



CHEMISTRY

BOOKS - CENGAGE CHEMISTRY (ENGLISH)

APPENDIX - INORGANIC VOLUME 1

Exercise

1. What is the basic theme of organisation in the periodic table?



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2. Which important property did Mendeleev use to classify the elements in his periodic table and did he stick to that?



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3. What is the basic difference in approach between the Mendeleev's Periodic Law and the Modern Periodic Law?



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4. On the basis of quantum number, which period of the periodic table should have 32 elements.



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5. In terms of period and group where would you locate the element with $Z = 114$?



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6. Write the atomic number of the element present in the third period and seventeenth group of the periodic table.



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7. Which element do you think would have been named by

- (i) Lawrence Berkeley Laboratory
- (ii) Seaborg's group?



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8. Why do elements in the same group have similar physical and chemical properties?



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9. What does atomic radius and ionic radius really mean to you?



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10. How do atomic radius vary in a period and in a group?
How do you explain the variation?



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11. What do you understand by isoelectronic species? Name a species that will be isoelectronic with each of the following atoms or ions.

(i) F^- (ii) Ar (iii) Mg^{2+} (iv) Rb^+



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12. Consider the following species :

N^{3-} , O^{2-} , F^- , Na^+ , Mg^{2+} and Al^{3+}

(a) What is common in them?

(b) Arrange them in the order of increasing ionic radii.



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13. Explain why cation are smaller and anions larger in radii than their parent atoms?



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14. What is the significance of the terms — ‘isolated gaseous atom’ and ‘ground state’ while defining the ionization enthalpy and electron gain enthalpy?

Hint : Requirements for comparison purposes.



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15. Energy of an electron in the ground state of the hydrogen atom is $-2.18 \times 10^{-18} J$. Calculate the

ionization enthalpy of atomic hydrogen in terms of J mol^{-1} .

Hint: Apply the idea of mole concept to derive the answer.



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16. Among the second period elements the actual ionization enthalpies are in the order

$$Li < B < Be < C < O < N < F < Ne.$$

Explain why

(i) Be has higher $\Delta_i H$ than B

(ii) O has lower $\Delta_i H$ than N and F?



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17. How would you explain the fact that the first ionisation enthalpy of sodium is lower than that of magnesium but its second ionisation enthalpy is higher than that of magnesium?



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18. What are the various factors due to which the ionization enthalpy of the main group elements tends to decrease down a group?



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19. The first ionization enthalpy values (in kJ mol^{-1}) of group 13 elements are :

B Al Ga In Tl

801 577 579 558 589

How would you explain this deviation from the general trend ?



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20. Which of the following pairs of elements would have a more negative electron gain enthalpy?

(i) O or F (ii) F or Cl



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21. Would you expect the second electron gain enthalpy of O as positive , more negative or less negative than the first? Justify your answer.



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22. What is the basic difference between the terms electron gain enthalpy and electronegativity?



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23. How would you react to the statement that the electronegativity of N on Pauling scale is 3.0 in all the nitrogen compounds?



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24. Describe the theory associated with the radius of an atom as it gains an electron



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25. Would you expect the first ionization enthalpies for two isotopes of the same element to be the same or different? Justify your answer.



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26. What are the major differences between metals and non-metals?



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27. Use the periodic table to answer the following questions.

(a) Identify an element with five electrons in the outer subshell.

(b) Identify an element that would tend to lose two electrons.

(c) Identify an element that would tend to gain two electrons.

(d) Identify the group having metal, non-metal, liquid as well as gas at the room temperature.



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28. The increasing order of reactivity among group 1 elements is $Li < Na < K < Rb < Cs$ whereas that among group 17 elements is $F > Cl > Br > I$. Explain.



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29. Write the general outer electronic configuration of s-, p-, d- and f- block elements.



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30. Assign the position of the element having outer electronic configuration (i) ns^2np^4 for $n=3$ (ii) $(n-1)d^2ns^2$

for $n=4$, and (iii) $(n-2)f^7(n-1)d^1ns^2$ for $n=6$, in the periodic table.



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31. The first ($\Delta_i H_1$) and the second ($\Delta_i H_2$) ionization enthalpies (in kJ mol^{-1}) and the ($\Delta_{eg} H$) electron gain enthalpy (in kJ mol^{-1}) of a few elements are given below:

Elements	ΔH_1	ΔH_2	$\Delta_{eg} H$
<i>I</i>	520	7300	-60
<i>II</i>	419	3051	-48
<i>III</i>	1681	3374	-328
<i>IV</i>	1008	1846	-295
<i>V</i>	2372	5251	+48
<i>VI</i>	738	1451	-40

Which of the above elements is likely to be : (a) the least reactive element.

(b) the most reactive metal.

(c) the most reactive non-metal.

(d) the least reactive non-metal.

(e) the metal which can form a stable binary halide of the formula MX_2 (X=halogen).

(f) the metal which can form a predominantly stable covalent halide of the formula MX (X=halogen)?



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32. Predict the formula of the binary compounds formed by combination of the following pairs of elements:

(i) Magnesium and nitrogen (ii) Silicon and oxygen



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33. In the modern periodic table, the period indicates the value of :



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34. Which of the following statements related to the modern periodic table is incorrect?



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35. Anything that influences the valence electrons will affect the chemistry of the element. Which one of the following factors does not affect the valence shell?



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36. The size of isoelectronic species — F^- , Ne and Na^+ is affected by



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37. Which one of the following statements is incorrect in relation to ionization enthalpy?



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38. Considering the elements B, Al, Mg, and K, the correct order of their metallic character is :



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39. Considering the elements B, C, N, F, and Si, the correct order of their non-metallic character is :



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40. Considering the elements F, Cl, O and N, the correct order of their chemical reactivity in terms of oxidizing property is :



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41. Explain the formation of a chemical bond.



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42. Write Lewis dot symbols for atoms of the following elements:

Mg, Na, B, O, N, Br.



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43. Write Lewis symbols for the following atoms and ions : S and S^{2-} , Al and Al^{3+} . H and H^{-} .



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44. Draw the Lewis structures for the following molecules and ions :

H_2S , $SiCl_4$, BeF_2 , CO_3^{2-} , $HCOOH$



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45. Define octet rule . Write its significance and limitations .



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46. Write the favourable factors for the formation of ionic bond .



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47. Discuss the shape of the following molecules using the VSEPR model : $BeCl_2$, BCl_3



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48. Although geometries of NH_3 and H_2O molecules are distorted tetrahedral, bond angle in water is less than that of ammonia. Discuss.



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49. How do you express the bond length in terms of bond order?



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50. Define the bond length.

