals would you expect the assumption of anion-anion contact to be valid?
a) CsBr b) NlaF c) KCl d) NaI

88. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar?
a) $Ca < S < Ba < Se < Ar$ b) $S < Se < Ca < Ba < Ar$ c) $Ba < Ca < Se < S < Ar$ d) $Ca < Ba < S < Se < Ar$

89. Valence electrons in the element A are 3 and that in element B are 6. Most probable compound formed from A and B is
a) A_2B b) AB_2 c) A_6B_3 d) A_2B_3

90. Which of the following ions has the smallest radius?
a) Ti^{2+} b) Pt^{2+} c) Ni^{2+} d) Zr^{2+}

91. As we proceed from top to bottom in the Periodic Table

a) Hydroxides are more basic b) Oxyacids are less acidic c) Neither of the above d) Both of the above

92. Element 113 is produced *via*

a) α-decay of element 115 b) β-decay of element 114 c) α-decay of element 111 d) β-decay of element 112

93. Two new elements (discovered in Aug 2003) with atomic number 113 and 115 are to be placed in

a) s-block b) p-block c) d-block d) f-block

94. Nitrogen is found to have higher value of ionization potential because

a) It has half-filled p-orbitals b) It is chemically inert c) Its shielding effect overcomes the nuclear charge d) All of the above are correct

95. Extent of hydration of Na^+, Mg^{2+}, Al^{3+} is in order

a) $Na^+ < Al^{3+} < Mg^{2+}$ b) $Na^+ < Mg^{2+} < Al^{3+}$ c) $Al^{3+} < Mg^{2+} < Na^+$ d) Equal

96. Which pair represents incorrect first IE?

a) $Be > B$ b) $N > O$ c) $Li > Na$ d) $He > He^+$

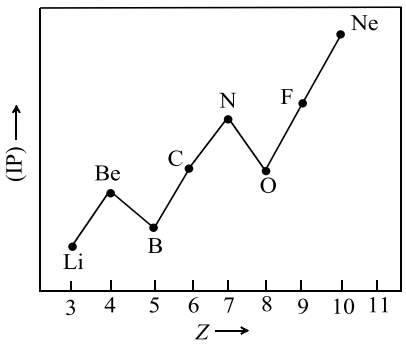
97. Of the following pairs, the one containing examples of metalloid elements in the Periodic Table is

a) Na and Kb) F and Cl c) Cu and Ag d) B and Si

98. Which of the following reactions should be most favoured thermodynamically?

a) $Na_2O + Cl_2O_7 \rightarrow 2NaCl($ b) $Na_2O + SO_3 \rightarrow Na_2SO$ c) $Na_2O + P_2O_5 \rightarrow 2Na_3P$ d) $Na_2O + SiO_2 \rightarrow Na_2SiC$

99.



which is the incorrect statements?

a) I_1 of $Be > I_1$ of B but I_2 of $Be < I_2$ of B b) I_1 of $Be < I_1$ of B but I_2 of $Be < I_2$ of B c) I_2 of $Be^+ < I_1$ of B^+ d) Be^{2+} is abnormally high

100. State, which one of the following has the largest atomic radius?

a) Cs b) Mg c) Ba d) Cr

101. The lanthanides have electron configuration with $6s^2$ in common but with variable occupation of the

a) $6p$-level b) $5p$-level c) $5d$-level d) $4f$-level

102. Which is largest in size in aqueous solution?

a) Li^+ b) Na^+ c) Cs^+ d) Rb^+

103. First, second and third IP values are 100 eV, 150 eV and 1500 eV. Element can be

a) Be b) B c) F d) Na

104. The high oxidizing power of fluorine is due to

a) High electron affinity b) High ionization energy c) Both (a) and (b) d) None of these

105. The relative extend to which the various orbitals penetrate the electron clouds of other orbitals is

a) $s > p > d > f$ b) $s < p < d < f$ c) $s < d < p < f$ d) $d < s < p < f$

106. The compound of vanadium has magnetic moment of 1.73 BM. The vanadium chloride has the formula

a) VCl_2 b) VCl_3 c) VCl_4 d) VCl_5

107. Recently discovered element with atomic number 115 is

a) Uun b) Uub c) Uup d) Uus

108. Consider the following statements,

1. Cs^+ is more highly hydrated than the other alkali metal ions
2. Among the alkali metals Li, Na, K and Rb, lithium has the highest melting point
3. Among the alkali metals only lithium forms a stable nitride by direct combination

Of these statements

a) I, II and III are correct b) I and II are correct c) I and III are correct d) II and III are correct

109. Which represents alkalies metals based on $(IE)_1$ and $(IE)_2$ values?

	$(IE)_1$	$(IE)_2$
a)	X	100
b)	Y	95
c)	Z	195
d)	M	200

110 120 500 250

110. Which has maximum polarizing power in cation?
a) Li^+ b) Mg^{2+} c) Al^{3+} d) O^{2-}

111. The correct order of increasing ionic character is
a) $BeCl_2 < MgCl_2 < CaCl_2 < BaCl_2$ b) $BeCl_2 < CaCl_2 < MgCl_2 < BaCl_2$ c) $BaCl_2 < CaCl_2 < MgCl_2 < BeCl_2$ d) $MgCl_2 < CaCl_2 < BeCl_2 < BaCl_2$

112. Recently discovered elements (August 2003) with atomic number 113 and 115 have valence electrons in
a) s-orbital b) p-orbital c) d-orbital d) f-orbital

113. Element with atomic number 113 has been reported in August 2003. Its electronic configuration is similar to that of
a) Si b) Ga c) Bi d) At

114. Which of the following properties shows a clear periodic variation?
a) First ionization energy b) Molar mass of the element c) Number of isotopes of the atom d) All of the above

115. Select the correct alternate about (IE)
a) $(IE)_1$ of Be > $(IE)_1$ of B b) $(IE)_1$ of O > $(IE)_1$ of N c) Both (a) and (b) d) None of the above

116. IP of an element does not depend on
a) Its nuclear charge b) The shielding effect c) Electron neutrality d) Penetration effect

117. Reducing action of hydrides is due to
a) Oxidation of H^- to H b) Oxidation of H to H^+ c) Reduction of H to H^- d) Reduction of H^+ to H

118. Which element has the highest electron affinity?
a) F b) Cl c) Br d) I

119. Ionic radii of
a) $Ti^{4+} < Mn^{7+}$ b) $^{35}Cl^- < {}^{37}Cl^-$ c) $K^+ > Cl^-$ d) $P^{3+} > P^{5+}$

120. Fluorine is more electronegative than nitrogen. The best explanation is that
a) The valence electrons in F are on the average, a little closer to the nucleus than in N b) The charge on a F nucleus is +9, while that on N nucleus is +7 c) The valence electrons in F and N are in different shells and thus their energy are greatly different d) Electronegativity increases from left to right in each of the periods

121. Select the incorrect order of size of ions/atoms
a) $I^+ < I < I^-$ b) Fe = Co = Ni c) Ni < Cu < Zn d) None is incorrect

122. The heat of hydration of Ca^{2+}, Sr^{2+} and Ba^{2+} in the decreasing order is
a) $Ca^{2+} > Sr^{2+} > Ba^{2+}$ b) $Ca^{2+} > Ba^{2+} > Sr^{2+}$ c) $Sr^{2+} > Ba^{2+} > Ca^{2+}$ d) $Ba^{2+} > Sr^{2+} > Ca^{2+}$

123. Following are the values of the electron affinities (in kJ mol^{-1}) of the formation of O^- and O^{2-} from O
a) $-142, -7$ b) $-142, 70$ c) $142, 702$ d) $-142, -1$

124. The second ionisation energy is always higher than the first ionization energy because the
a) Ion becomes more stable attaining an octet or duplet configurations b) Electron is more tightly bound to the nucleus in an ion c) Electron is attracted more by the core electrons d) None of the above is the correct

125. SI unit of IE is
a) kJ mol^{-1} b) eV $atom^-$ c) J mol^{-1} d) kcal mol^-

126. Out of C, Si, Ge, Sn, Pb metallic nature is in
a) Ge, Sn, Pb b) Sn, Pb c) Ge, Pb d) Ge, Sn

127. Which element has the highest first IP?
a) N b) Ne c) He d) H

128. An oxide behaves as an acid or a base depending on its
a) Size and charge b) Size only c) Charge only d) None of these

129. The electronegativities of N, C, Si and P are such that
a) $P < Si < C < N$ b) $Si < P < N < C$ c) $Si < P < C < N$ d) $P < Si < N < C$

130. Recently (in 2003) element with atomic number 110 has been named by IUPAC as

a) HS b) Mt c) Ds d) Sg

131. The size of the second and third row transition elements being almost the same. This is due to

a) d-and f-orbitals do not shield the nuclear charge very effectively b) Lanthanide contraction c) Both (a) & (b) are true d) None of the above is true

132. Out of F_2, Cl_2, Br_2 and I_2, most oxidizing agent is

a) F_2 b) Cl_2 c) Br_2 d) I_2

133. Select the correct order of $(IE)_1$

a) $Cu < Zn < Ga$ b) $Ag < Cd < In$ c) $Hg > Au > Tl$ d) None of these

134. Of the four ΔH values needed to calculate the lattice energy using the Born-Haber cycle, the one that is most difficult to measure is

a) The heat of sublimation of the metal b) The heat of formation of gaseous atoms of the non-metal c) The ionization energy of the metal d) The electron affinity of the non-metal

135. The lanthanides contraction refers to

a) Ionic radius of the series b) Valence electrons of the series c) The density of the series d) Electronegativity

136. The statement that is not correct for the periodic classification of elements is

a) The properties of elements are the periodic functions of their atomic numbers b) Non-metallic elements are lesser in number than metallic elements c) The first ionization energies of elements along a period do not vary in a regular manner with increase in atomic number d) For transition elements the d-subshells are filled with electron monotonically with increase in atomic number

