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**MEGA SCHOLARSHIP TEST  
(₹ 200000)**

**TEST - 40**

**LEVEL - 1 & LEVEL - 2**

**TOPIC:**

**CHEMISTRY  
(XI Syllabus)**

**Test Date: 07.04.2018 (Saturday)**

**Time: 11:00 AM to 01:30 PM**

**Empowered By:**

**TEST SERIES**

**PCB**  
**QUANTUM<sup>+</sup> Plus**

**PCM**  
**INTELLIQUEST**



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## IMPORTANT INSTRUCTIONS

- Test Duration: 11:00 AM to 1:30 PM
- This test consist of 2 Levels.

### Level – I

Time: 60 Minutes [11:00 to 12:00 Noon]

45 Qs.  $\times$  4 = 180 Marks

(Single Answer Type) [Negative Marking = - 1]

### Level – II

Time: 90 Minutes [12:00 NOON to 1:30 PM]

45 Qs = 217 Marks

- Single Answer Type [Negative Marking (-1)] =  $7 \times 4 = 28$  Marks
  - Assertion & Reason [Negative Marking (-1)] =  $10 \times 4 = 40$  Marks
  - Comprehension Type [Negative Marking (-1)] =  $9 \times 5 = 45$  Marks
  - More than One Answer [No Negative Marking] =  $8 \times 5 = 40$  Marks
  - Matrix Match Type [No Negative Marking] =  $3 \times 8 = 24$  Marks
  - Integer Type [No Negative Marking] =  $8 \times 5 = 40$  Marks
- Every candidate will get 2 OMR Sheets for answering Level – I and Level – II separately. The candidate will start with Level – I first and return Level I OMR sheet immediately at 12:00 pm after 60 minutes. So please ensure to fill up OMR on time.
  - OMR sheet for Level – II will be collected immediately after completion of test time at 1:30 pm.
  - Usage of Mobile is strictly prohibited in the examination hall. The mobile must be kept switched off during exam time. Anybody seen using or fiddling with mobile phone will get disqualified for the test.
  - Unfair means of any sort during exam will entail cancellation and disqualification of his/her paper.
  - Answer Key will be given only after completion of paper. Detailed solutions will be uploaded on website.

**“BEST OF LUCK”**

**MEGA SCHOLARSHIP TEST (XI Syllabus) – Level – 1**

**Single Answer Type (Negative Marking [-1])**

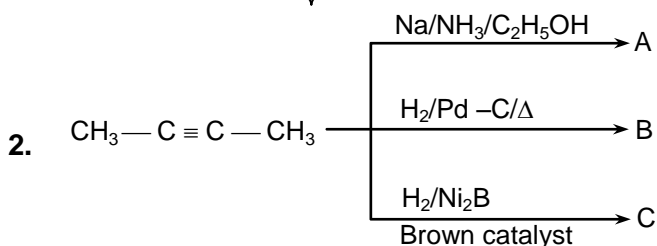
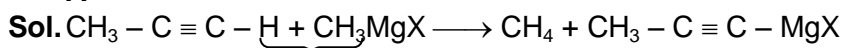
This Section contains **45 multiple choice questions**. Each question has four choices A), B), C) and D) out of which **ONLY ONE** is correct. (Mark only One choice) **45 x 4 = 180 Marks**

**45 x 4 = 180 Marks**

1. The treatment of  $\text{CH}_3\text{MgX}$  with  $\text{CH}_3 - \text{C} \equiv \text{C} - \text{H}$  produces:

- a. CH<sub>4</sub>  
c. CH<sub>3</sub> – C ≡ C – CH<sub>3</sub>

# A

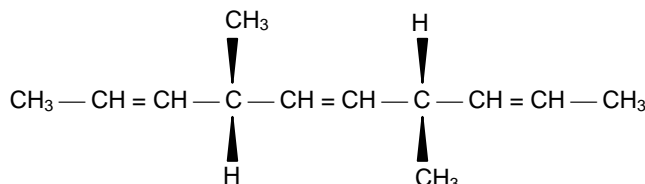


A, B and C, respectively are :