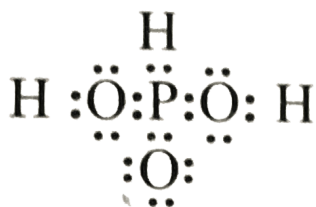


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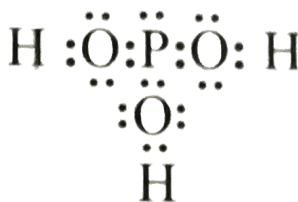
51. Explain the structure of CO_3^{2-} ion in terms of resonance

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52. H_3PO_3 can be represented by structure (a) and (b) shown below. Can these two structures be taken as the canonical forms of the resonance hybrid representing H_3PO_3 ? If not, give reasons for the same.



(a)



(b)

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53. Write the resonance structures for SO_3 and NO_3^-



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54. Use Lewis symbols to show electron transfer between the following atoms to form cations and anions: (a) K and O and (b) Al and N .



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55. Although both CO_2 and H_2O are triatomic molecules, the shape of H_2O molecule is bent while that of CO_2 is linear. Explain this on the basis of dipole moment.



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56. a) Discuss the significance/applications of dipole moment.

b) Represent diagrammatically the bond moments and the resultant dipole moment in CO_2 , NF_3 and $CHCl_3$



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57. ELECTRON GAIN ENTHALPY OF GROUP 17



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58. Explain with the help of suitable example polar covalent bond.



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59. Arrange the following in order of decreasing ionic character.

a. ClF_3 , SO_2 , N_2 , K_2O and LiF

b. $Cl - H$, $F - H$, $Br - H$, $Na - I$, $K - F$ and $Li - Cl$

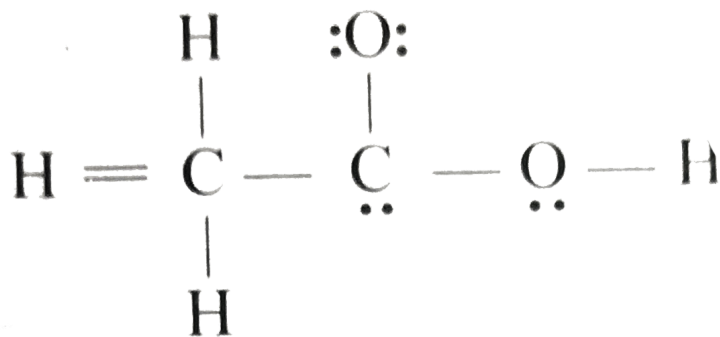
c. AlF_3 , $AlCl_3$, $AlBr_3$



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60. The skeletal structure of CH_3COOH as shown below is correct, but some of the bonds are shown incorrectly. Write

the correct Lewis structure for acetic acid.



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61. Apart from tetrahedral geometry, another possible geometry for CH_4 is square planar with the four H atoms at the corners of the square and the C atom at its centre. Explain why CH_4 is not square planar ?



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62. Explain why BeH_2 molecule has a zero dipole moment although the Be–H bonds are polar.



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63. What is the correct dipole moment of NH_3 and NF_3 respectively ?



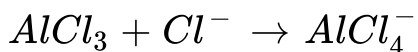
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64. What is meant by hybridisation of atomic orbitals?
Describe the shapes of sp , sp^2 , sp^3 hybrid orbitals.



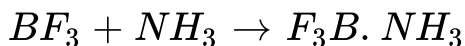
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65. Describe the change in hybridisation (if any) of the Al atom in the following reaction.



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66. Is there any change in the hybridisation of B and N atoms as a result of the following reaction?



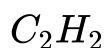
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67. Draw diagrams showing the formation of a double bond and a triple bond between C atoms in C_2H_4 and C_2H_2 molecules?



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68. What is the total number of sigma and pi bonds in the following molecules?



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69. Considering x-axis as the internuclear axis which out of the following will not form a sigma bond and why? (a) 1s and 1s (b) 1s and $2p_x$ (c) $2p_y$ and $2p_y$ (d) 1s and 2s.



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70. Which hybrid orbitals are used by carbon atoms in the following molecules?

CH_3-CH_3 , (b) $CH_3-CH=CH_2$, (c) CH_3-CH_2-OH ,
(d) CH_3-CHO (e) CH_3COOH



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71. What do you understand by bond pairs and lone pairs of electrons? Illustrate by giving one example of each type.



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72. Give two differences between a sigma bond and a pi bond. * *





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73. Discuss the formation of H_2 molecule on the basis of Valence-bond theory.



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74. Write the important conditions required for the linear combination of atomic orbitals to form molecular orbitals.



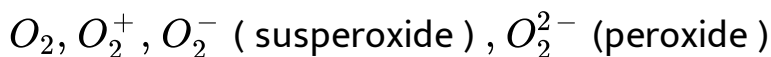
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75. Use molecular orbital theory to explain why the Be_2 molecule does not exist.



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76. Compare the relative stability of the following species and indicate their magnetic properties :



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77. Write the significance of plus and minus sign shown in representing the orbitals.



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78. Describe the hybridisation in case of PCl_5 . Why are the axial bonds longer as compared to equatorial bonds?



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79. Define hydrogen bond. Is it weaker or stronger than the van der Waals' forces?



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80. What is meant by the term bond order? Calculate the bond order of N_2 , O_2 , O_2^+ and O_2^-



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81. COMPARISON of IE of ALKALI METALS



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82. Write the names of isotopes of hydrogen. What is the mass ratio of these isotopes?



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83. Why does hydrogen occur in a diatomic form rather than in a monoatomic form under normal conditions?



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84. How can the production of dihydrogen, obtained from 'coal gasification', be increased?



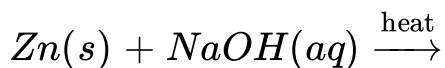
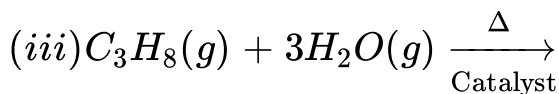
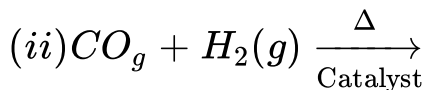
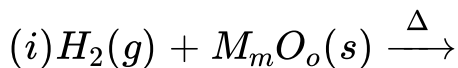
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85. Describe the bulk preparation of dihydrogen by electrolytic method. What is the role of an electrolyte in this process ?



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86. Complete the following reactions:



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87. Discuss the consequences of high enthalpy of H–H bond in terms of chemical reactivity of dihydrogen



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88. What do you understand by (i) electron-deficient, (ii) electron-precise, and (iii) electron-rich compounds of hydrogen? Provide justification with suitable examples.



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89. What characteristics do you expect from an electron-deficient hydride with respect to its structure and chemical reactions?