137. $N_0/2$ atoms of $X(g)$ are converted into $X^+(g)$ by energy E_1. $N_0/2$ atoms of $X(g)$ are converted into $X^-(g)$ by energy E_2. Hence, ionization potential and electron affinity of $X(g)$ are

a) $\frac{2E_1}{N_0}, \frac{2(E_1}{}$ b) $\frac{2E_1}{N_0}, \frac{2E_2}{N_0}$ c) $\frac{(E_1 - E_2)}{N_0}$ d) None is correct

138. Following the transition elements, $(IE)_1$ drops abruptly in Ga, In and Tl. This is due to

a) Decrease in effective nuclear charge b) Increase in atomic radius c) Removal of an electron from the singly occupied np-orbitals of higher energy than the ns-orbitals of Zn, Cd and Hg d) None of the above is correct

139. Electronegativity and electron affinity of an element A are X and Y respectively. Hence, ionization potential of A is

a) $\frac{X+Y}{2}$ b) $2X - Y$ c) $2Y - X$ d) $2X + Y$

140. Following triads have approximately equal size

a) Na^+, Mg^{2} -electronic b) F^-, Ne, O^{2} -electronic c) Fe, Co, Ni d) Mn^+, Fe^{2-} -electronic

141. The first ionization potential of Al is smaller than that of Mg because

a) The atomic size of Al > Mg b) The atomic size of Al < Mg c) Al has one unpaired electron in p-orbital d) The atomic number of Al > Mg

142. The ionization potential of nitrogen is

a) Same as that of oxygen b) Less than that of oxygen c) Greater than that of oxygen d) None of the above

143. Which of the following sets of elements is arranged in order of increasing electronegativity based on Pauling scale?
a) S, Si, P b) P, S, Si c) S, P, Si d) P, Si, S

144. For Be, $Z_{eff} = 1.95$ and for Be^{x+}, $Z_{eff} = 2.30$. Hence, ion is
a) Be^{+} b) Be^{2+} c) Be^{3+} d) Be^{0}

145. Ionic hydrides react with water to give
a) A basic solution b) An acidic solution c) A hydride ion d) Protons

146. Going down in a group from F to I, which of the following properties increases
a) Ionic radius b) Ionization energy c) Oxidizing power d) Electronegativity

147. In which case bond length is shortened?
a) When multiplicity occurs between atoms b) When electronegativities are different c) In both cases d) None of the above cases

148. Ionization energy of the element $X(g)$ is I and the electron affinity of $X^{+}(g)$ is E then
a) $I = E$ b) $I = -E$ c) $I = \frac{E}{2}$ d) $I = -\frac{E}{2}$

149. The ionization energy of hydrogen is 13.6 eV and the first ionization energy of helium is 24.6 eV. Energy evolved in the following electron-gain process is
$He^{2+} + 2e^{-} \rightarrow He$
a) -49.2 eV b) -54.4 eV c) -27.2 eV d) -79.0 eV

150. Which pair is different from the others?
a) $Li - Mg$ b) $B - Si$ c) $Be - Al$ d) $Li - Na$

151. Pick out the property which is not shown by transition elements
a) Show variable oxidation state b) Impart colour to flame c) Are paramagnetic in nature d) Act as catalytic agents

152. The ions O^{2-}, F^{-}, Na^{+}, Mg^{2+} and Al^{3+} are isoelectronic. Their ionic radii show
a) An increase from O^{2-} to F^{-} and then decrease from Na^{+} to Al^{3+} b) A decrease from O^{2-} to F^{-} and then increase from Na^{+} to Al^{3+} c) A significant increase from O^{2-} to Al^{3+} d) A significant decrease from O^{2-} to Al^{3+}

153. Select the correct statement.
a) $(IE)_1$ of the corresponding elements of $3d$ and $4d$ series are almost similar b) $(IE)_1$ of $5d$-series elements are smaller than that of $3d$ and $4d$-series elements c) Both (a) & (b) are correct d) Both of the above are incorrect

154. Which set does not show correct matching?
a) Sc^{3+}[Ne] zero group b) Fe^{2+}[Ar]3d^6 VIII group c) Cr[Ar]3d^5 VIB group d) All of the above

155. The basic character of hydrides of group 15 (VA) is in which of the following order?
a) $NH_3 < PH_3 < BiH_3$ b) $NH_3 > PH_3 > AsH_3$ c) $NH_3 < PH_3 < AsH_3 < SbH_3$ d) None of the above

Multiple Correct Answers Type

156. The first element of a group in many ways differs from the other heavier members of the group. This is due to
a) The smaller size b) The high electronegativity and high ionization potential c) The unavailability of d-orbitals d) The higher shielding effect

157. Pick out the isoelectronic structures from the following:
(I) CH_3^{+} (II) H_3O^{+} (III) NH_3 (IV) CH_3^{-}:
a) I and II b) III and IV c) I and III d) II, III and IV

158. Which of the following compounds possesses zero dipole moment?
a) Water b) Benzene c) Carbon tetrachloride d) Boron trifluoride

159. Which of the following statements is/are true?
a) Metallic and covalent b) Atomic and ionic radii of c) Ionisation energy is d) The first ionisation

radii of potassium are 2.3 Å and 2.03 Å respectively	niobium and tantalum are almost same	inversely proportional to the screening effect	energies of Be and Mg are more than ionisation energies of B and Al respectively

160. An increase in both atomic and ionic radii with atomic number occurs in any group of the Periodic Table and in accordance with this the ionic radii of Ti(IV) and Zr(IV) ions are 0.68 Å and 0.74 Å respectively; but for Hf(IV) ion the ionic radius is 0.75 Å which is almost the same as that for Zr(IV) ion. This is due to

a) Greater degree of covalency in compound of Hf^{4+}	b) Lanthanide contraction	c) Difference in the coordination number of Zr^{4+} and Hf^{4+} in their compounds	d) Actinide contraction

161. Which of the following pairs of species have nearly same size?

a) Rb^+, O^{2-} b) Cl^-, Na^+ c) Mg^{2+}, Nad) Li^+, Mg^{2+}

162. Which form two or more chlorides?

a) Na b) Hg c) Cu d) Fe

163. Which of the following statements is/are correct?

a) The peroxide ion has a bond order of 1 while the oxygen molecule has a bond order of 2	b) The peroxide ions has a longer and weaker bond than the oxygen molecule has	c) The peroxide ion as well as the oxygen molecule are paramagnetic	d) The bond length of peroxide ion is greater than that of the oxygen molecule

164. Which statement(s) is/are correct?

a) A pi-bond is weaker than sigma-bond	b) A sigma-bond is weaker than pi-bond	c) A(=) bond stronger than single bond	d) A covalent bond is stronger than H-bond

165. Intermolecular H-bonding in HF makes it:

a) High b.p. liquid	b) Capable of forming two series of salt	c) Dibasic	d) Capable of forming acid salt

166. IE_2 for an element are invariably higher than IE_1 because:

a) The size of cation is smaller than its atom	b) It is difficult to remove $'e'$ from cation	c) IE is endothermic	d) All of the above

167. Which statement(s) is/are correct?

a) PF_3 has higher bond angle than PCl_3	b) Dipole moment of NH_3 is more than NF_3	c) I^+ is smaller than I^- ion	d) I^- is smaller than I^+ ion

168. The melting point of RbBr is 682°C while that of NaF is 988°C. The principal reason that the melting point of NaF is much higher than that of RbBr is that

a) The molar mass of NaF is smaller than that of RbBr	b) The bond in RbBr has more covalent character than the bond in NaF	c) The difference in electronegativity between Rb and Br is smaller than the difference between Na and F	d) The internuclear distance, $r_c + r_a$ is greater for RbBr than for NaF

169. Which among the following is/are linear?

a) BeF_2 b) $Ag(CN)_2^-$ c) CO_2 d) XeF_2

170. The isotone(s) of $^{76}_{32}Ge$ is/are:

a) $^{77}_{32}Ge$ b) $^{77}_{33}As$ c) $^{77}_{34}Se$ d) $^{78}_{34}Se$

171. Electrovalency is favoured by:

a) Low IE values b) High EA values c) High lattice energy d) None of these

172. Resonance occurs due to the:

a) Delocalization of a lone pair of electrons b) Delocalization of sigma-electrons c) Delocalization of pi-electrons d) Migration of protons

173. Which molecules(s) has/have V-shape?

a) H_2O b) $SnCl_2$ c) H_2S d) None of these

174. Which is/are correct order of ionic mobility?

a) $Li^+ < Na^+ < K^+$ b) $< Mg^{2+} < Al^{3+}$ c) $< Mg^{2+} < Na^+$ d) $< Na^+ < Li^+$

175. Resonance structures of a molecule should have:

a) Identical arrangement of atoms b) Nearly the same energy content c) The same number of paired electrons d) Identical bonding

176. Consider the following ionization steps

$M(g) \rightarrow M^+(g) + e^-, \quad \Delta H = 100$ eV

$M(g) \rightarrow M^{2+}(g) + 2e^-, \Delta H = 250$ eV

Select the correct statement(s)

a) $(IE)_1$ of $M(g)$ is 100 eV b) $(IE)_1$ of $M^+(g)$ is 150 eV c) $(IE)_2$ of $M(g)$ is 250 eV d) $(IE)_2$ of $M(g)$ is 150 eV

177. Select the correct statements

a) Ce, Pr and Nd are f-block elements b) Cu, Pd and Ni are d-block elements c) Cu([Ar]3d and K([Ar]4s have been placed in s-block d) Si, Ge and As are metalloids

178. The molecule(s) which show H-bonding is/are:

a) o-nitrophenol b) Water c) HCl d) Ethyl acetoacetate

179. The compound which contains both ionic and covalent bond is/are:

a) CH_4 b) NH_4OH c) KCN d) $K_4[Fe(CN$

180. When an isotope undergoes K-capture, its mass number

a) Remains the same while the atomic number increases by one b) Remains the same while the atomic number increases by two c) Remains the same while the atomic number decreases by one d) As well as the atomic number decreases by one

