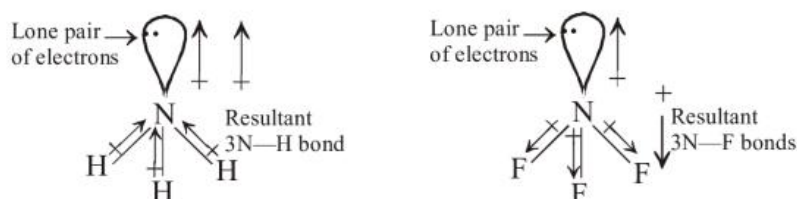


Sample Question Paper – E

1. Three nods. 1
 2. $\begin{array}{c} \ddot{\text{S}} \\ \diagup \quad \diagdown \\ :\text{O}: \quad :\text{O}: \end{array} \longleftrightarrow \begin{array}{c} \ddot{\text{S}} \\ \diagdown \quad \diagup \\ :\text{O}: \quad :\text{O}: \end{array}$ $\frac{1}{2} + \frac{1}{2}$
 3. Nm^{-2}s . 1
 4. $\text{H}_2^{\text{+1}} \text{S}_2^x \text{O}_7^{-2}$
 $2(+1) + 2(x) + 7(-2) = 0$
 $2x - 12 = 0$ $x = +6$. 1
 5. Acetanilide and glycerine. $\frac{1}{2} + \frac{1}{2}$
 6. (i) 4.8×10^{-3} (ii) 2.34×10^5 (iii) 8.008×10^3 (iv) 5.000×10^2 . $\frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2}$
 7. (i) 1 mol of N_2 , i.e., 28 g react with 3 mol of H_2 , i.e., 6 g of H_2
 $\therefore$ 2000 g of N_2 will react with $\text{H}_2 = \frac{6}{28} \times 2000 \text{ g} = 428.6 \text{ g}$.
 Thus, N_2 is the limiting reagent while H_2 is the excess reagent.
 2 mol of N_2 , i.e. 28 g of N_2 produce $\text{NH}_3 = 2 \text{ ml} = 34 \text{ g}$
 $\therefore$ 2000 g of N_2 will produce $\text{NH}_3 = \frac{34}{28} \times 2000 \text{ g} = 2428.57 \text{ g}$ 1
 (ii) H_2 will remain unreacted. 1
 8. BF_3 , H^+ and NH_4^+ . 2
 9. Anaemia is caused by lead contamination in drinking water while methemoglobinemia is caused by nitrate contamination in drinking water. 2
 10. (i) 2-methyl phenol. 1
 (ii) 5-(2-methyl propyl) decane. 1
- OR**
- An aldehyde having molecular mass of 44 a.m.u. is ethanal, CH_3CHO .
 Since alkene gives two moles of ethanal $\text{CH}_3\text{CH}=\text{O}$ $\text{O}=\text{CHCH}_3$
- Therefore, alkene is $\text{CH}_3\text{CH}=\text{CH}-\text{CH}_3$ or $\begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & & \text{H} \\ & | & & | & & | & & | \\ \text{H} & -\text{C} & - & \text{C} & = & \text{C} & - & \text{C} & - & \text{H} \\ & | & & & & & & | \\ & \text{H} & & & & & & \text{H} \end{array}$
- But-2-ene has three C—C, one C = C eight C—H bonds. 2
11. (1) Heisenberg's uncertainty principle state that is not possible to measure simultaneously both the position and momentum (or velocity) of a microscopic particle, with absolute accuracy. 1
 (2) Cu ($Z = 29$) : $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$ $\frac{1}{2}$
 Cr^{3+} ($Z = 21$) : $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$ $\frac{1}{2}$
 (3) $4f$ 1
 12. (a) 11, (b) 7, (c) 18. 1 + 1 + 1
 13. The dipole moment of NH_3 (1.46 D) is much higher than that of NF_3 . $\frac{1}{2}$

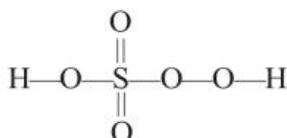
This is due to different directions of the bond moments of N—H and N—F bonds. In the first case H is more electronegative but in the second case F is more electronegative. Thus in NH_3 , the dipole moments of N—H bonds are in the same direction as that of the lone pair but in NF_3 , the dipole moments of N—F bonds oppose that of the lone pair (as shown in the diagram below).