- a.  $\begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} = \text{C} \\ \diagup \\ \text{H} \end{array} \begin{array}{c} \text{H} \\ \diagup \\ \text{C} = \text{C} \\ \diagdown \\ \text{CH}_3 \end{array} ; \quad \begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} = \text{C} \\ \diagup \\ \text{H} \end{array} \begin{array}{c} \text{CH}_3 \\ \diagup \\ \text{C} = \text{C} \\ \diagdown \\ \text{H} \end{array} ; \quad \text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
- b.  $\begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} = \text{C} \\ \diagup \\ \text{H} \end{array} \begin{array}{c} \text{CH}_3 \\ \diagup \\ \text{C} = \text{C} \\ \diagdown \\ \text{H} \end{array} ; \quad \begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} = \text{C} \\ \diagup \\ \text{H} \end{array} \begin{array}{c} \text{H} \\ \diagup \\ \text{C} = \text{C} \\ \diagdown \\ \text{CH}_3 \end{array} ; \quad \text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
- c.  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 ; \quad \begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} = \text{C} \\ \diagup \\ \text{H} \end{array} \begin{array}{c} \text{H} \\ \diagup \\ \text{C} = \text{C} \\ \diagdown \\ \text{CH}_3 \end{array} ; \quad \begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} = \text{C} \\ \diagup \\ \text{H} \end{array} \begin{array}{c} \text{CH}_3 \\ \diagup \\ \text{C} = \text{C} \\ \diagdown \\ \text{H} \end{array}$
- d.  $\begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} = \text{C} \\ \diagup \\ \text{H} \end{array} \begin{array}{c} \text{H} \\ \diagup \\ \text{C} = \text{C} \\ \diagdown \\ \text{CH}_3 \end{array} ; \quad \text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 ; \quad \begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C} = \text{C} \\ \diagup \\ \text{H} \end{array} \begin{array}{c} \text{CH}_3 \\ \diagup \\ \text{C} = \text{C} \\ \diagdown \\ \text{H} \end{array}$

**D**

3. The number of optically active products obtained from the complete ozonolysis of the given compound is:



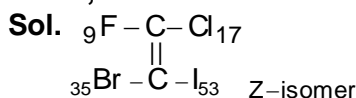
- a. 0                      b. 1                      c. 2                      d. 4

# A

4. The Z-isomer is:

- a.  $\begin{array}{c} \text{H}-\text{C}-\text{H} \\ || \\ \text{H}_5\text{C}_2-\text{C}-\text{C}_3\text{H}_7 \end{array}$       b.  $\begin{array}{c} \text{F}-\text{C}-\text{Cl} \\ || \\ \text{Br}-\text{C}-\text{I} \end{array}$       c.  $\begin{array}{c} \text{H}-\text{C}-\text{Cl} \\ || \\ \text{I}-\text{C}-\text{Br} \end{array}$       d.  $\begin{array}{c} \text{CH}_3-\text{C}-\text{C}_2\text{H}_5 \\ || \\ \text{H}_5\text{C}_2-\text{C}-\text{C}_3\text{H}_7 \end{array}$

**B.D**

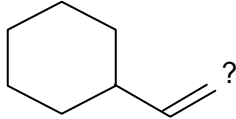


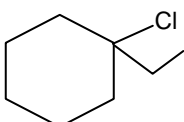
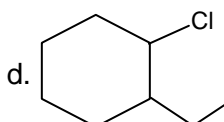
5. Which is the correct sequence of stability of the following enols? (Ph = C<sub>6</sub>H<sub>5</sub>)

- a.  $\text{Ph} - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{Ph} > \text{Ph} - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{H} > \text{CH}_3 - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{OCH}_3$
- b.  $\text{CH}_3 - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{O} - \text{CH}_3 > \text{Ph} - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{H} > \text{Ph} - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{Ph}$
- c.  $\text{Ph} - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{H} > \text{CH}_3 - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{OCH}_3 > \text{Ph} - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{Ph}$
- d.  $\text{Ph} - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{H} > \text{Ph} - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{Ph} > \text{CH}_3 - \overset{\text{OH}}{\underset{|}{\text{C}}} = \text{CH} - \overset{\text{O}}{\underset{||}{\text{C}}} - \text{O} - \text{CH}_3$