181. The octet rule is not obeyed in:

a) CO_2 b) BCl_3 c) PCl_5 d) SiF_4

182. The species that does not contain peroxide bond is/are:

a) PbO_2 b) H_2O_2 c) MnO_2 d) BaO_2

183. Which combination(s) given below is/are correct?

a) $HgCl_2$-linear b) ClF_3-T-shaped c) ICl_4^--square planar d) XeF_6-pentagonal bypyrami

184. A, B, C are three substances. A does not conduct electricity in the solid or liquid state. B conducts electricity both in the fused and solution states, while C conducts electricity only in the solution state. Which of the following statement(s) is/are true regarding A, B and C?

a) A has polar covalent linkage b) A has non-polar covalent linkage c) B is ionic in nature d) C has polar covalent linkage

185. Which of the following statements is/are correct?

a) CH_3^+ shows sp^2-hybridization whereas CH_3^- shows sp^3-hybridization b) NH_4^+ has a regular tetrahedral geometry c) sp^2-hybridized orbitals have equal s- and p-character d) Hybridized orbitals always form σ-bonds

186. The type of bond(s) present in ammonium chloride is/are

a) Ionic b) Covalent c) Coordinate d) None of these

187. Which of the following is/are coloured and paramagnetic?
a) Cu^+ b) NO_2 c) $[Fe(H_2O)$ d) $[Al(OH)_4$

188. Which of the following compounds contain both ionic and covalent bonds?
a) NH_4Cl b) KCN c) $CuSO_4, 5H$ d) NaOH

189. Select the correct statement(s)
a) Cs^+ is more highly hydrated that the other alkali metal ions b) Among the alkali metals Li, Na, K and Rb, lithium has the highest melting point c) Ionic mobility of Li^+ is maximum among Li^+, Na^+ and K^+ ions d) Ionization potential of Li is smaller than that of Na

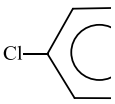
190. The linear structure is assumed by:
a) $SnCl_2$ b) NCO^- c) CS_2 d) NO_2^+

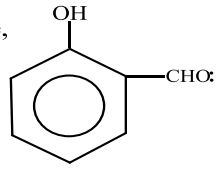
191. Which possess fractional bond order?
a) O_2^+ b) O_2^- c) H_2^+ d) N_2

192. Which of the following elements have the similar value of electronegativity?
a) Te b) S c) P d) H

193. Chlorine atom does not differ from chlorine ion in the number of which of the following?
a) Neutrons b) Electrons c) Size d) Protons

194. Ionization energy is influenced by:
a) Size of atom b) Charge on the nucleus c) Electrons present in inner shells d) None of the above

195. Which has/have zero value of dipole moment?
a) $[Ni(CN)_4$ b) $CHCl_3$ c) CO_2 d) 

196. The molecule, 

a) Has intermolecular H-bonding b) Has intermolecular H-bonding c) Reduces Tollen's reagent d) Is steam-volatile

197. Which of the following conditions apply to resonating structures?
a) The contributing structures should have similar energies b) The contributing structures should be represented such that unlike charges reside on atoms that far apart c) The electropositive element should always has positive charge and the electronegative element negative charge d) The contributing structures must have the same number of unpaired electrons

198. Which has/have magnetic moment?
a) $[Fe(H_2O)$ b) $[Ni(CN)_4$ c) $[Fe(CN)_6$ d) O_2

199. The factors that influence the ionization energies are
a) The size of the atom b) The charge on the nucleus c) How effectively the inner electrons screen the nuclear charge d) The atomic mass

200. In which, central atom(s) has/have one lone pair of electron?
a) Cl_2 b) NH_3 c) PCl_3 d) XeF_6

201. Which of the following force(s) is/are weak?
a) Covalent forces b) Van der Waals' forces c) Coulombi forces d) London forces

202. Stability of ions of Ge, Sn and Pb will be in order
a) $Ge^{2+} < Sn^{2+} < Pb^{2+}$ b) $Pb^{4+} < Sn^{4+} < Ge^{4+}$ c) $Sn^{2+} < Sn^{4+}$ d) $Pb^{4+} < Pb^{2+}$

203. Which one of the following arrangements does not give the correct picture of the trends indicated against it?
a) $F_2 > Cl_2 >$ b) $F_2 > Cl_2 >$ c) $F_2 > Cl_2 >$ d) $F_2 > Cl_2 >$

$Br_2 > I_2$: Electron gain enthalpy	$Br_2 > I_2$: bond dissociation energy	$Br_2 > I_2$: Electronegativity	$Br_2 > I_2$: Oxidising power

204. The properties that show similar trends down the group among the elements of group 1 to 17, is/are

a) Metallic character	b) Reactivity	c) Electronegativity	d) Melting or boiling points

205. Which of the following have a dipole moment?

a) 2,2,3,3-tetramethyl	b) $Trans$-2-pentene	c) Cis-1, 2-dichloroethene	d) $Trans$-1, 2-dichloroethene

206. Which of the following statements is/are correct regarding ionic compounds?

a) They are good conductors at room temperature	b) They are generally soluble in polar solvents	c) They consist of ions	d) They generally have high melting and boiling points

Assertion - Reasoning Type

This section contain(s) 0 question(s) numbered 207 to 206. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

207

Statement 1: If difference of electronegativity between two atoms is zero the resultant molecule will be non-polar covalent

Statement 2: The shared pair of electron lies just in the middle of two atoms

208

Statement 1: PCl_5 conducts current in solid state

Statement 2: PCl_5 exists as $[PCl_4]^+$ and $[PCl_6]^-$ ions

209

Statement 1: Solubility of NaOH in water increases with rise in temperature, although it is exothermic dissolution

Statement 2: Changes showing exothermic nature occurs in backward direction if temperature is raised

210

Statement 1: The electron attachment enthalpy of fluorine is more negative than that of chlorine

Statement 2: All alkaline earth and noble gas elements have positive value of electron attachment enthalpies

211

Statement 1: N and P show a maximum covalency of five

Statement 2: P can expand the outer shell of electrons beyond an octet by involving d-orbitals present in its valence shell

212

Statement 1: Shielding effect increases as we go down the group

Statement 2: More is the electrons in the penultimate shell, more is shielding

213

Statement 1: The lattice energy of silver halides is AgF $> AgCl > AgBr > AgI$

Statement 2: AgF is water soluble

214

Statement 1: The bond angle in H_2O is greater than H_2S

Statement 2: H-bonding does not occur in H_2S due to low electronegativity of S

215

Statement 1: Manganese has a less favourable electron affinity than its neighbours in either side

Statement 2: The magnitude of an element's electron affinity depends on the element's valence shell electrons configuration

216

Statement 1: Plutonium among the transuranic elements is the longest lived element.

Statement 2: Plutonium is not radioactive.

217

Statement 1: NH_3 and CH_3^- both have pyramidal shape

Statement 2: N in NH_3 and C in CH_3^- both have sp^3-hybridization with one lone pair of electron on each

218

Statement 1: The bond angle in BF_3 is smaller than that in BF_4

Statement 2: BF_3 has sp^2-hybridization, whereas BF_4^- has sp^3-hybridization

219

Statement 1: The ionisation energy of $_1H^2$ is more than ionisation energy of $_1H^1$

Statement 2: This is due to isotopic effect

220

Statement 1: Atomic size of silver is almost equal to that of gold.

Statement 2: *d*-subshell has low penetration power and produce poor shielding.

221

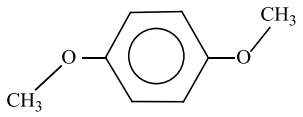
Statement 1: F atom has less electron affinity than Cl atom

Statement 2: Additional electrons are repelled more effectively by $3p$-elctrons in Cl atom than by $2p$-electrons in F atom

222

Statement 1: *p*-dimethoxy benzene is polar molecule

Statement 2: The two methoxy groups at para positions are located as



223

Statement 1: The molecule cis-1-chloropropene is more polar than $trans$-1-chloropropene

Statement 2: The magnitude of resultant vector in $trans$-1-chloro-propene is non-zero

224

Statement 1: The first ionization energy of Be is greater than B.

Statement 2: $2p$- orbitals have lower energy than $2s$- orbitals .

225

Statement 1: The dipole moment of NF_3 is more than NH_3

Statement 2: The presence of lone pair of electron on N shows an additive contribution in dipole moment of NH_3 whereas it shows a negative contribution towards dipole moment of NF_3

226

Statement 1: E_{A_2} for halogens is endothermic

Statement 2: Halogens have ns^2np^5 configuration and can accommodate only one electron

227

Statement 1: In any period, the radius of the noble gas is lowest

Statement 2: He has the highest IE in the Periodic Table

228

Statement 1: Nobel gases have large positive electron gain enthalpy.

Statement 2: Electron has the enter the next higher principal quantum level.

229

Statement 1: P − Cl bond in PCl_3 and PCl_5 had different bond energy

Statement 2: P in PCl_3 and PCl_5 is sp^3-hybridized

230

Statement 1: The first ionisation energy of N is greater than O

Statement 2: N atom has half filled p-orbitals

231

Statement 1: Sulphur atom has higher electron affinity than oxygen.

Statement 2: Oxygen is more electronegative than sulphur, that's why can hold electron better.

232

Statement 1: IF_7 is super octet molecule

Statement 2: Central atom of I in IF_7 has 14 electrons

233

Statement 1: $FeCl_2$ is more covalent than $FeCl_3$ because electro negativity of $Fe^{3+} > Fe^{2+}$

Statement 2: Higher is the charge on cation, more is deformation of anion, more is covalent character

234

Statement 1: Solubility of NaCl in D_2O is less than, H_2O

Statement 2: Higher viscosity of D_2O I responsible for low solubility of NaCl

235

Statement 1: The bond energy of P − Cl bond in PCl_3 and PCl_5 are different

Statement 2: In PCl_3, $sp^3 - p$ overlapping whereas in PCl_5, $sp^3d - p$ overlapping is noticed

236

Statement 1: BF_3 molecule is planar with an angle of 120°C

Statement 2: BF_3 has bond pair-lone pair electron ratio 1 : 3

237

Statement 1: First ionization energy for nitrogen is lower than oxygen.