Molecular orbital formula of O_2^{2-} : $(\sigma_{1s})^2 (\sigma_{1s}^*)^2 (\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\sigma_{2pz})^2 (\pi_{2px})^2 = (\pi_{2py})^2 (\pi_{2px}^*)^2 = (\pi_{2py}^*)^2$

14. (i) **O.N. of S in H_2SO_5**

The structure of H_2SO_5 is

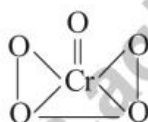


$$2 \times (+1) + x + 2(-1) + 3 \times (-2) = 0 \quad \text{or} \quad x = +6$$

(for H) (for S) for (O—O) (for other O atoms)

(ii) **O. N. of Cr in CrO_5**

The structure of CrO_5 is



From this structure, the O.N. of Cr can be calculated as follows :

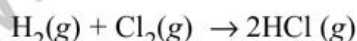
$$x + 4(-1) + 1(-2) = 0 \quad \text{or} \quad x = +6$$

(for O—O) (for = O)

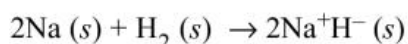
(iii) **O.N. of N in NO_3^-**

$$\text{O.N. of N in } \text{NO}_3^- = x + 3(-2) = -1 \quad \text{or} \quad x = +5$$

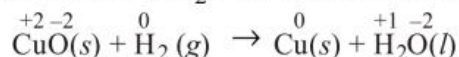
15. (i) Dihydrogen reduces chlorine to Cl^- ion and itself gets oxidized to H^+ ions. An electron pair is then shared between these two species to form a covalent molecule of hydrogen chloride.



(ii) Sodium reduces dihydrogen to form hydride ion (H^-) and itself gets oxidized to sodium ion (Na^+). During this reaction, an electron is completely transferred from Na to H thereby forming ionic sodium hydride, $\text{Na}^+ \text{H}^-$.

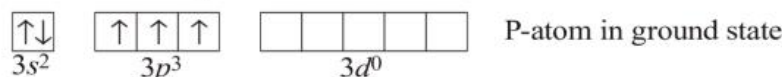


(iii) Hydrogen reduces copper (II) oxide to copper metal. (zero oxidation state) while itself gets oxidized to form a covalent molecule of H_2O (in which H has an oxidation state of +1).



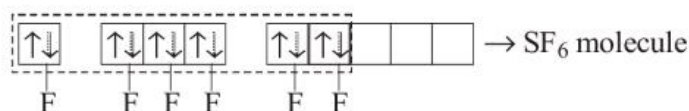
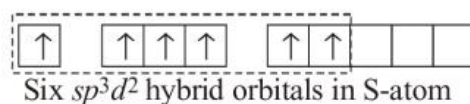
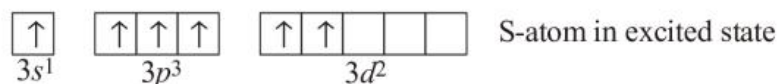
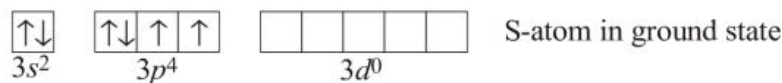
16. **Hybridization** is defined as the mixing of the atomic orbitals belonging to the same atom but having slightly different energies so that a redistribution of energy takes place between them resulting in the formation of new orbitals of equal energies and identical shapes. The new orbitals thus formed are known as **hybrid orbitals**.

Hybridization in PCl_5





1



1

17. (1) $K_c = \frac{[\text{PCl}_3(\text{g})][\text{Cl}_2(\text{g})]}{[\text{PCl}_5(\text{g})]}$

1

(2) $K' = \frac{1}{K_c} = \frac{1}{8.3 \times 10^{-3}} = 120.48$

1

(3) No effect.