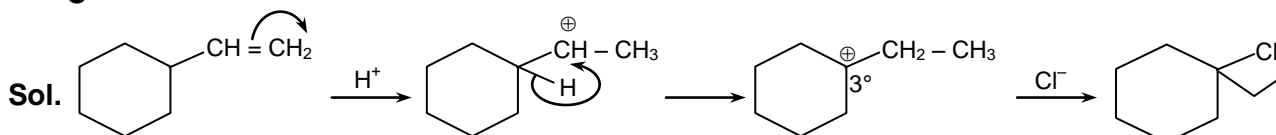
**A**

**Sol.** Increased conjugation in I; and ester gp has less tautomeric effect (in III)

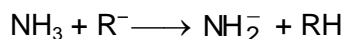
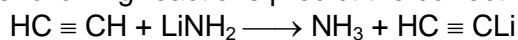
6. What is the major product of the addition of HCl on  ?

- a. 
- b. 
- c. 
- d. 

**C**



7. From the following reactions predict the correct order about acid strength.



- a.  $\text{RH} < \text{NH}_3 < \text{HC} \equiv \text{CH}$       b.  $\text{RH} > \text{NH}_3 > \text{HC} \equiv \text{CH}$
- c.  $\text{RH} > \text{NH}_3 < \text{HC} \equiv \text{CH}$       d.  $\text{RH} < \text{NH}_3 > \text{HC} \equiv \text{CH}$

**A**

**Sol.** From 1<sup>st</sup> equation  $\text{HC} \equiv \text{CH}$  is more acidic than  $\text{NH}_3$

From 2<sup>nd</sup> equation,  $\text{NH}_3$  is more acidic than  $\text{RH}$

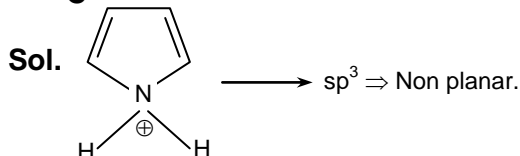
(Acid being produced is weaker than the one that produces it)

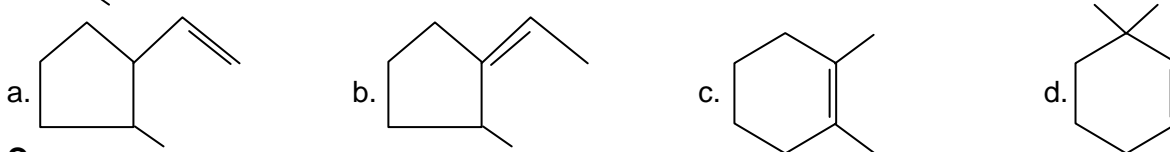
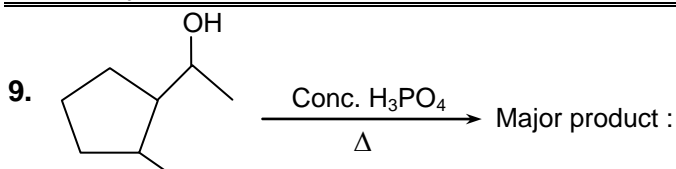
Acidic strength  $\text{HC} \equiv \text{CH} > \text{NH}_3 > \text{RH}$  or  $\text{RH} < \text{NH}_3 < \text{HC} \equiv \text{CH}$

8. Choose the non aromatic compound among the following:

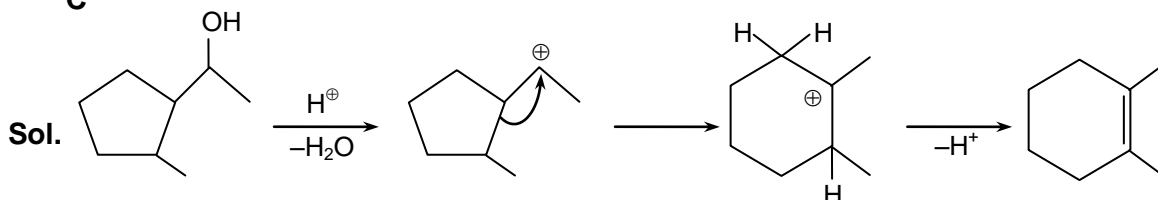
- a. 
- b. 
- c. 
- d. 