Statement 2: Across a period effective nuclear charge decreases.

238

Statement 1: SF_4 has lone pair of electron at equatorial position in preference to apical position in the overall trigonal bipyramidal geometry

Statement 2: If lone pair is at equatorial position then only repulsion is minimum

239

Statement 1: All molecules with polar bond have dipole moment

Statement 2: Dipole moment is a vector quantity

240

Statement 1: Isoelectronic species are having same number of electrons but different radii.

Statement 2: Higher the charge, smaller the ion.

241

Statement 1: The dipole moment of NH_3 is less than NF_3

Statement 2: The lone pair present on N shows additive nature to N − H vector whereas it is

subtractive to N − F vector

242

Statement 1: MO configuration of CO is $\sigma 1s^2, \sigma^* 1s^2\ \sigma 2s^2, \sigma 2p_x^2, \pi 2p_y^2, \pi$

Statement 2: The bond energy level $\sigma^* 2s^2$ possesses higher energy because then only bond length order for CO (more) and CO^+ (less) can be explained

243

Statement 1: IE_1 for He is maximum and EA_1 for Cl is more than E_{A_1} of F

Statement 2: He possesses electrons in 1s sub-shell, closest to nucleus, whereas electron density in F is maximum which exerts more electron-electron repulsion

244

Statement 1: Known elements may contain as many as 32 electrons in an energy level but only *s* and p sublevel electrons are considered for the octet rule.

Statement 2: For any atom, electrons present in *s*- and *p*- subshells assume greater stability.

245

Statement 1: Ionisation energy of nitrogen (7) is more than that of oxygen (8)

Statement 2: Half-filled p-orbitals in nitrogen ($2p^3$) are more stable

246

Statement 1: The first ionisation energy of Be is greater than that of B

Statement 2: 2p-orbital is lower in energy than 2s-orbital

Matrix-Match Type

This section contain(s) 0 questions. Each question contains Statements given in 2 columns which have to be matched. Statements in **columns I** have to be matched with Statements in **columns II**.

247. Match the element (in Column I) with its unique properties (in Column II)

Column-I	Column- II
(A) F	(1) Maximum ionization energy
(B) Cl	(2) Maximum electronegativity
(C) Fe	(3) Maximum electronaffinity
(D) He	(4) Recently named by IUPAC
(E) Ds	(5) Variable valency

Codes :

	A	B	C	D	E
(a)	3	4	2	5	1
(b)	1	2	3	4	5
(c)	2	3	5	1	4
(d)	5	1	4	3	2

248. Match the type of elements (in Column I) with the corresponding electronic configuration (in Column II)

Column-I	Column- II
(A) Inert gas elements	(1) ns^1 to ns^2np^5
(B) Main group elements	(2) $1s^2$ to ns^2np^6
(C) Transition elements	(3) $(n-2)f^{1-14}$ $(n-1)s^2p^6d^{10}ns^2$
(D) Inner transition elements	(4) $(n-1)d^{1-9}ns^2$
	(5) $(n-1)d^{10}ns^2$

Codes :

	A	B	C	D
(a)	1	2	3	4
(b)	2	1	4	3
(c)	4	3	2	1
(d)	3	4	1	2

249 The correct match of contents in Column I with

. those in column II is

Column-I	Column- II
(A) He	(1) High electron affinity
(B) Cl	(2) Most electropositive element
(C) Ca	(3) Strongest reducing agent
(D) Li	(4) Highest ionisation energy

Codes :

	A	B	C	D
(a)	3	1	2	4
(b)	4	3	2	1
(c)	2	4	1	3
(d)	1	2	3	4
(e)	4	1	2	3

250 Match the atomic number (in Column I) with
. its IUPAC nomenclature (in Column II)

Column-I	Column- II
(A) 105	(1) Uuh
(B) 107	(2) Uun
(C) 109	(3) Uns
(D) 110	(4) Unp
(E) 116	(5) Une

Codes :

	A	B	C	D	E
(a)	4	3	5	2	1
(b)	1	2	3	4	5
(c)	2	5	4	3	2
(d)	5	1	2	5	4

251 Match atomic number of elements (in Column
. I) with position of elements in the Periodic Table (in Column II)

Column-I	Column- II
(A) 19	(1) p-block
(B) 22	(2) f-block
(C) 32	(3) d-block
(D) 64	(4) s-block

Codes :

	A	B	C	D
(a)	4	3	1	2
(b)	3	4	2	1
(c)	2	1	3	4
(d)	1	2	4	3

252
.

Column-I	Column- II
(A) Melting point	(1) $O^{2-} < O^{-} < O < O^{+}$
(B) Thermal stability	(2) $F^{-} < Cl^{-} < Br^{-} < I^{-}$
(C) Polarisability	(3) $HI < HBr < HCl < HF$
(D) Electron affinity	(4) $XeF_6 < XeF_4 < XeF_2$

Codes :

	A	B	C	D
(a)	4	3	2	1
(b)	2	1	4	3
(c)	3	2	1	4
(d)	1	4	3	2

Linked Comprehension Type

This section contain(s)0 paragraphs. Based upon each paragraph, multiple choice questions have to be answered. Each question has at least 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 253 - 252

Ionic radius is the effective distance from the nucleus of an ion up to which it has its influence on

its electron cloud. A cation is always much smaller than the corresponding atom. Further more the number of electrons removed, smaller will be the size of the resulting positive ion. For example
$r_{Fe} > r_{Fe^{2+}} > r_{Fe^{3+}}$
A cation formed by the loss of electrons may result in the complete disappearance of the outer shell and since, the remaining inner shells do not extend so far in space, the cation is much smaller than the metal atom. For example

$$\underset{(2,8,1)}{Na} \longrightarrow \underset{(2,8)}{Na^{+}}$$

In case of isoelectronic ions, the greater the nuclear charge, the greater is the attraction for electrons and smaller is ionic radius

253. The size of the species Pb, Pb^{2+} and Pb^{4+} decreases as
a) $Pb^{4+} > Pb > Pb^{2+}$ b) $Pb^{2+} > Pb^{4+} > Pb$ c) $Pb > Pb^{2+} > Pb^{4+}$ d) $Pb^{4+} > Pb^{2+} > Pb$

Paragraph for Question Nos. 254 - 254

Just as energy is required to remove an electron from an atom, energy is generally released when an electron is added to a neutral atom. When an electron is added to a neutral gaseous atom to convert it into a negative ion, the enthalpy change accompanying the process is called the electron gain enthalpy ($\Delta_{eg}H$). It provides a quantitative measure of the ease with which an atom adds an electron to form anion
$X(g) + e^- \rightarrow X^-(g) + \text{Energy}$
Electron gain enthalpy, like ionisation potential, is expressed in electron volt/atom or kcal/mol or kJ/mol. Electron gain enthalpy of chlorine is -349 kJ/mol. This means that 349 kJ of energy is released when one mole of chlorine atoms (6.02×10^{23} atoms) change into Cl^- ions
$Cl(g) + e^- \rightarrow Cl^-(g) + 349$ kJ
$Cl(g) + e^- \rightarrow Cl^-(g)\ \ \Delta_{eg}H = -349\ \text{kJ mol}^{-1}$

254. Second electron gain enthalpy
a) Can be positive or negative b) Is always zero c) Is always negative (energy is released) d) Is always positive (energy is absorbed)

Paragraph for Question Nos. 255 - 255

Following questions are based on Sc($Z = 21$)

255. Out of Sc^{3+}, Sc^{2+} and Sc^+ paramagnetic as well coloured ions are
a) Sc^+, Sc^{2+} b) Sc^+, Sc^{3+} c) Sc^{2+}, Sc^{3+} d) d-block element

Paragraph for Question Nos. 256 - 256

Following rule in general, classifies p-block elements into metals, non-metals and metalloids (where P is the period and N the valence electrons)
$(P + 1) > N$, the element would be metal
$(P + 1) < N$, the element would be non-metal
$(P + 1) = N$, the element would be metalloid
Answer the following question

256. Metalloid will be out of elements with atomic number 13, 14, 15, 16
a) 13 b) 14 c) 15 d) 16

Paragraph for Question Nos. 257 - 257

In the following table I_1, I_2 and I_3 of the main group elements in 2nd period have been given

	Li	Be	B	C	N	O	F	Ne
I_1	513	899	801	1086	1402	1314	1681	2080
I_2	7298	1757	2427	2352	2856	3388	3374	3952
I_3	11815	14848	3660	4620	4578	5300	6050	6122

Answer the following questions based on the above table

257. There is increase in ionization energy along a period going Li to Ne, but I_1 of B is less than that of Be. This is due to
a) Valence electron in B is in $2p$-orbital of higher energy than that of Be in $2s$-orbital of lower energy b) Removal of paired electron in Be requires higher energy than that of removal of unpaired electron in B c) Both (a) and (b) d) None of the above

Paragraph for Question Nos. 258 - 258

The sums of first and second ionization energies

and those of third and fourth ionization energies (in MJ mol^{-1}) of nickel and platinum are

	$(IE)_1 + (IE)_2$	$(IE)_2 + (IE)_4$
Ni	2.49	8.80
Pt	2.66	6.70

Based on this information, answer the following questions

258. Most common oxidation states of Ni and Pt are respectively
a) $+2, +2$ b) $+4, +2$ c) $+2, +4$ d) $+4, +4$

Paragraph for Question Nos. 259 - 259

The $(IE)_1$ and the $(IE)_2$ on kJ mol^{-1} of a few elements designated by Roman numerals are shown below

Element	$(IE)_1$	$(IE)_2$
A	2372	5251
B	520	7300
C	900	1760
D	1680	3380

Based on the above information, answer the following questions

259. Which of the above elements is likely to be a reactive metal?
a) A b) B c) C d) D

Paragraph for Question Nos. 260 - 260

Consider the following table comparing ionic radius

Ion →	**N^{3-}**	**O^{2-}**	**F^-**	**Na^+**	**Mg^{2+}**
Number of electron	10	10	10	10	10
Number of nuclear protons	7	8	9	11	12
Ionic radius (pm)	146	140	133	98	79

Answer the following questions.