1

18. (i) Time required = $\frac{6.02 \times 10^{23}}{10^{10}} \text{ s} = 6.02 \times 10^{13} \text{ s} = \frac{6.02 \times 10^{13}}{60 \times 6 \times 24 \times 365} \text{ years}$
 = 1.9089 × 10⁶ years approx.

1

(ii) Decreases to half, Boyle's Law.

1 + 1

19. (a) Yes, Insecticides, pesticides which are generally used for the protection of the crop cause soil pollution even herbicides cause soil pollution.

½

(b) **Measures :** (1) Domestic waste should be collected in two separate bins-biodegradable like food and vegetable waste, non-biodegradable waste like plastic, toys, cans etc.

1

(2) Minimum usage of synthetic fertilizers, pesticides, insecticides, herbicides should be done.

½

(3) Proper management of not only domestic waste, but also medical agricultural, industrial and mining waste should be increased.

½

(4) Use of polythenes should be avoided and should not allowed to get mixed with animal fodder.

½

20. (i) Resonance or delocalization of electrons usually leads to stability. Since, in benzene all the six π -electrons of the three double bonds are completely delocalized to form one lowest energy molecular orbital which surrounds all the carbon atoms of the ring, therefore, it is extraordinarily stable.

1

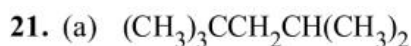
(ii) As the branching increases, the surface area of an alkane approaches that of a sphere. Since, a sphere has minimum surface area, therefore, van der Waals forces of attraction are minimum and hence the boiling point of the alkane decreases with branching.

1

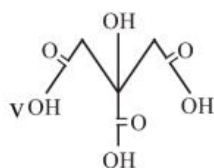
(iii) The acidic character of 1-alkynes can be explained on the basis of *sp* hybridization state of the carbon atoms in alkynes. We know that an electron in *s*-orbital is more tightly held than in a *p*-orbital because *s*-electrons are more closer to the nucleus. In *sp* hybridization, *s*-character is more (50%) as compared to *sp*² (33%) or *sp*³ (25%) hybrid orbitals, Due to very large *s*-character, the electrons in *sp* hybrid orbitals are held more tightly by the nucleus and are quite electronegative, Consequently, the electron pair of H—C $\equiv$ bond gets displaced more towards the carbon atom and helps in the release of a proton (H⁺ ion).



1



1



1



1

22. (a) Small size $\propto$ Hydration energy

$$\propto \frac{1}{\text{ionic}} \text{ mobility}$$

1

(b) Lithium on account of its small size, shows anomalous behaviour.

1

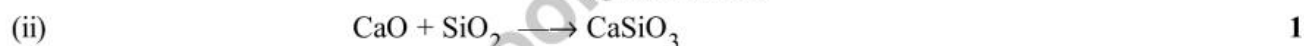
(c) E° for $\text{M}^{2+}/\text{M}(s)$ depends upon (i) enthalpy of vaporisation (ii) ionisation enthalpy and (iii) enthalpy of hydration. The combined effect of these factors is approximately the same for Ca, Sr, and Ba so that their electrode potentials are nearly same.

1

OR



Magnesium nitride



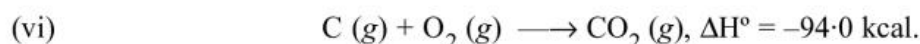
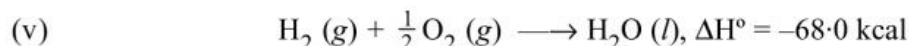
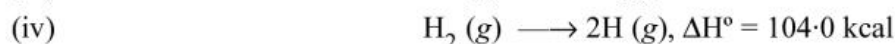
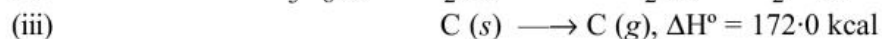
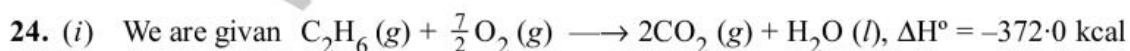
Calcium silicate