**C**





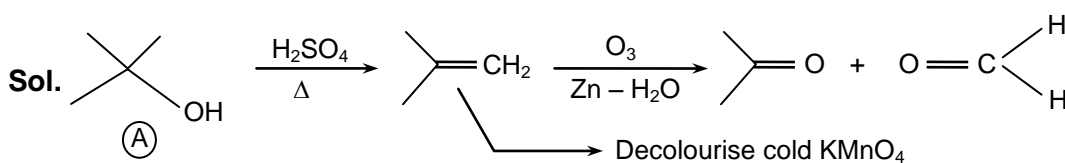
C



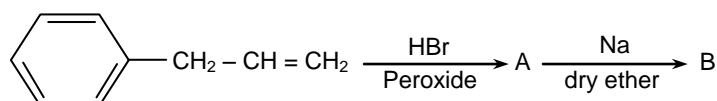
10. An alcohol (A) on dehydration gives (B), which on Ozonolysis gives acetone and formaldehyde. (B) decolourises alkaline  $\text{KMnO}_4$  solution but (A) does not. (A) and (B) are respectively:

- a.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$  and  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$   
 b.  $\text{CH}_3\text{CH}_2-\underset{\text{OH}}{\text{CH}}-\text{CH}_3$  and  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$   
 c.  $(\text{CH}_3)_3\text{C}-\text{OH}$  and  $(\text{CH}_3)_2\text{C}=\text{CH}_2$   
 d.  $\text{CH}_3-\text{CH}_2-\underset{\text{OH}}{\text{CH}}-\text{CH}_3$  and  $(\text{CH}_3)_2\text{C}=\text{CH}_2$

C

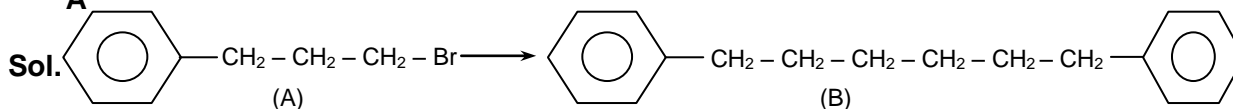


11. End product of the following reaction is



- a. 1,6-Diphenylhexane  
 b. 3-Phenyl-1-Bromopropane  
 c. 3-Bromo-1-phenylpropene  
 d. 1,5-Diphenyl hexane

A



12. Which one of the following arrangements of molecules is correct on the basis of their dipole moments?

- a.  $\text{BF}_3 > \text{NF}_3 > \text{NH}_3$       b.  $\text{NF}_3 > \text{BF}_3 > \text{NH}_3$       c.  $\text{NH}_3 > \text{BF}_3 > \text{NF}_3$       d.  $\text{NH}_3 > \text{NF}_3 > \text{BF}_3$

D

13. Which of the following can be used as raw material for synthesising silicone

- a.  $(\text{CH}_3)_2\text{SiCl}_2$       b.  $(\text{CH}_3)_3\text{SiCl}$       c.  $\text{CH}_3\text{SiCl}_3$       d. all

D

14. Match List I with List II and select the correct answer using the code given below the lists:

List I

1. Heavy water  
 2. Temporary hard water  
 3. Soft water  
 4. Permanent hard water

List II

- (a) Bicarbonates of Mg and Ca in water  
 (b) No foreign ions in water  
 (c)  $\text{D}_2\text{O}$   
 (d) Sulphates and chlorides of Mg and Ca in water

**Codes:**

a. 1 – c, 2 – d, 3 – b, 4 – a

b. 1 – b, 2 – a, 3 – c, 4 – d

c. 1 – b, 2 – d, 3 – c, 4 – a

d. 1 – c, 2 – a, 3 – b, 4 – d

**D**

**Sol.** Heavy water – D<sub>2</sub>O

Temporary Hard water – Bicarbonates of Mg/Ca in water

Soft water – No foreign ions in water

Permanent hard water – Sulphates and chlorides of Mg/Ca in water

Soft water – No foreign ions in water

Permanent hard water – Sulphates and chlorides of Mg/Ca in water

**15.** Consider the following abbreviations for hydrated alkali metal ions:

X = [Li(H<sub>2</sub>O)<sub>n</sub>]<sup>+</sup>; Y = [K(H<sub>2</sub>O)<sub>n</sub>]<sup>+</sup>; Z = [Cs(H<sub>2</sub>O)<sub>n</sub>]<sup>+</sup>