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90. Carbon hydrides of the type, C_nH_{2n+2} do not act as Lewis acid or Lewis base. They behave as normal covalent hydrides because

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91. What do you understand by the term 'non-stoichiometric hydrides' ? Do you expect this type of hydrides to be formed by alkali metals? Justify your answer.

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92. How do you expect the metallic hydrides to be useful for hydrogen storage? Explain.



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93. How does the atomic hydrogen or oxy-hydrogen torch function for cutting and welding purposes ? Explain.



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94. Among NH_3 , H_2O , HF and H_2S which would have highest magnitude of hydrogen bonding ?



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95. Saline hydrides are known to react with water violently producing fire. Can CO_2 , a well known fire extinguisher, be used in this case? Explain.



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96. Arrange the following

a. CaH_2 , BeH_2 and TiH_2 in order of increasing electrical conductance.

b. LiH , NaH and CsH in order of increasing ionic character.

c. $H - H$, $D - D$ and $F - F$ in order of increasing bond dissociation enthalpy.

d. NaH , MgH_2 and H_2O in order of increasing reducing property.

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97. Compare the structures of H_2O and H_2O_2 .

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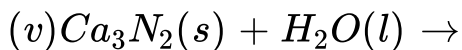
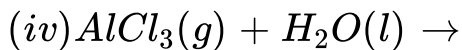
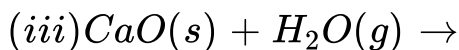
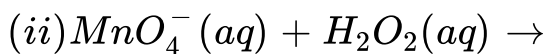
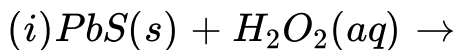
98. What do you understand by the term 'auto-protolysis' of water? What is its significance?

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99. Consider the reaction of water with F_2 and suggest, in terms of oxidation and reduction, which species are oxidised/reduced.

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100. Complete the following chemical reactions.



Classify the above into (a) hydrolysis, (b) redox and (c) hydration reactions.

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101. Describe the structure of the common form of ice.

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102. What are the causes for

Permanent hardness



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103. Discuss the principle and method of softening of hard water by synthetic ion- exchange resins.



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104. Write chemical reactions to justify that hydrogen peroxide can function as an oxidising as well as reducing agent.



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105. Write chemical reactions to justify that hydrogen peroxide can function as an oxidising as well as reducing agent.

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106. What is meant by demineralised water?

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107. Is demineralised or distilled water useful for drinking purposes? If not, how can it be made useful?

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108. Describe the usefulness of water in biosphere and biological systems.



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109. What properties of water make it useful as a solvent?
What types of compound can it (i) dissolve, and (ii) hydrolyse ?



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110. Knowing the properties of H_2O and D_2O , do you think that D_2O can be used for drinking purposes?



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111. What is the difference between the terms 'hydrolysis' and 'hydration' ?



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112. How can saline hydrides remove traces of water from organic compounds?



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113. What do you expect the nature of hydrides is, if formed by elements of atomic numbers 15, 19, 23 and 44 with dihydrogen? Compare their behaviour towards water.



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114. Do you expect different products in solution when aluminium(III) chloride and potassium chloride treated separately with (i) normal water (ii) acidified water, and (iii) alkaline water? Write equations wherever necessary.



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115. How does H_2O_2 behave as a bleaching agent?



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116. What do you understand by the terms:

(i) hydrogen economy

(ii) hydrogenation

(iii) syngas

(iv) water-gas shift reaction

(v) fuel-cell



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117. What are the common physical and chemical features of alkali metals?



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118. Discuss the general characteristics and gradation in the properties of Alkaline Earth metals.



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119. Why are alkali metals not found in nature ?



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120. Find out the oxidation state of sodium in Na_2O_2



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121. Explain, why is sodium less reactive than potassium ?



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122. Compare the alkali metals and alkaline earth metals with respect to

(i) ionisation enthalpy

(ii) basicity of oxides and

(iii) solubility of hydroxides



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123. In what ways lithium shows similarities to magnesium in its chemical behaviour?



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124. Explain why can alkali and alkaline earth metals not be obtained by chemical reduction methods ?



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125. Why are potassium and caesium rather than lithium used in photoelectric cells ?



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126. When an alkali metal dissolves in liquid ammonia the solution can acquire different colours. Explain the reasons for this type of colour change



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127. Beryllium and magnesium do not give colour to flame whereas other alkaline earth metals do so. Why ?



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128. How is sodium carbonate manufactured by Solvay's process? Draw a schematic diagram and explain all the steps involved in the process. What is the action of heat on sodium carbonate ?



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129. Potassium carbonate cannot be prepared by Solvay process. Why ?



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130. Why is Li_2CO_3 decomposed at a lower temperature whereas Na_2CO_3 at higher temperature ?



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131. Starting with sodium chloride how would you proceed to prepare (i) sodium metal (ii) sodium hydroxide (iii) sodium peroxide (iv) sodium carbonate ?



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132. What happens when (i) magnesium is burnt in air (ii) quick lime is heated with silica (iii) chlorine reacts with

slaked lime (iv) calcium nitrate is heated ?



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133. Describe two important uses of each of the following: (i) caustic soda (ii) sodium carbonate (iii) quicklime



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134. Draw the structure of (i) $BeCl_2$ (vapour) (ii) $BeCl_2$ (solid)



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135. The hydroxides and carbonates of sodium and potassium are easily soluble in water while the corresponding salts of magnesium and calcium are sparingly soluble in water. Explain.



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136. Describe the importance of the following: (i) limestone (ii) cement (iii) plaster of paris



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137. Why are lithium salts commonly hydrated and those of the other alkali ions usually anhydrous?





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138. Why is LiF almost insoluble in water whereas LiCl soluble not only in water but also in acetone ?



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139. Explain the significance of sodium, potassium, magnesium and calcium in biological fluids.



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140. What happens when

(i) sodium metal is dropped in water?

(ii) sodium metal is heated in free supply of air?

(iii) sodium peroxide dissolves in water?



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141. Comment on each of the following observations:

(a) The mobilities of the alkali metal ions in aqueous solution are $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

(b) Lithium is the only alkali metal to form a nitride directly

(c) E^\ominus for $M^{2+} (aq) + 2e^- \rightarrow M(s)$ (where M=Ca, Sr or Ba) is nearly constant



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142. State as to why

(a) a solution of Na_2CO_3 is alkaline ?

(b) alkali metals are prepared by electrolysis of their fused chlorides?

(c) sodium is found to be more useful than potassium ?



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143. Write balanced equations for reactions between

(a) Na_2O_2 and water

(b) KO_2 and water

(c) Na_2O and CO_2



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144. How would you explain the following observations ?