260. Select the correct alternate(s) in term of size
a) $Na > Na^+$ b) $Mg > Mg^+ > Mg^{2+}$ c) $F^- > F$ d) $O^{2-} > O^- > O$

Paragraph for Question Nos. 261 - 261

The heats of formation ($\Delta H_f°$) of the oxides of the third period, sodium to chlorine, are in kJ mol^{-1}

Na_2O MgO Al_2O_3 SiO_2 P_4O_{10} SO_3 Cl_2O_7

-416 -602 -1676 -911 -2984 -395 $+250$

Based on these data, answer the following questions

261. Which oxide has maximum negative heat of formation per oxygen atom?
a) P_4O_{10} b) Al_2O_3 c) Na_2O d) MgO

Paragraph for Question Nos. 262 - 262

The singly-bonded metallic radius of Na is 157 pm. Assume that the increment between radii of different magnitudes is 60 pm
Answer the following questions

262. The covalent radius of Na is
a) 157 pm b) 97 pm c) 217 pm d) 267 pm

Paragraph for Question Nos. 263 - 263

Following species have been given. Assign the species (by its number) showing the indicated property

(1) LiCl (2) $AlCl_3$ (3) Al_2O_3 (4) BaO
(5) LiH (6) Cl_2
(7) F_2 (8) Br_2 (9) $MgCl_2$

263. Which is maximum hydrated?
a) 4 b) 3 c) 2 d) 1

Paragraph for Question Nos. 264 - 264

Dipole moment of a bond is a vector and physical quantity to calculate the percentage ionic character in a covalent bond. It is expressed as:
Dipole moment $(\mu) = \vec{\delta} \times d$
Where, δ is dipole moment and d is the bond length
It is usually expressed in terms of CGS unit known as Debye (D)$1D = 10^{-18}$ esu cm. In SI unit it is expressed in coulomb meter. Resultant dipole moment (μ_R) of two bond moments (μ_1 and μ_2) acting at an angle θ, is given by:

$$\mu_R = \sqrt{\mu_1^2 + \mu_2^2 + 2\mu_1\mu_2 \cos\theta}$$

If $\mu_1 = \mu_2$, also if $\cos\theta = -1, i.e., \theta = 180°$ then $\mu = 0$ (molecule is nonpolar)
If $\mu \neq 0$ molecule is polar.
Dipole moment plays an important role in deciding the stability order of alkanes, $i.e.$, a more stable alkane has less dipole moment. The dipole moment of a molecule can predict the geometrical and position isomers as well as orientations in benzene nucleus and polarity of molecule

264. Dipole moment of HCl molecule is found to be 0.816 D. Assuming HCl bond length to be equal to 1 Å, the % ionic character of HCl molecule is:
a) 10% b) 17% c) 27% d) 37%

Integer Answer Type

: ANSWER KEY :

1)	b	2)	b	3)	a	4)	b
5)	a	6)	a	7)	a	8)	a
9)	d	10)	c	11)	c	12)	a
13)	a	14)	b	15)	c	16)	c
17)	c	18)	b	19)	a	20)	a
21)	d	22)	b	23)	a	24)	d
25)	b	26)	d	27)	c	28)	c
29)	a	30)	a	31)	c	32)	d
33)	c	34)	c	35)	c	36)	b
37)	d	38)	b	39)	c	40)	b
41)	d	42)	c	43)	d	44)	b
45)	a	46)	a	47)	d	48)	c
49)	a	50)	a	51)	a	52)	a
53)	c	54)	c	55)	c	56)	c
57)	b	58)	d	59)	a	60)	d
61)	a	62)	b	63)	b	64)	d
65)	a	66)	a	67)	c	68)	d
69)	c	70)	b	71)	c	72)	d
73)	b	74)	d	75)	d	76)	a
77)	c	78)	a	79)	d	80)	a
81)	a	82)	c	83)	c	84)	c
85)	b	86)	a	87)	d	88)	c
89)	d	90)	c	91)	d	92)	a
93)	b	94)	a	95)	b	96)	d
97)	d	98)	a	99)	b	100)	a
101)	d	102)	a	103)	a	104)	a
105)	a	106)	c	107)	c	108)	d
109)	c	110)	c	111)	a	112)	b
113)	b	114)	a	115)	a	116)	c
117)	a	118)	b	119)	d	120)	a
121)	d	122)	a	123)	b	124)	b
125)	c	126)	b	127)	c	128)	a
129)	c	130)	c	131)	c	132)	a
133)	c	134)	d	135)	a	136)	d
137)	b	138)	c	139)	b	140)	c
141)	c	142)	c	143)	b	144)	d
145)	a	146)	a	147)	c	148)	b
149)	d	150)	d	151)	b	152)	d
153)	a	154)	a	155)	b	156)	a,b,c
157)	b,d	158)	b,c,d	159)	a,b,c,d	160)	b
161)	a,d	162)	b,c,d	163)	a,b	164)	a,c,d
165)	a,b,c,d	166)	a,b	167)	a,b,c	168)	d
169)	a,b,c,d	170)	b,d	171)	a,b,c	172)	a,c
173)	a,b,c	174)	a,c	175)	a,b	176)	a,b,d
177)	a,b,d	178)	a,b,d	179)	b,c,d	180)	c
181)	b,c	182)	a,c	183)	a,b,c	184)	b,c,d
185)	a,b,d	186)	a,b,c	187)	b,c	188)	a,b,c,d
189)	b	190)	b,c,d	191)	a,b,c	192)	a,c,d
193)	a,d	194)	a,b,c	195)	a,c,d	196)	b,d
197)	a,b,c,d	198)	a,c,d	199)	a,b,c	200)	b,c,d
201)	b,d	202)	a,b,c,d	203)	a,b	204)	a,c
205)	b,c	206)	b,c,d	207)	c	208)	b
209)	d	210)	d	211)	b	212)	a
213)	d	214)	d	215)	b	216)	c
217)	c	218)	b	219)	c	220)	b
221)	a	222)	a	223)	b	224)	c
225)	b	226)	b	227)	d	228)	a
229)	a	230)	c	231)	b	232)	c
233)	b	234)	c	235)	c	236)	d
237)	d	238)	c	239)	b	240)	c
241)	b	242)	c	243)	c	244)	b
245)	a	246)	a	247)	c	248)	b
249)	c	250)	a	251)	a	252)	a
253)	b	254)	d	255)	a	256)	b
257)	c	258)	c	259)	b	260)	a,b,c,d
261)	d	262)	a	263)	c	264)	b
265)	8	266)	5	267)	1	268)	7
269)	6	270)	2	271)	2	272)	1
273)	6	274)	5	275)	2	276)	3
277)	1	278)	7	279)	3	280)	5
281)	6	282)	7	283)	2	284)	4
285)	4	286)	7	287)	5	288)	3
289)	6	290)	4	291)	4		

: HINTS AND SOLUTIONS :

Single Correct Answer Type

1 **(b)**

Fe(26): $[Ar]3d^6 4s^2$

Fe^{3+}: $[Ar]3d^5$

3 **(a)**

(a) Ionic (A) — Amphoteric (B) — Giant (C)

Na_2O — Al_2O_3 — SiO_2

Oxide Acidic

Basic

Thus, atomic number increases in the order

$A < B < C$

4 **(b)**

First long period starts with 3rd period [K(19) − Kr(36)]

Thus, total = 18 elements

6 **(a)**

Ni^{2+} is smallest in size

7 **(a)**

K(19) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$

$K^+(19)$ $1s^2 2s^2 2p^6 3s^2 3p^6$ Colourless ion due to lack of electron in d-orbitals

Thus, (a) is incorrect

10 **(c)**

E.C. of K = 19 in the absence of Aufbau rule is

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$

↑

Last-filling electron goes into d-orbital

Thus, d-block element

11 **(c)**

$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$

Basic oxide

$ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$

Acidic oxide

14 **(b)**

A (1.2) is electropositive element

B (3.4) is electronegative element

Thus, ionic bond is formed

15 **(c)**

(b) and (d) with s^2p^6 configuration has zero values of EA

Cl(c) with empty d-orbital has greater EA than F(a)

17 **(c)**

PbO is soluble in NaOH − an acidic oxide

PbO is soluble in HCl − a basic acid

18 **(b)**

Radius decreases along a period left to right

B C N O F

max. 70 pm

Thus, covalent radius of B would be higher than that of N

19 **(a)**

Smaller the size of anion, smaller the polarizing power and thus larger the ionic character of NaX.