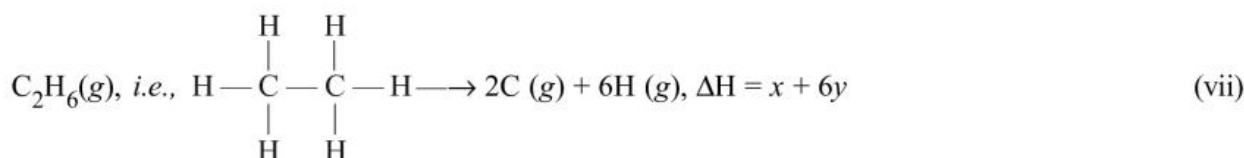
Bleaching power

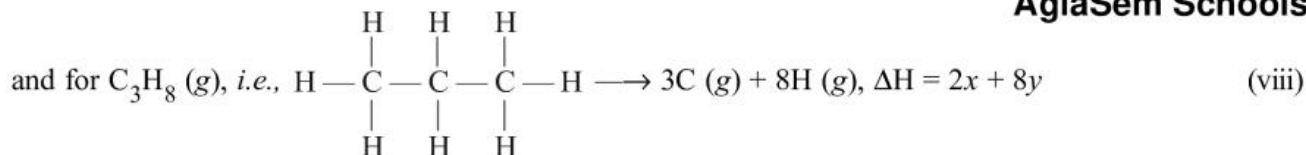
23. (i) *d*-block elements have close packed structure in which *d*-block elements are linked with powerful metallic bonds. As a consequence, *d*-block elements are hard solid with high density. 2

(ii) Transition metals have higher ionisation enthalpies in comparison to alkaline earth metals. Therefore, transition metals are less electropositive than alkaline earth metals. 2



Suppose the bond energy of C—C—bond = $x \text{ kcal mole}^{-1}$ and that of C—H bond = $y \text{ kcal mole}^{-1}$.





To get Eqn. (vii), operate Eqn. (i) + 2 × Eqn. (iii) + 3 × Eqn. (iv) – 3 × Eqn. (v) – 2 × Eqn. (vi).

This gives $\Delta H = 676 \text{ kcal}$

To get Eqn. (viii), operate Eqn. (ii) + Eqn. (iii) + 4 × Eqn. (iv) – 4 × Eqn. (v) – 3 × Eqn. (vi).

This gives $\Delta H = 956 \text{ kcal}$

Thus,

$$x + 6y = 676$$

$$2x + 8y = 956$$

On solving these equations, we get $x = 82, y = 99$

Hence, C—H bond energy = 82 kcal mol^{-1} and C—H bond energy = 99 kcal mol^{-1}

5

OR

(i)
$$\text{Energy left unutilized} = \frac{1560}{2} \text{ kJ} = 780 \text{ kJ}$$

For losing 44 kJ of energy water to be evaporated = 1 mole = 18 g

$\therefore$ For losing 780 kJ of energy, water to be evaporated = $\frac{18}{44} \times 780 \text{ g} = 319 \text{ g}$

2

(ii) Electrolysis of water takes place as : $2H_2O(l) \longrightarrow 2H_2(g) + O_2(g)$

Thus, 2 moles of H_2O , i.e., $2 \times 18 = 36 \text{ g}$ of H_2O on electrolysis produce 2 moles of H_2 gas and one mole of O_2 gas, i.e., total 3 moles of the gases.

$\therefore$ 100 g of water will produce gases = $\frac{3}{36} \times 100 = 8.33 \text{ moles}$

Volume occupied by 8.33 moles of gases at 25°C and 1 atm pressure is given by

$$V = \frac{nRT}{P} = \frac{(8.33 \text{ mole})(0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1})(298\text{K})}{1 \text{ atm}} = 203.8 \text{ L}$$

Taking the volume of liquid water as negligible (being 100 mL = 0.1 L), $\Delta V = 203.8 \text{ L}$

$\therefore w = -P_{\text{ext}} \Delta V = -1 \text{ atm} \times 203.8 \text{ L} = -203.8 \text{ L atm} = 203.8 \times 101.3 \text{ J} = -20.6 \text{ kJ}$