(i) BeO is almost insoluble but BeSO_4 is soluble in water

(ii) BaO is soluble but BaSO_4 is insoluble in water

(iii) LiI is more soluble than KI in ethanol



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145. Which of the alkali metal is having least melting point?

A. Na

B. K

C. Rb

D. Cs

Answer:





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146. Which one of the following alkali metals gives hydrated salts?

A. Li

B. Na

C. K

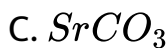
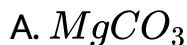
D. Cs

Answer:



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147. Which one of the alkaline earth metal carbonates is thermally the most stable ?



Answer:



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148. Discuss the pattern of variation in the oxidation states of (i) B to Tl and (ii) C to Pb.



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149. How can you explain higher stability of BCl_3 as compared to $TlCl_3$?

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150. Why does boron trifluoride behave as a Lewis acid ?

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151. Consider the compounds, BCl_3 and CCl_4 . How will they behave with water ? Justify.

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152. what Is boric acid



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153. Explain what happens when boric acid is heated .



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154. Describe the shapes of BF_3 and BH_4^- . Assign the hybridisation of boron in these species.



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155. Write reaction of justify amphoteric nature of zinc oxide

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156. What are electron deficient compounds ? Are BCl_3 and $SiCl_4$ electron deficient species ? Explain.

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157. Write the resonance structures of CO_3^{2-} and HCO_3^- .

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158. What is the state of hybridisation of carbon in (a) CO_3^{2-} (b) diamond (c) graphite?

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159. Explain the difference in properties of diamond and graphite on the basis of their structures.



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160. Rationalise the given statements and give chemical reactions : • Lead(II) chloride reacts with Cl_2 to give $PbCl_4$. • Lead(IV) chloride is highly unstable towards heat. • Lead is known not to form an iodide, PbI_4 .



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161. Suggest reasons why the B–F bond lengths in BF_3 (130 pm) and BF_4^- (143 pm) differ.



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162. If B–Cl bond has a dipole moment, explain why BCl_3 molecule has zero dipole moment.



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163. Aluminium trifluoride is insoluble in anhydrous HF but dissolves on addition of NaF. Aluminium trifluoride precipitates out of the resulting solution when gaseous BF_3 is bubbled through. Give reasons.



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164. Suggest a reason as to why CO is poisonous.



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165. How is excessive content of CO_2 responsible for global warming ?



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166. Explain structures of diborane and boric acid.



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167. What happens when

- (a) Borax is heated strongly,
- (b) Boric acid is added to water,
- (c) Aluminium is treated with dilute NaOH,
- (d) BF_3 is reacted with ammonia ?



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168. Explain the following reactions

- (a) Silicon is heated with methyl chloride at high temperature in the presence of copper,
- (b) Silicon dioxide is treated with hydrogen fluoride,
- (c) CO is heated with ZnO,
- (d) Hydrated alumina is treated with aqueous NaOH solution.



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169. Give reasons

Diamond is used as an abrasive.



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170. Explain why is there a phenomenal decrease in ionization enthalpy from carbon to silicon ?



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171. How would you explain the lower atomic radius of Ga as compared to Al ?

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172. ALLOTROPES OF CARBON

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173. a. Classify following oxides as neutral, acidic, basic or atphoteric: CO , B_2O_3 , SiO_2 , CO_2 , Al_2O_3 , PbO_2 , Tl_2O_3 .

b. Write suitable chemical reaction to show their nature.

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174. In some of the reactions thallium resembles aluminium, whereas in others it resembles with group I metals. Support this statement by giving some evidences.



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175. The metallic salt (XY) is soluble in water.

(a) When the aqueous soluble of (XY) is treated with $NaOH$ solution, a white precipitate (A) is formed. In excess of $NaOH$ solution, a white precipitate (A) is formed. In excess of $NaOH$ solution, white precipitate (A) dissolves to form a compound (B). When this solution is boiled with solid NH_4Cl , a precipitate of compound (C) is formed.

(b) An aqueous solution on treatment with $BaCl_2$ solution gives a white precipitate (D) which is insoluble in conc HCl .

(c) The metallic salt (XY) forms a double salt (E) with potassium sulphate.

Identify (XY), (A), (B), (C), (D) and (E).



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176. What do you understand by (a) inert pair effect (b) allotropy and (c) catenation?



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177. A certain salt (X) gives the following tests :

(a) Its aqueous solution is alkaline to litmus.

(b) On strong heating, it swells up to give a glassy material (Y).

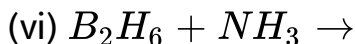
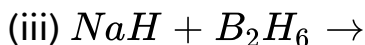
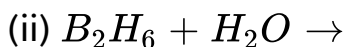
(c) When conc. H_2SO_4 is added to a hot concentrated solution of (X), white crystal of a weak acid (Z) separates out.

Identify (X), (Y) and (Z) and write down the chemical equations for reaction at steps a , b and c .



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178. Write balanced equations for:



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179. Give one method for industrial preparation and one for laboratory preparation of CO and CO_2 each.



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180. An aqueous solution of borax is

- A. Neutral
- B. Amphoteric
- C. Basic
- D. Acidic

Answer:



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181. Boric acid is polymeric due to :

- A. Its acidic nature

B. The presence of hydrogen bonding

C. Its monobasic nature

D. Its geometry

Answer:



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182. The type of hybridization of boron in diborane is

A. sp

B. sp^2

C. sp^3

D. dsp^2

Answer:



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183. Which is hardest allotrope of carbon.

A. Diamond

B. Graphite

C. Fullerene

D. Coal

Answer:



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184. Elements of group 14 exhibit oxidation state of

- A. Exhibit oxidation state of +4 only
- B. Exhibit oxidation state of +2 and +4
- C. Form M^{2+} and M^{4+} ions
- D. Form M^{3+} and M^{4+} ions

Answer:



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185. If the starting material for the manufacture of silicones is $RSiCl_3$, write the structure of the product formed.



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186. Why trihalides of group 13 elements fume in moist air?



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187. Account for the following:

Boron forms electron deficient compounds.



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188. Which element among group 13 has the highest ionisation enthalpy?



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189. Answer the following :

(a) Name of element of group 13 which forms the most stable compound in +1 oxidation state. .



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190. Name the most abundant metal in the earth's crust. To which group does it belong?



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191. Name the elements of group 13 which form amphoteric hydroxides.



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192. Name the metal which is commonly used as a reducing agent in metallurgical operations.



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193. What is the valence shell electronic configuration of group 1 elements?



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194. What is Tincal?



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195. Name the two metals present in common alum.



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196. Give the formula of inorganic benzene?



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197. What is thermite mixture?



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198. Give the name of compound of aluminium which is used as germicide and coagulant in the purification of water.



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199. What is the oxidation state of *Ga* in $GaCl_2$?