Thus, ionic character

$NaI < NaBr < NaCl < NaF$

and mp : $NaI < NaBr < NaCl < NaF$

20 **(a)**

(a) Li − Mg diagonal relationship

(b) Na − K

(c) Ca − Mg } same group

(d) B − Al

21 **(d)**

$X(g) + e^- \rightarrow X^-(g), \quad \Delta H = x$

(EA of $X(g)$)

$X^-(g) \rightarrow X(g) + e^-, \quad \Delta H = y =$ IE of

$X^-(g) = -$EA of $X(g)$

Thus, (a), (b), (c) true

22 **(b)**

Elements in a group have same (EC) in valence shell

25 **(b)**

Ce (58)$[Xe]_{54}$ $4f^1 5d^1 6s^2$

Thus, Ce^{4+} has [Xe] configuration

27 **(c)**

Atomic number 113 belong to p-block (Group IIIA)

Probable oxidation states are +1, +3, but due to inert-pair effect

stability of $+1 > +3$

Thus, M^+

29 **(a)**

Cl_2O_7 Cl = +7

30 **(a)**

Going down the group effective nuclear charge remains almost constant, hence (IE) is dependent on radius of two element

32 **(d)**

(IV) B contain C, Si, Ge, Sn, Pb

Ge, Sn, Pb are strongly electropositive

33 **(c)**

Isoelectronic N(7) and O^+(8) have same EC

$\left.\begin{matrix}N(7)\\O^+(8)\end{matrix}\right]$ $1s^2 2s^2 2p^3$

1	1	1

$2p_x^1\ 2p_y^1\ 2p_z^1$

Most stable due to all unpaired electrons

$O_8]$ $1s^2 2s^2 2p^4$

1↓	1	1

Less stable than O^+ and N

Since Z of $O^+ > Z$ of N

Hence IP of $O^+ > N$

Na with only one unpaired electron in $3s^1$ has lowest IP

34 **(c)**

$Mg \rightarrow Mg^+ + e^-$ $(IE)_1$

$Mg^+ \rightarrow Mg^{2+} + e^-$ $(IE)_2$

$Mg^{2+} \rightarrow Mg^{3+} + e^-$ $(IE)_3$

$(IE)_1 < (IE)_2 < (IE)_3$

35 **(c)**

$M(g) \rightarrow M^+(g) + e^-, I_1(M) = \Delta H_1 = 100$ eV

(a) is correct

$M^+(g) \rightarrow M^{2+}(g) + e^-, I_2(M) = 250 - 100 = 150$ eV

or $I_2(M^+) = 150$ eV (b) is correct

I_2 of M(g) is 150 eV thus (c) is incorrect

36 **(b)**

$Pb^{4+} + 2e^- \rightarrow Pb^{2+}$

Stability of $Pb^{2+} > Pb^{4+}$

Hence, Pb^{4+} is reduced most easily and is thus best oxidizing agent

37 **(d)**

Valence shell electronic configuration is $d^5 s^1$

Differentiating electron goes into d-orbitals. Thus, d-block element. Group VIB

38 **(b)**

$5f$-block elements

39 **(c)**

EC: $1s^2 2s^2 2p^6 3s^3 3p^6 4s^1$

(Total 19 electrons i.e. $Z = 19$)

It is K (alkali metals of Group 1)

Graded property will be that of same group

1. $[Ar]3d^{10}4s^1 -$ Cu group 11
2. $[Kr]4d^{10}5s^1 -$ Ag group 11
3. $[Kr]5s^1 -$ Rb group 1

43 **(d)**

$Na \xrightarrow{(IE)_1} Na^+$

$[Ne]3s^1$ $[Ne]$

$Na^+ \xrightarrow{(IE)_2} Na^{2+}$

Ne

Na^+ has stable inert gas configuration

Thus, $(IE)_2$ is very high

46 **(a)**

Size of $Li^+ < Na^+ < Rb^+ < Cs^+$

Hydration $Li^+ > Na^+ > Rb^+ > Cs^+$

Size of hydrated ion $Li^+ > Na^+ > Rb^+ > Cs^+$

Smaller the size, $Li^+ < Na^+ < Rb^+ < Cs^+$

Larger the hydration, hence larger the size of the hydrated ion (in aqueous solution)

Heavier the ion, smaller the ionic mobility

Size $Li^+ < Na^+ < K^+$

Hydration $Li^+ > Na^+ > K^+$

Ionic mobility $Li^+ < Na^+ < K^+$

Discharged at cathode $Li^+ < Na^+ < K^+$ (Most easiest)

47 **(d)**

He^+, Li^{2+} and Be^{3+} are isoelectronic of H atom (with one electron). Hence, single electron is not screened

48 **(c)**

As, Sb, Bi are group 15 having oxidation +3 and +5. Stability is in order

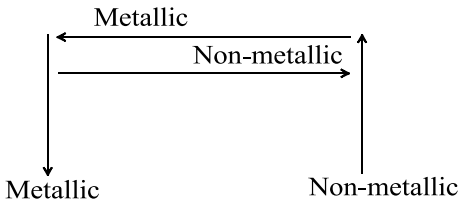
$As^{5+} > Sb^{5+} > Bi^{5+}$

$As^{3+} < Sb^{3+} < Bi^{3+}$ due to inert-pair effect

Thus, $BiCl_3$ is most stable

49 **(a)**

Smaller the (IE), greater the metallic nature



52 **(a)**

In case of Ne van der Waals' radius is taken. Hence, it should have maximum size out of the given option

54 **(c)**

Due to inert-pair effect, stability of

$Ga^{3+} > In^{3+} > Tl^{3+}$

and $Ga^+ < In^+ < Tl^+$

Thus, $Tl^{3+} + 2e^- \rightarrow Tl^+$

Is most spontaneous. Thus $\Delta G° < 0$ and is most negative

57 **(b)**

F is the most electronegative element which

cannot loose electron to other so it exhibits only−1 state. Na is alkali metal which can loose only one electron so exhibits only +1 state.

58 **(d)**

1. $NaH + H_2O \rightarrow NaOH + H_2$

Reducing nature

(b) $LiH \quad BeH_2 \quad BH_2 \quad CH_4 \rightarrow$ Covalent

Ionic ↓ NaH, KH

(c) $>C{=}O + LiAlH_4 \longrightarrow >CHOH$

59 **(a)**

Greater the electronegativity of $X(\text{Cl} > Br > I)$ greater the acid strength

Thus, I > II > III

60 **(d)**

Gd : $4f^7 5d^1$

Unpaired electrons = 8

Sum of spin $= 8 \times \frac{1}{2} = 4$

61 **(a)**

$Cu^+ \quad \underbrace{1s^2}_{(n-2)} \quad \underbrace{2s^2 2p^6}_{(n-1)} \quad \underbrace{3s^2 3p^6 3d^{10}}_{n}$

$\downarrow \qquad \downarrow \qquad \downarrow$

$S = \overbrace{2 \times 1} + \overbrace{8 \times 0.85} + \overbrace{17 \times 0.35} = 14.75$

(One d-electron is screened by 17 electrons in nth, 8 electrons in $(n-1)$ and 2 electrons in $(n-2)$

$Z_{\text{eff}} = 29 - 14.75 = 14.25$

62 **(b)**

$\underset{\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+}{\overset{\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Rb}^+ < \text{Cs}^+}{\longleftarrow}}$ Size

$\overset{\text{Maximum}}{\longleftarrow}$ Covalent nature MCl

$\overset{\text{Maximum}}{\longleftarrow}$ Lattice energy of MCl

$\overset{\text{Maximum}}{\longleftarrow}$ Thermal stability

63 **(b)**

(b) (a) NH_3, PH_3, AsH_3 ↓ acidic — correct

(b) Li < B < Be < C (IE)

Be has paired electron hence its (IE) is larger than that of B

Thus, (b) is incorrect

(c) Correct (d) correct

65 **(a)**

Atomic number (115) has E.C. has

$[\text{Rn}]_{86} 7s^2 5d^{10} 4f^{14} 7p^3$

Probable oxidation states are +3, +5

But due to inert pair effect M^{3+} is the most stable cation

66 **(a)**

Effective nuclear charge $Z_{\text{eff}} = Z - S$

Where, Z = atomic number

and S = screening constant

= 0.35 per electron for electron in nth orbit

= 0.85 per electron for electron in $(n-1)$th orbit

= 1.00 per electron for electrons in $(n-2)$th, $(n-3)$th, $(n-4)$th orbit

= 0.30 per electron in 1s-orbital (when alone)

Be $1s^2 2s^2$ one valence-electron in 2s is screened by one electron in $2s$-orbital (nth orbit) and two electrons in $1s$-orbital ($(n-1)$th orbit)

$\therefore S = 0.35 + 2 \times 0.85 = 2.05$

$\therefore Z_{\text{eff}} = 4 - 2.05 = 1.95$ (given)

Be^+ $1s^2 2s^1$ 2 s electron is screened by two electrons in $1s$-orbital ($(n-1)$th orbital)

$S = 2 \times 0.85 = 1.70$

$\therefore Z_{\text{eff}} = 4 - 1.70 = 2.30$

Be^{3+} $1s^1$ one electron in 1s-orbital (alone exists) is screened by another electron in same orbit.

Thus,

$S = 0.30$

$\therefore Z_{\text{eff}} = 4 - 0.30 = 3.70$

$\text{Be}^{3+} 1s^1$ no-screening (single electron)

Thus, $Z_{\text{eff}} = 4$

Thus, $Z_{\text{effective}}$: Be < Be^+ < Be^{2+} < Be^{3+}

67 **(c)**

(IP) of Na (11)<(IP) of Li(3)

69 **(c)**

$A \rightarrow A^+ + e^- \quad (\text{IP})_A < (\text{IP})_B$

$B + e^- \rightarrow B^- \quad (\text{EA})_B > (\text{EA})_A$

$(\text{EN})_B > (\text{EN})_B$

70 **(b)**

M^{3+}: $[\text{Ar}]3d^{10}4s^2$

M: $[\text{Ar}]3d^{10}4s^2 4p^3$

Three electrons have been removed from $4p$-suborbit

Thus, p-block element

72 **(d)**

$\begin{vmatrix} O & F \\ S & Cl \\ Se & Br \\ & I \end{vmatrix}$ Thus, $\begin{matrix} F < O \\ F^- < O^{2-} \\ Se > O \\ Se^{2-} > O^{2-} \end{matrix}$ $\begin{matrix} I > Br > F \\ I^- > Br^- > F^- \end{matrix}$

$I > Se$

$\therefore I^- > Se^{2-}$

Thus, $I^- > Se^{2-} > Br^- > O^{2-} > F^-$

73 **(b)**

A-19 s-block

B-22 d-block

C-32 p-block

D-64 f-block

79 **(d)**

Chalcogens are the elements of oxygen family:

Valence shell configuration : ns^2np^4

Group: 16

Block: p

81 **(a)**

$r_n = \dfrac{n^2 a_0}{Z_{\text{effective}}}$

Thus, $r_n \propto \frac{1}{Z_{\text{effective}}}$

82 **(c)**

NaH is an ionic hydride, others are covalent hydrides

83 **(c)**

Ni: $[Ar]3d^8 4s^2$

Last electron enters into $3d$-suborbit

Thus, d-block element

84 **(c)**

$X: ns^2np^1$

Valency $= +3$ (as in Al)

It can loss three electrons to attain stable configuration

$Y: ns^2np^3$

Valency $= -3$ (as in N)

It can gain five electrons to attain stable configuration

Thus, $X^{3+}\ Y^{3-}$ or XY

86 **(a)**

I^- is oxidized by Br_2, Cl_2, F_2

Br^- is oxidized by Cl_2, F_2

Cl^- is oxidized by F_2

89 **(d)**

Element	Valence electrons	Possible ion
A	3	A^{3+}
B	6	B^{2-}

$B + 2e^- \rightarrow B^{2-}$

8 electrons in valence shell (stable)

$A \rightarrow A^{3+} + 3e^-$

Stable

Thus, $A^{3+}B^{2-}A_2B_3$

90 **(c)**

$r_n \propto \dfrac{1}{Z}$

$Ti^{2+}(22) > Ni^{2+}(28)$

smaller

$Pt^{2+}(5d\text{-series})$

$Zr^{2+}(4d\text{-series})$

Have higher number of orbits

Hence, larger size

92 **(a)**

$^{m}_{115}A \rightarrow {}^{m-4}_{113}B + \alpha(^4_2He)$

93 **(b)**

$113 - 32 - 32 - 18 = 31$

Thus, 113 and 115 are placed as shown

IIIA	VA
Ga 31	33 As
In 49	51 Sb
Tl 81	81 Bi
$\underbrace{113}_{ns^2np^1}$	$\underbrace{115}_{ns^2np^3}$

Thus, these belong to p-block

95 **(b)**

Na^+, Mg^{2+} and Al^{3+} are isoelectronic

Size $Na^+ > Mg^{2+} > Al^{3+}$

Charge $+1$ $+2$ $+3$

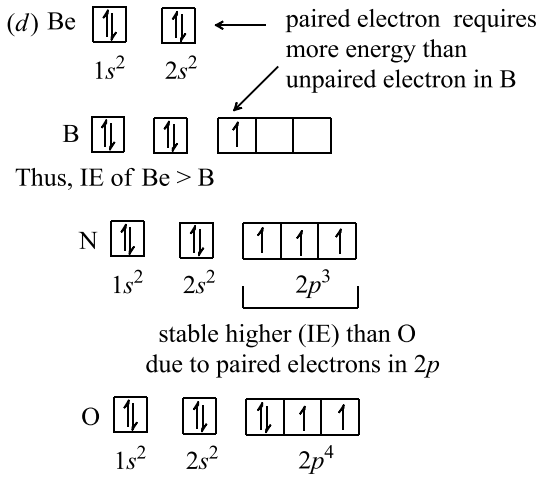
Smaller the size of cation,

Larger the charge,

Greater the hydration

Thus, $Na^+ < Mg^{2+} < Al^{3+}$

96 **(d)**



Thus, IE of N > 0

$(IE)_{Li>Na}$ due to smaller size of Li

$He \rightarrow He^+ + e^-$ $(IE)_1$

$He^+ \rightarrow He^{2+} + e^-$ $(IE)_2$

$(IE)_2 > (IE)_1$

Thus, (IE) of $He^+ > He$

Thus, (d) is incorrect

97 **(d)**

2. Na, K – Metals

3. F, Cl – Non-metals

4. Cu, Ag – Metals

5. B, Si – Metalloids

98 **(a)**

Na_2O is basic in nature and other oxides are acidic/basic/amphoteric

	SiO_2	P_2O_5	SO_3	Cl_2O_7
O. N. of element	+4	+5	+6	+7
Acidic nature	⟶ increases ⟶			

Thus, greater the acidic nature, greater the tendency of the reaction to occur

Thus, Cl_2O_7

100 **(a)**

$r_n = \dfrac{n^2 a_0}{Z_{\text{eff}}}$

Cs (alkali metal) has largest atomic radius

101 **(d)**

Lanthanides form $4f$-series

102 **(a)**

Size of $Li^+ < Na^+ < Rb^+ < Cs^+$

Hydration $Li^+ > Na^+ > Rb^+ > Cs^+$

Size of hydrated ion $Li^+ > Na^+ > Rb^+ > Cs^+$

Smaller the size, $Li^+ < Na^+ < Rb^+ < Cs^+$

Larger the hydration, hence larger the size of the hydrated ion (in aqueous solution)

103 **(a)**

$M \rightarrow M^+ + e^-$ $(IE)_1 = 100$ eV

$M \rightarrow M^{2+} + e^-$ $(IE)_2 = 150$ eV

$M^{2+} \rightarrow M^{3+} + e^-$ $(IE)_3 = 1500$ eV

$(IE)_3$ is very high indicating that M^{3+} is not formed easily. Thus, M^{3+} has attained inert gas configuration

$Be \rightarrow Be^+ + e^-$

$1s^2 2s^2 \quad 1s^2 2s^1$

$Be^+ \rightarrow Be^{2+} + e^-$

$1s^2 2s^1 \quad 1s^2$

104 **(a)**

$F + e^- \rightarrow F^-$

Can be reduced easily

106 **(c)**

$V(Z = 23) = [Ar]4s^2 3d^3$

$V^{x+} = ?$

⇅
$4s^2$

1	1	1		
$3d^3$				

If there are N unpaired electrons then

Magnetic moment $= \sqrt{N(N+2)}BM = 1.73$

$\therefore N(N+2) = 3$

$\therefore N = 1$

Thus, vanadium exists as V^{4+}

$V^{4+} = [Ar]3d^1$

Thus, vanadium chloride is VCl_4

107 **(c)**

1 1 5

↑ ↑ ↑

U u p

Thus, Uup

109 **(c)**

M^+ (alkali metal ion) has inert gas configuration. Thus, after M^+ is formed from M (by$(IE)_1$), further ionization to M^{2+} from M^+ (by$(IE)_2$) requires very high energy

110 **(c)**

Maximum charge

Least size

Maximum polarizing power

Thus, (c) [Note O^{2-} is anion]

111 **(a)**

Based on Fajan's rule

112 **(b)**

$113 - 32 - 32 - 18 = 31$

Thus, 113 and 115 are placed as shown

IIIA	VA
Ga 31	33 As
In 49	51 Sb
Tl 81	81 Bi
$\underbrace{113}_{ns^2np^1}$	$\underbrace{115}_{ns^2np^3}$

Thus, these belong to p-orbital

113 **(b)**

Element with atomic number 113 is placed in group 13 (IIIA) and has EC of valence shell as ns^2np^1

Si – Group 14

Ga – Group 13

Bi – Group 15

At – Group 17

114 **(a)**

$(IE)_1$ decreases regularly

117 **(a)**

$H^- \rightarrow H + e^-$

119 **(d)**

Greater the charge on cation smaller the size

1. $Ti^{4+}(Z = 22, \text{electron} = 18) > Mn^{7+}(Z = 25 \text{ electrons} = 18)$

2. $^{37}Cl^- = {}^{35}Cl^-(Z = 17)$

3. $K^+ < Cl^-$

4. $P^{3+} > P^{5+}$

Thus, correct

121 **(d)**

1. True

2. True

3. True

123 **(b)**

$O + e^- \rightarrow O^-$ (EA) < 0

$O^- + e^- \rightarrow O^{2-}$ (EA) > 0

132 **(a)**

$F_2 > Cl_2 > Br_2 > I_2$

137 **(b)**

$X(g) \rightarrow X^+(g) + e^-$ E_1 for $\frac{N_0}{2}$ atoms

$\frac{N_0}{2}$ atoms of $X(g)$ have been ionized, by energy $= E_1$

Thus, ionization energy $X(g) = \frac{2E_1}{N_0}$ per atom

$X(g) + e^- \rightarrow X^-(g)$ E_2 for $\frac{N_0}{2}$ atoms

Thus, electron affinity of $X(g)$ is $\frac{2E_0}{N_0}$ per atom

139 **(b)**

$(EN)_A = \frac{(EN)_A + (IE)_A}{2}$

$X = \frac{Y + (IE)_A}{2}$

$(IE)_A = 2X - Y$

140 **(c)**

(a) $r_n \propto \frac{1}{Z}$

$Na^+ > Mg^{2+} > Al^{3+}$

(b) $O^{2-} > F^- < Ne$

(c) Repulsive forces are balanced by attractive force

Thus, true

(d) $Mn^+ > Fe^{2+}$

143 **(b)**

$Si_{14}[Ne]3s^2 3p^2$

1	1	

2.8

$P_{15}[Ne]3s^2 3p^3$

1	1	1

2.1

$S_{16}[Ne]3s^2 3p^4$

1↓	1	1

2.5

Thus, P < S < Si

144 **(d)**

Effective nuclear charge $Z_{eff} = Z - S$

Where, Z = atomic number

and S = screening constant

= 0.35 per electron for electron in nth orbit

= 0.85 per electron for electron in $(n-1)$th orbit

= 1.00 per electron for electrons in $(n-2)$th, $(n-3)$th, $(n-4)$th orbit

= 0.30 per electron in 1s-orbital (when alone)

Be $1s^2 2s^2$ one valence-electron in 2s is screened by one electron in $2s$-orbital (nth orbit) and two electrons in $1s$-orbital ($(n-1)$th orbit)

$\therefore S = 0.35 + 2 \times 0.85 = 2.05$

$\therefore Z_{eff} = 4 - 2.05 = 1.95$ (given)

Be^+ $1s^2 2s^1$ 2 s electron is screened by two electrons in $1s$-orbital ($(n-1)$th orbital)

$S = 2 \times 0.85 = 1.70$

$\therefore Z_{eff} = 4 - 1.70 = 2.30$

Be^{3+} $1s^1$ one electron in 1s-orbital (alone exists) is screened by another electron in same orbit.