25. (i) (a) $\overset{+}{C}H_3$ is most stable. The replacement of H by Br increases positive charge on carbon atom because Br is more electronegative than H and consequently the species becomes less stable. 1

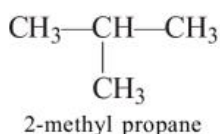
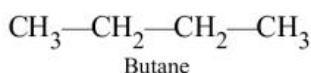
(b) $\overset{+}{C}Cl_3$ is most stable because Cl is more electronegative than hydrogen. On replacing hydrogen by chlorine, negative charge on C is reduced and the species becomes stable. 1

(ii)	Inductive effect	Resonance effect	
1.	This effect involves displacement of σ -electrons.	The resonance involves displacement of π -electrons or lone pair electrons.	1
2.	It operates in saturated compounds.	It operates only in unsaturated conjugated systems.	1
3.	This effect moves upto three carbon atoms and becomes negligible from the fourth carbon atom onwards.	This effect moves all along the length of the conjugates system.	1

OR

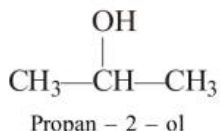
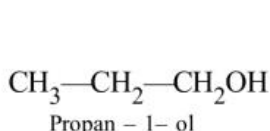


- (b) The compounds having same molecular formula but different arrangement of atoms within the molecule are called **chain isomers** or skeletal isomers and the phenomenon is termed as **chain isomerism**. for example,



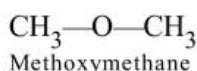
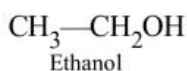
1

The compounds which have the same molecular formula but differ in the position of the functional groups, carbon-carbon multiple bond or substituent group are called position isomers and this phenomenon is termed as position isomerism, e.g.,



1

The compounds having same molecular formula but different functional groups in the molecule are called functional group isomers and this phenomenon is termed as functional group isomerism. For example,

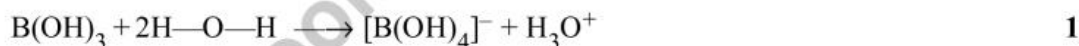


1

26. (1) F^- is a powerful ligand in comparison to Cl^- , therefore, it can easily form coordination compound with SiF_4 .



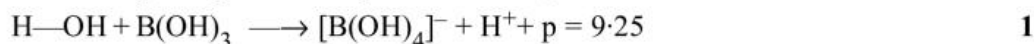
- (2) Since diamond exists as a three-dimensional network solid, it is the hardest substance known with high density and melting point. 1
- (3) Boric acid is a weak monobasic acid ($K_a = 1.0 \times 10^{-9}$). It may be noted that boric acid does not act as a protonic acid (*i.e.*, proton donor) but behaves as a Lewis acid by accepting a pair of electrons from OH^- ion.



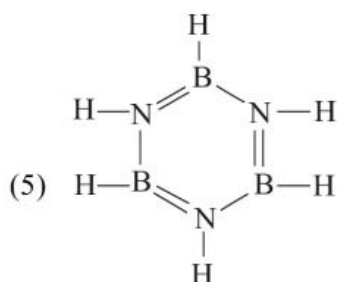
- (4) Boron tri fluoride is an electron deficient species, therefore, it behaves like a Lewis acid. 1
- (5) Carbon dioxide is a linear molecule while silicon dioxide is covalent three dimensional molecule therefore SiO_2 is a solid while CO_2 is gas. 1

OR

- (1) In 1985, scientists discovered a new family of carbon allotropes consisting of cluster of carbon atoms such as C_{32} , C_{50} , C_{60} , C_{70} , C_{84} , etc. These were called fullerenes. 1
- (2) Since boric acid release only one proton in aqueous solution, therefore it is monobasic in nature.



- (3) In heavier elements electrons from s-orbitals do not take part in bond formation. Such a pair of electrons is called **Inert-Pair** and this effect is called **Inert-Pair Effect**. 1
- (4) Since Pb^{4+} is less stable due to inert pair effect, therefore PbCl_4 is a good oxidising agent. 1



Borazine, $\text{B}_3\text{N}_3\text{H}_6$

1