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200. Why $[BF_6]^{2-}$ ion does not exist?



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201. What are the basic units in the structure of orthoboric acid? How are they linked?



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202. What are silver paint and german silver made of?



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203. Which element of group 13 forms covalent compounds only



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204. Why aluminium shows a higher covalency than boron?



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205. Which oxide of carbon is an anhydride of carbonic acid?

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206. What happens when a borax solution is acidified ?

Write a balanced equation for the reaction.

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207. With the help of a balanced chemical equation, show that $B(OH)_3$ behaves as an acid in water.

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208. Explain what happens when boric acid is heated .

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209. How does electron deficient compound BF_3 achieve electron saturation, i.e. fully occupied outer electronic shells?



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210. Why the elements of the second row (first short period)? exhibit a number of differences in properties from other members of their respective families ?



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211. Why do boron halides form addition compounds with ammonia ?



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212. What are boranes? How is diborane prepared from boron halides? Discuss its structure.



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213. To which block of the periodic table group 13 belongs. What is the general outer electronic configuration of this group?



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214. Write the general valence shell electronic configuration of group 14 elements.



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215. Out of CCl_4 and $SiCl_4$, which one react with water.



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216. Explain why silicon shows a higher covalency than carbon.



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217. Why is diamond a bad conductor of electricity but a good conductor of heat?



Watch Video Solution

218. What is the correct structural formula of borax?



Watch Video Solution

219. What is dry ice and why is it called so ?



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220. What is catenation ? Why is it most prominent for carbon ?



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221. What is water gas? How it is prepared?



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222. Which of two elements, carbon and silver, form multiple bonds?



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223. Mention an industrial application of silicones.



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224. The basic structural unit of silicates is



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225. Name three allotropic forms of carbon. Which one is a good conductor of electricity?



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226. The recently discovered allotrope of carbon (e. g C_{60} is commonly known as _____.



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227. Which isotope of carbon is radioactive?



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228. The soldier of Napoleon 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 :



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229. Why is not sulphuric acid used for the preparation of CO_2 from marble chips?



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230. Why Al_2O_3 is amphoteric while B_2O_3 is acidic ?



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231. Why is borazole called inorganic benzene?



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232. Which of the following reactions of Al is known as the thermite reaction?



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233. The Lewis acid character of halides of boron are as follows :



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234. Why is BF_3 a Lewis acid?



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235. How many sigma and pi bonds are present in borazole?



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236. There are two *H*-bridge bonds in diborane molecule because there are



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237. What happens when aluminium is treated with conc. HNO_3 ?



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238. What type of bonding is there in aqueous aluminium chloride?



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239. What is the purpose of using alum in dyeing of cloth?



Watch Video Solution

240. What is the number of hydrogen atoms bridging the boron atoms in diborane?



Watch Video Solution

241. Why boron forms electron deficient compounds?



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242. Name three important amorphous forms of silica.



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243. Name three important crystalline forms of silica.



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244. HNO_3 has no action of aluminium, whether it is dilute or concentrated?



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245. Name the following boric acids:

a. H_3BO_3 or $B_2O_3 \cdot 3H_2O$

b. HBO_2 or $B_2O_3 \cdot H_2O$

c. $H_2B_4O_7$ or $2B_2O_3 \cdot H_2O$

d. $H_6B_4O_9$ or $2B_2O_3 \cdot 3H_2O$



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246. Why is CO combustible and CO_2 non-combustible?



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247. Pure silicon and germanium are



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248. Why is the melting point of diamond high, in spite of the fact that it is covalent in nature?



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249. Why carbon exists as the hardest crystalline solid, though it is a non metal?



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250. Why is $C - C$ bond length in graphite shorter than in $C - C$ bond length in diamond?



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251. What is mononuclear metal carbonyl?



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252. Tin gives sulphates and nitrates, but silicon does not. Why?



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Exercise Very Short

1. What is the basis of the long form of the periodic table?



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2. Give a general idea of Dobereiner triads with one example.



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3. Newland's law of octaves states that



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4. State Mendeleev's periodic law.



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5. What is meant by periodicity of properties?



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6. Why do elements in the same group have similar physical and chemical properties?



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7. State modern periodic law of classification of elements.



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8. State the reason for periodicity of elements in periods and groups.



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9. How many groups and how many periods are there in long form of periodic table?



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10. With which quantum number every period in periodic table begins?





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11. What are s-block elements ? Write their general electronic configurations.



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12. Give general electronic configuration of s – block elements.



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13. What are p -block elements? Give their general electronic configuration.



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14. Representative elements are elements of



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15. What are *d*-block elements? Why are they called transition metals?



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16. The general electronic configuration of *d*-block elements is



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17. To which series man-made elements belong?



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18. What is meant by lanthanides and actinides?



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19. Which of lanthanides is man-made element?



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20. What are inner transition metals? Why are they called rare earth metals?



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21. Give general electronic configuration of f -block elements.



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22. Which orbitals are filled with electrons in 3^{rd} period?



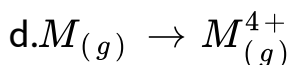
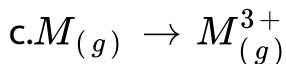
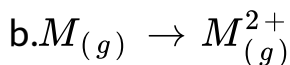
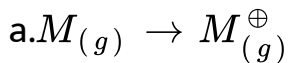
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23. Give general electronic configuration of least reactive group. Why are they least reactive?



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24. Which of the following requires highest energy:



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25. How do atomic radius vary in a period and in a group?

How do you explain the variation?



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26. Define (a) ionic radii and (b) covalent radii.



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27. Why do noble gases have comparatively large atomic sizes?



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28. Define ionisation energy . What is its value for a hydrogen atom ?



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29. How does ionisation energy vary (a) down the group and (b) along the period from left to right?



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30. A and B belong to same group of periodic table. A has higher atomic number than B . Which will have lower ionisation energy and why?



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31. The problem of position of isotopes in the periodic table was avoided by arranging elements in ascending order of _____.



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32. Two different elements may have same mass number but not the same _____.



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33. When compared to lithium, it is easier to remove valence electron from K (potassium) because potassium has lower _____.



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34. Chlorine has more electron affinity than fluorine.



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35. Among (the non-radioactive) halogens the element that has the lowest electron affinity is _____.



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36. Name the radioactive element of group 17 _____ and group 18 _____.



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37. Among Li, Na, K, Rb, Cs , the element with the lowest ionisation energy is _____.



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38. Electron Gain Enthalpy



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39. Generally electron gain enthalpy _____ on going down a group, and _____ on going across the period from left to right.



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40. Why is the second electron gain enthalpy negative (i.e. energy is absorbed)?



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41. Give reasons for the following :

Fluorine has lower electron gain enthalpy than chlorine.