Thus,

$S = 0.30$

$\therefore Z_{eff} = 4 - 0.30 = 3.70$

$Be^{3+} 1s^1$ no-screening (single electron)

Thus, $Z_{eff} = 4$

Thus, $Z_{effective}$: $Be < Be^+ < Be^{2+} < Be^{3+}$

145 **(a)**

$2NaOH + 2H_2O \rightarrow 2NaOH + 2H_2$

Ionic hydride basic

148 **(b)**

$X(g) \rightarrow X^+(g) + e^-$, $\Delta H = I$

$X^+(g) + e^- \rightarrow X(g)$, $\Delta H = -I$

Thus, $I = -E$

149 **(d)**

$H(g) \rightarrow H^+(g) + e^-$ $(IE)_1 = 13.6$ eV

$He(g) \rightarrow He^+(g) + e^-$ $(IE)_1 = 24.6$ eV

$He^+(g)$ is now isoelectronic of H(g)

Thus, $IE(He^+) = (IE)_H(Z)^2 = 13.6 \times 2^2 = 54.4$ eV

Thus, $(IE)_1$ of He = 24.6 given

$(IE)_2$ of He = $(IE)_1$ of He^+ = 54.4 eV

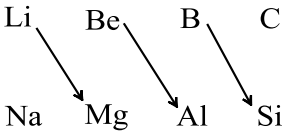
Thus, $He(g) \rightarrow He^{2+}(g) + 2e^-$

$(IE)_1 + (IE)_2 = 24.6 + 54.4 = 79.0$ eV

Hence, $He^{2+} + 2e^- \rightarrow He$ $\Delta H = -79.0$ eV

150 **(d)**

Except (d) all show diagonal relationship



151 **(b)**
Transition metals have very high (IE). They do not emit colour in flame

152 **(d)**

	O^{2-}	F^-	Na^+	Mg^{2+}	Al^{3+}
Z	8	9	10	11	12
Electron	10	10	10	10	10

$r_n \propto \frac{1}{Z}$

Thus, correct order is

$O^{2-} > F^- > Na^+ > Mg^+ > Al^{3+}$

154 **(a)**
Sc^{3+} 18 electrons
Thus, Z (atomic number = 21)
$[Ar]4s^2 3d^1$
Thus, IIIB group, thus given matching is incorrect

155 **(b)**
Smaller the size of element, greater the tendency to donate electron-pair. Thus, greater the basic nature

Multiple Correct Answers Type

159 **(a,b,c,d)**
(a)$r_{\text{metallic}} > r_{\text{covalent}}$ because covalent bond formation involves the overlapping of orbitals
(b)Due to lanthanide contraction
(c)If screening effect increases, the valence shell electron get loosely bound. Hence, ionisation energy decreases
(c)Be and Mg has ns^2 configuration, ie, stable configuration, thus have higher IE

161 **(a,d)**
Li and Mg show diagonal relationship, thus have same size. Rb^+ and O^{2-} also have similar size

192 **(a,c,d)**
Electronegativity of H (1.2), Te (2.1) and P (2.1) on Pauling's scale are similar but the electronegativity of S (2.5) is different from the other three elements

193 **(a,d)**
Number of protons (17) and neutrons (18) in Cl and Cl^- ion are equal. The ionic size of Cl^- ion is larger than that of Cl atom and also it has one electron more (18) than Cl (17)

204 **(a,c)**
Metallic character and electronegativity always follow the similar trends down the group among the elements of group 1 to 17

Assertion - Reasoning Type

207 **(c)**
Explanation is correct reason for statement

208 **(b)**
Solid ionic compounds conduct current only in fused state. PCl_5 in solid state exists as $[PCl_6]^-[PCl_4]^+$

209 **(d)**
Assertion is an experimental fact observed against Le Chatelier principle

210 **(d)**
All alkaline earth metals and noble gases have positive values of electron attachment enthalpies as they have ns^2 and ns^2np^6 (fully-filled) electronic configuration

Cl has more electron affinity than F because the more compact electronic configuration in F imparts greater electron repulsion to the incoming electron

211 **(b)**
N shows maximum covalence of +3 along with one coordinate bond whereas P shows maximum covalence of +5 due to given explanation

212 **(a)**
The phenomenon in which the penultimate shell, ie, $(n-1)$ electrons act as shield in between nucleus and valence shell electrons thereby reducing the effective nuclear charge is known as shielding effect

213 **(d)**
Inspite of higher lattice energy AgF is soluble because F^- is extensively hydrated and heat of hydration predominates over lattice energy

214 **(d)**
The bond angle in H_2S is smaller because S atom has bigger size than O. Also H_2S does not show H-bonding

215 **(b)**
$_{25}Mn = 3d^5, 4s^2$; $_{24}Cr = 3d^5, 4s^1$; $_{26}Fe = 3d^6, 4s^2$

Electron affinity of an element depends upon

electronic configuration

216 **(c)**
$^{38}_{94}$Pu has longest half-life period. It is used in breeder reactor as a fissionable nucleides and break up by slow neutrons and from fission product. It is a radioactive element.

217 **(c)**
Explanation is correct reason for statement

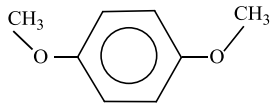
218 **(b)**
In sp^2-hybridization bond angle is 120°. In sp^3 it is 109°28′

219 **(c)**
Explanation is correct reason for statement

220 **(b)**
Atomic size of silver is almost equal to that of gold due to lanthanide contraction.

221 **(a)**
Electron affinity of F $<$ Electron affinity of Cl. Due to more $2p$-test electron repulsion in F atom

222 **(a)**
p-dimethoxy benzene is polar due to orientation of CH_3 group as, The resultant vector is not zero



223 **(b)**
Both cis-and $trans$-forms are polar. $Trans$ is more polar due to higher value of dipole moment due to additive nature of CH_3 and Cl vectors

224 **(c)**
The lower IE_1 of B than that of Be is because in boron $(1s^2 2s^2 2P^1)$ electron is to be removed from 2 P which is easy, while in Be$(1s^2 2s^2)$ electron is to be removed from $2s$-which is difficult.

225 **(b)**
The dipole moment of NH_3 is more than NF_3 because of the given explanation

226 **(b)**
Halogens can have only EA_1 value because they can accommodate only one electron $(ns^2np^5$ to $ns^2np^6)$: No scope for further addition, thus EA_2 for halogens is zero

227 **(d)**
Statement I is incorrect as in any period, the radius of the noble gas is largest and not the lowest

228 **(a)**
Noble gases have large positive electron gain enthalpy because the electron has to enter the next high principle quantam level leading to a very unstable electronic configuration.

229 **(a)**
P in PCl_3 is sp^3-hybridized; P $-$ Cl bond is $sp^3 - p$ bond

P in PCl_5 is sp^3d-hybridized; P $-$ Cl bond is $sp^3d - p$ bond

230 **(c)**
Removal of electron from N atom requires more energy due to half filled p-orbital in N atom

231 **(b)**
Sulphur valence shell is less dense than oxygen.

232 **(c)**
Explanation is correct reason for statement

233 **(b)**
This is Fajans' rule. $FeCl_3$ is more covalent

234 **(c)**
Explanation is correct reason for statement

235 **(c)**
Explanation is correct reason for statement

236 **(d)**
BF_3 is planar due to sp^2-hybridization. Also in BF_3, three bond pair on boron atom and 9 lone pairs of electrons on F atoms

237 **(d)**
The ionization energy of N $(V\,A)$ is more than O VI A because half filled and completely filled orbitals are more stable. Across a period effective nuclear charge increases with increase in atomic number and atomic size in atomic number and atomic size decreases.

238 **(c)**
Explanation is correct reason for statement

239 **(b)**
Molecules having polar bonds may ($e.g.$, ClF_3 polar) or may not ($e.g.$, BF_3) have dip[ole moment. The resultant vector of bond moment decides the net dipole moment in molecule

240 **(c)**
Charge is not defined as positive or negative [Isoelectronic species having higher the negative charge, larger the size, higher the positive charge smaller the size].

241 **(b)**
That is why $\mu_{NH_3} > \mu_{NF_3}$

242 **(c)**
Explanation is correct reason for statement

243 **(c)**
Explanation is correct reason for statement

244 **(b)**
Electrons in *d* and *f* sublevels can never be in the outer level of a neutral atom. The *s*-and *p*-electrons are in the highest energy level in the atom and are the electrons involved in the chemical reactions.

245 **(a)**
Symmetrical configuration (half-filled) is stable. Oxygen also gains half-filled configuration by losing an electron

246 **(a)**
Energy level of $2s$ is lesser than $2p$-orbital

Matrix Match Type

249 **(c)**
(i) For noble gases (*e.g.*, He), ionisation energy is highest due to their completely filled electronic configuration.

(ii) Generally electron affinity increases in a period (from IA to VII A group) and decreases in a group but electron affinity is highest for chlorine (Cl) (due to smaller size and high electron density of fluorine).

(iii) The ionization energy is lowest for Li, so it can lose electrons very easily, thus it behaves as a strongest reducing agent.

(iv) Electropositive character generally decreases in a period (from left to right) and increases in a group (on moving down), thus Ca is the most electropositive element among the given.

Hence, on the basis of above facts, the correct matches are (A)-iv (B)-i (C)-ii (D)-iii

Linked Comprehension Type

253 **(b)**
Higher is the positive charge, smaller is the size of the atom

254 **(d)**
During addition of second electron to a uninegative gaseous ion to form divalent gaseous ion, energy is absorbed to overcome the repulsions between the incoming second electron and the negative charge on the ion

264 **(b)**
$\mu_m = \overline{\delta} \times d$
$0.816 \times 10^{-18} = \delta \times 10^{-8}$
$\therefore \delta = 0.816 \times 10^{-10}$ esu
$\therefore$ % ionic character $= \dfrac{0.816 \times 10^{-10}}{4.803 \times 10^{-10}} \times 100$
$= 16.9\%$