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42. Isoelectronic species have the same number of _____.



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43. Lanthanides and actinides belong to _____ block of the periodic table.



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44. Generally, the atomic size along a period gradually decreases due to increase in _____.



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45. The formula for fluoride of carbon is _____.



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46. The solubility of alkali metal carbonate _____ as one goes down the group.



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47. The electronic configuration of Re^{3+} is $(Xe)4f^{14}5d^4$, the number of unpaired electrons in this ion is _____.



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48. Lather Meyer drew a graph showing the relation between atomic _____ and atomic _____.



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49. Second period ends with _____.



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50. The first transition series is called _____transition series.



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51. Alkali metals have low ionisation energy. Why is it so?



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52. Why lanthanides and actinides have been placed separately in the periodic table ?



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53. Why does the solubility of alkaline earth metal hydroxides in water increase down the group ?



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54. Explain :

Cation has smaller size than neutral atom.

.....



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55. Explain :

Anion has larger size than neutral atom.

.....





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56. Which of the following species will have the largest and the smallest size Mg , Mg^{2+} , Al , Al^{3+} ?



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57. Which has the largest ionic radius Ca^{2+} , Mg^{2+} , Ba^{2+} ?



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58. Define various types of atomic radii. Why is covalent radius smaller than metallic and van der Waals' radii? How do atomic radii vary in a group and in a period.



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59. Electronegativity is



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60. Define electronegativity. How does it vary in the periodic table?



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61. Write the general outer electronic configuration of s-, p-, d- and f- block elements.



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62. What is the nature of oxides formed by most of p -block elements?



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63. Identify the atom or ion which has larger radius in each of the following pair:

a. Cl or S

b. Cl^{\ominus} or S^{2-}

c. Na or Mg

d. Mg^{2+} or Al^{3+}



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64. Among the elements , Li , K , Ca , Cl and Kr , the element K has the lowest IE and Kr has the highest IE .



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65. Which element in each of the following pairs of elements would you expect to have lower first ionisation energy? Explain.

Cl , S



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66. Ionisation potential increases in a period from left to right because



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67. Which out of the N or O has higher electron gain enthalpy?

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68. Which of the following pairs would have a larger size? Explain.

Br or Br^-

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69. Atomic number (Z) of elements is 108. Write its electronic configuration and name the group to which does

it belong?



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70. Out of Na and Mg which has higher second ionisation energy?



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Exercise Short

1. The first(IE_1) and second (IE_2) Ionization energies (KJ/mol) of a few elements designated by roman numerals are given below. Which of these would be an alkali metal?



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2. Give four characteristics of s -block elements.



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3. Give four defects of Mandeleev's periodic table.



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4. why the number of elements in the first period is only 2?



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5. On the basis of their electronic configuration, explain why alkali metals are highly reactive?



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6. Why do the melting points decrease in going from NaF to NaI?



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7. Why are group 1 elements called alkali metals ?



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8. Give five characteristics of d -block elements.



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9. (a) What was the basis of Mendeleev's Classification of elements ?

(b) List two achievements of Mendeleev's periodic tables.

(c) List any two observations which posed a challenge to Mendeleev's periodic law.



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10. Why does the solubility of alkaline earth metal carbonates and sulphates in water decrease down the

group ?



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11. why is melting point of $LiCl$ lower than $NaCl$?



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12. Arrange the following in increasing order:

a. $BeCO_3, BaCO_3, CaCO_3, MgCO_3$, (thermal stability)

b. $BeCl_2, BaCl_2, MgCl_2, CaCl_2$, (ionic character)



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13. Which alkali metal carbonate is thermally unstable and why?



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14. The element which has highest electron affinity ?



Watch Video Solution

15. What is diagonal relationship?



Watch Video Solution

16. Give four characteristics of f -block elements.

 [Watch Video Solution](#)

17. Why are electron affinities of noble gases zero? Arrange halogens in increasing order of electron affinity.

 [Watch Video Solution](#)

18. Arrange the species in each group in order of increasing ionisation energy and give reason:

a. K^{\oplus} , Cl^{\ominus} , Ar , b. Na , Mg , Al , c. C , N , O

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19. State the factors which affect
electronaffinity



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20. Explain the term (a) screening effect



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21. which has higher 1st ionisation energy B or Be and why?



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22. How does reducing power of elements vary in group 1?



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23. a. Among Cu^{\oplus} , Cu^{2+} and Cu which is the largest in size and why?

b. Which element in periodic table has the highest IE (ionisation energy)?

c. Which element, Mg or Al , is more metallic and why?



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24. Give two characteristics of p -block elements.



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25. What is modern periodic law? Mention the important features of the long form of the periodic table. Why is this periodic table supposed to be superior to other periodic tables ?



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26. Elements A and B have atomic numbers 11 and 24 respectively. Write their electronic configuration and predict (a) group, (b) period, (c) block to which they belong? Which of them is representative element?



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27. How do melting and boiling points vary in a (a) period and (b) group in periodic table?



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28. a. Name the most metallic element in second period and most non-metallic element.

b. The element with (i) largest atomic radius and (ii) smallest atomic radius in third period.

c. The element having general electronic configuration ns^2np^4 in fourth period.



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29. How does electronegativity vary down the group 17 and why? How does it vary from left to right in period? Name an element having highest electronegativity.



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30. Among the elements of second period pick out the element with the largest atomic radius.



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31. Why CaCl_2 and NaCl are bad conductor of electricity in the solid state.





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32. Write the Lewis dot symbols and predict the valencies for the elements:

Phosphorous



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33. Out of KCl and CaO , which has higher lattice energy and why?



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34. Is $MgCl_2$ linear or bent or neither of two? Explain



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35. $NaBr$ gives pale yellow precipitate with $AgNO_3$ solution but CBr_4 does not. Why?



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36. Assertion Geometrical isomers are non-inter-convertible by rotation.

Reason Alkenes have restricted rotation about π bond.



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37. In which cases the octet rule is violated:

$BeBr_2$, NH_3 , $AlBr_3$, PBr_5 , CO_3^{2-} , CO_2 , SO_2 , SF_2 , SF_2 , SF_6



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38. Give the decreasing order of $C - H$ bond length in ethane, ethene and ethyne and why?



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39. Which bond is stronger in each of the following cases and why?

a. H_2 , Br_2 , b. O_2 , N_2 , c. F_2 , Cl_2



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40. Give the decreasing order of dipole moments of HF , HCl , HBr , and HI .



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41. what is a sigma and a pi bond.



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42. Which of the following molecule/molecules have zero dipole moment?

CO_2 , CBr_4 , BCl_3 , $BeCl_2$



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43. Differentiate between VB theory and Lewis concept.



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44. What orbitals can overlap to form a σ -bond and which orbitals can overlap to form a π -bond?



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45. Write the important conditions required for the linear combination of atomic orbitals to form molecular orbitals.



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46. Answer the following:

- a. Which electron takes part in bond formation?
- b. What types of forces hold the atoms together in an ionic compound?
- c. What change in energy takes place when a molecule is formed from its atoms?
- d. In terms of IE and $\Delta_{eg}H^\ominus$, what types atoms combine to form ionic bond?
- d. What types of orbitals can overlap to form a covalent bond.



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47. Out of the following, select the compounds containing ionic, covalent and coordinate bonds.

$CaCl_2, C_2H_6, MgO, HCl, NH_4^{\oplus}, O_3$



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48. What are the conditions which must be satisfied for H -bonding to take place in a molecule.



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49. What happens to the probability of finding an electron in the MO 's after the combination of two AO 's?



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50. What are SI units of dipole moment?



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51. Out of CS_2 and OCS which have higher dipole moment and why?



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52. How do you express the bond strength in terms of bond order?



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53. Is $\pi - MO$ weaker or stronger than $\sigma - MO$?



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54. The hybridization of carbon atoms in fullerene molecule is :



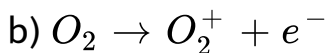
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55. With what molecule is CO isoelectronic?



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56. What is the effect of the following processes on the bond order in N_2 and O_2 ?



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57. The magnetic moment of KO_2 at room temperature is ---
----- BM.



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58. On the basis of *VSEPR* theory, predict the shapes of the following molecules/ions?

a. AsF_5 , b. $SbCl_3$, c. F_2O , d. H_3O^{\oplus}

e. $HC \equiv CH$, f. $\overset{\oplus}{N}H_4$, g. $\overset{o-}{N}H_2$, h. GeF_4



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59. Why is HCl predominantly covalent in the gaseous state but ionic in the aqueous solution?



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60. Why molbilities of H^{\oplus} ions in ice is greater as compared to liquid water.



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61. Assertion : Ionic bonds are directional in nature whereas covalent bonds are non-directional.

Reason : According to orbital overlap concept , the formation of a covalent bond between two atoms results by

pairing of electrons present in the valence shell having same spins.



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62. Write two resonance structure of N_2O that satisfy the octet rule.



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63. Whether molecular ion HeH^{\ominus} exist or not? Explain.



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64. Out of but-1-yne or but-1-ene which has higher dipole moment?



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65. Write the structures of the following hydrates which contains ionic, covalent, coordinates and $H - bonds$.

a. $CuSO_4 \cdot 5H_2O$. , b. $ZnSO_4 \cdot 5H_2O$

c. $FeSO_4 \cdot 7H_2O$.



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66. What happens when steam is passed over red hot coke .



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67. What is the name of the isotope of hydrogen which contains 1 proton and 1 neutron?



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68. Give the chemical reaction in which dihydrogen acts as an oxidising agent.



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69. Which element on treatment with caustic soda solution produces H_2 gas?



Watch Video Solution

70. What is meant by hardening of oils?



Watch Video Solution

71. Which gaseous compound on treatment with dihydrogen produces methanol?



Watch Video Solution

72. In order to produce pure dihydrogen gas, which combination is used?



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73. Assertion : Nascent hydrogen is more reactive than molecular hydrogen.

Reason : Nascent hydrogen is associated with more energy



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74. What is the name given to hydrogen if nuclei of both the atoms have same spin?



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75. what happens if conc H_2SO_4 is used in preparing hydrogen by its reaction with a metal?





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76. A sample of hard water is allowed to pass through anion exchange resin. Will it produce lather with soap easily?



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77. What is the mass of one of deuterium oxide?



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78. What is deionised water? Describe the process used to obtain it.



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79. Which gas will be produced when heavy water is treated with a mixture of calcium nitride and magnesium nitride? Give equations.



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80. What type of substances can easily dissolve in water?



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81. Give a reaction in which H_2O acts as an oxidising agent.



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82. What requirement should be fulfilled by potable water (water for drinking purpose)?



Watch Video Solution

83. Which is heavier: water or ice?



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84. What type of bonds are broken when water evaporates?



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85. The degree of hardness of a given sample of hard water is 40ppm . If the entire hardness is due to MgSO_4 , how much of MgSO_4 is present per kg of water?



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86. Why cannot the dilute solution of hydrogen peroxide be concentrated by strong heating?

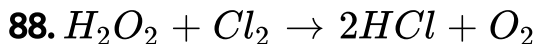


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87. Which organic reagent can be used for the manufacture of hydrogen peroxide?



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In the above reaction, H_2O_2 act as _____.



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89. Assertion (*A*): The colour of old lead painting can be restored by washing with dilute solution of H_2O_2 .

Reason (*R*) : Black lead sulphide is oxidised by H_2O_2 to white lead sulphate.



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90. What is the dihedral angle between two *H* atoms of H_2O_2 in gaseous state?



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91. What is the product of the reaction between benzene and H_2O_2 ?



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92. Which isotope of hydrogen contains equal number of protons and neutrons?



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93. Why is dihydrogen not preferred in weather balloons these days?

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94. Name two compounds which retard the decomposition of H_2O_2 .

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95. What do you mean by 15 volume H_2O_2 solution?

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96. Give an example of a compound in which hydrogen exists in (a) $+1$, (b) -1 ,

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97. Can aquatic animals live in distilled water?



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98. Give an example each of an ionic hydride and a covalent hydride.



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99. Why oxide ion is called a hard ion?



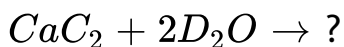
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100. How is D_2O_2 prepared?



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101. Complete the following:



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102. 10mL of a given solution of H_2O_2 contains 0.91g of H_2O_2 .

Express its strength in volume.



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103. In some toothpastes hydrogen peroxide is used. What is the role of H_2O_2 in them?



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104. What is Fenton's reagent?



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105. What is perhydrol? Give its composition and use.



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106. Explain why calcium ion makes water hard, but sodium ion does not.



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107. Name the alkali metals which combine directly with nitrogen.



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108. What is the order of reactivity of alkali metals towards hydrogen?



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109. Arrange the alkali metals in increasing order of their density.



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110. Which among Na , K , Cs and Li forms most stable hydride?



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111. Which among Li , Na , K and Cs has density greater than water?



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112. Arrange K , Ca and Li in order of increasing electrode potential.



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113. The ionisation enthalpy of Na is less than Ne . Why?



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114. Arrange alkali metal fluorides and halides in the decreasing order of solubility.



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115. Which among Na , Mg , Ba and Ca is the poor reducing agent?



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116. Arrange alkali metal carbonate in increasing order of solubility.



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117. Arrange $CaCO_3$, $KHCO_3$ and $NaHCO_3$ in increasing order of solubilities.



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118. Why *Be* generally form covalent compounds?



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119. Barium compounds are poisonous, even then $BaSO_4$ is used in barium meal. Why?



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120. Which of the two cations Mg^{2+} and Al^{3+} is smaller?



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121. Why alkaline earth metal oxides are quite stable?





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122. Why does the solubility of alkaline earth metal sulphates decrease on moving down the group?



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123. Why does the solubility of alkaline earth metal hydroxides in water increase down the group ?



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124. When sodium is dissolved in liquid ammonia, a solution of deep blue colour is obtained. The colour of the solution is due to



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125. Arrange alkaline earth metal fluorides in order of increasing solubility in water.



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126. Arrange alkaline earth metal chlorides in order of increasing solubility in water.



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127. Compared with the alkaline earth metals, the alkali metals exhibit

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128. Arrange sulphates of group 2 in decreasing order of solubility of water.

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129. Arrange carbonates of group 2 in increasing order of thermal stability.

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130. Arrange hydroxides of group 2 elements in order of increasing basicity.

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131. Arrange *Be*, *Mg*, *Ca*, *Sr* and *Ba* in increasing order of reactivity.

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132. What kind of metals can form superoxides?

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133. Name the alkali metal which can combine directly with *As*, *P*, *S* and halogens.

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134. Which among Na_2O_2 , Li_2O , K_3N and Li_3N is not known?



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135. Which among Na , K , Pb and Li has the lowest melting point?



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136. Name an element which is invariably bivalent and whose oxide is soluble in excess of $NaOH$ and its dipositive ion has a noble gas core.



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137. List the raw materials required in the manufacture of portland cement. What is the role of gypsum in it?



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138. Arrange the following in order of the increasing covalent character:

MCl , MBr , MF , MI (where M = alkali metals)



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139. Which alkali metal and alkaline earth metal are radioactive? Give their atomic numbers also.



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140. Which alkali metal forms covalent compound?



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141. Give one important ore of each of sodium and magnesium.



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142. Give chemical formula of dolomite and carnallite.



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143. Why the elements of the second row (first short period)? exhibit a number of differences in properties from other members of their respective families ?



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144. Name one reagent or one operation to distinguish between:

$Be(OH)_2$ and $Ba(OH)_2$



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145. Sodium cannot be obtained by the electrolysis of aqueous solution of $NaCl$ using Pt electrodes.





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146. Dead burnt plaster is



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Chapter 2 Multiple Correct Answer

1. Hydrogen bonding plays a central role in the following phenomena .

A. Ice floats in water

B. Higher Lewis basicity of primary than tertiary amines
in aqueous solutions

C. Formic acid is more than acetic acid

D. Dimerisation of acetic acid in benzene

Answer: A::B::D



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2. When O_2 is adsorbed on a metallic surface electron transfer occurs from the metal to O_2 . The *TRUE* statement(s) regarding this adsorption is (are) .

- A. O_2 is physisorbed
- B. heat is released
- C. occupancy of π_{2p} of O_2 is increased
- D. bond length of O_2 is increased

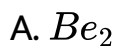
Answer: A::B::C::D



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Chapter 2 Single Correct Answer

1. Assuming $2s - 2p$ mixing is *NOT* operative, the paramagnetic species among the following is .



Answer: C



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2. The intermolecular interaction that is dependent on the inverse cube of distance between the molecule is :

- A. ion-ion interaction
- B. ion-dipole interaction
- C. London force
- D. hydrogen bond

Answer: B



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3. The ionic radii (in Å) of N^{3-} , O^{2-} and F^{-} are respectively :

A. 1.36, 1.40 and 1.71

B. 1.36, 1.71 and 1.40

C. 1.71, 1.40 and 1.36

D. 1.71, 1.36 and 1.40

Answer: C



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Chapter 2 Integer

1. Among the triatomic molecules/ions, $BeCl_2$, N_3^\ominus , N_2O , NO_2^\oplus , O_3 , SCI_2 , ICI_2^\ominus , I_3^\ominus and XeF_2 the total number of linear molecule (s) ion (s) where the hybridization of the central atoms does not have contribution from the d-

orbital (s) is .

[Atomic number $S = 16$, $Cl = 17$, $I = 53$ and $Xe = 54$].



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Chapter 3 Multiple Correct Answer

1. Hydrogen peroxide in its reaction with KIO_4 and NH_4OH respectively, is acting as a

- A. reducing agent, oxidising agent
- B. reducing agent, reducing agent
- C. oxidising agent, oxidising agent
- D. oxidising agent, reducing agent

Answer: A



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Chapter 3 Single Correct Answer

1. From the following statements regarding H_2O_2 , choose the incorrect statement :

- A. It can act only as an oxidizing agent
- B. It decomposes on exposure to light
- C. It has to be stored in plastic or wax lined glass bottles
in dark
- D. It has to be kept away from dust

Answer: A



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Chapter 4 Multiple Correct Answer

1. The pair(s) of reagents that yield paramagnetic species is/are

- A. Na and excess of NH_3
- B. K and excess of O_2
- C. Cu and dilute HNO_3
- D. O_2 and 2-ethylantraquinol

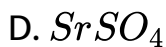
Answer: A::B::C



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Chapter 5 Single Correct Answer

1. Which one of the following alkaline earth metal sulphates has its hydration enthalpy greater than its lattice enthalpy ?



Answer: B



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1. The correct statement(s) for orthoboric acid is/are :

- A. It behaves as a weak acid in water due to self-ionization
- B. Acidity of its aqueous solution increases upon addition of ethylene glycol
- C. It has a three-dimensional structure due to hydrogen bonding.
- D. It is a weak electrolyte in water

Answer: B::D



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1. In the correct of the Hall-Heroult process for the extraction of Al , which of the following statements is false ?

A. CO and CO_2 are produced in this process

B. Al_2O_3 is mixed with CaF_2 which lowers the melting point of the mixture and brings conductivity

C. Al^{3+} is reduced at the cathode to form Al

D. Na_3AlF_6 serves as the electrolyte

Answer: D



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Chapter 6 Integer

1. Three moles of B_2H_6 are completely reacted with methanol. The number of moles of boron containing products formed is _____.



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Chapter 7 Single Correct Answer

1. Under hydrolytic conditions, the compounds used for preparation of linear polymer and for chain termination, respectively, are

A. CH_3SiCl_3 and $Si(CH_3)_4$

B. $(CH_3)_2SiCl_2$ and $(CH_3)_3SiCl$

C. $(CH_3)_2SiCl_2$ and CH_3SiCl_3

D. $SiCl_4$ and $(CH_3)_3SiCl$

Answer: B



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