Which is the correct order of conductance of hydrated alkali metal ions?

a. X > Y > Z

b. Z > Y > X

c. X = Y = Z

d. Z > X > Y

**B**

**Sol.** Smaller cation, will have more ionic conductance. Size of hydrated ion decreases from Li<sup>+</sup> to Cs<sup>+</sup>, so conductance increases.

**16.** Wrong statement among the following is

a. Diamond is the best conductor of heat but insulator.

b. Graphite act as bad conductor of heat but good conductor of electricity.

c. Bucky ball, C<sub>60</sub>, has 20 six membered & 12 five membered ring.

d. In Fullerene, a six-membered ring is fused with either six or five-membered rings but a five-membered ring is also fused with five membered ring.

**D**

**17.** For reversible reaction:

X<sub>(g)</sub> + 3 Y<sub>(g)</sub>  $\rightleftharpoons$  2Z<sub>(g)</sub>;  $\Delta H = -40 \text{ kJ}$

Standard entropies of X, Y and Z are 60, 40 and 50 J K<sup>-1</sup> mol<sup>-1</sup> respectively. The temperature at which the above reaction is in equilibrium is

a. 273 K

b. 600 K

c. 500 K

d. 400 K

**C**

**Sol.** X + 3 Y  $\rightleftharpoons$  2Z

$\Delta S = 2 \times 50 - (60 + 3 \times 40) = -80 \text{ kJ}$

$\Delta G = \Delta H - T\Delta S$  when  $\Delta G = 0$

$T = \frac{\Delta H}{\Delta S} = -40 \times \frac{1000}{-80} = 500 \text{ K}$

**18.** A solution containing Mn<sup>2+</sup>, Fe<sup>2+</sup>, Zn<sup>2+</sup> and Hg<sup>2+</sup> with a molar concentration of 10<sup>-3</sup> M each is treated with 10<sup>-16</sup> M sulphide ion solution. Which ions will precipitate first if K<sub>sp</sub> of MnS, FeS, ZnS and HgS are 10<sup>-10</sup>, 10<sup>-23</sup>, 10<sup>-20</sup> and 10<sup>-54</sup> respectively?

a. FeS

b. MnS

c. HgS

d. ZnS

**C**

**Sol.** M<sup>2+</sup> + S<sup>2-</sup> → MS

Lower the value K<sub>sp</sub>, lower will be solubility. Hence HgS will precipitate first.

**19.** An orbital is described with the help of a wave function. Since many wave functions are possible for an electron, there are many atomic orbitals. When atom is placed in a magnetic field the possible number of orientations for an orbital of azimuthal quantum number 3 is

a. three

b. two

c. five

d. seven

**D**

**Sol.** When  $\ell = 3$ , magnetic quantum number has 7 values  $m_\ell = (2\ell + 1)$ . These values are represented as -3, -2, -1, 0, +1, +2, +3

**20.** Which of the following is not correct statement as indicated.

- a.  $C > Si > Ge > Pb > Sn$  (Ionization energy)      b.  $B < Ga < Al < In < Tl$  (Atomic size)  
 c.  $Al^{+3} < In^{+3} < Tl^{+3}$  (Stability)      d.  $CO_2 > SiO_2 > SnO_2 > PbO_2$  (acidic strength)

**C**

**21.** Which of the following is not a correct statement regarding the energies of orbitals in multielectron atom.

- a. The lower the value of  $(n + \ell)$  for an orbital, lower is its energy  
 b. Energies of the orbitals in the same subshell decreases with increase in atomic number.  
 c. Energies of s-orbital is lower than the p-orbital and that of p-orbital is lower than the d-orbital  
 d. If two orbitals have same value for  $(n + \ell)$ , the orbital with higher value of  $n$  will have lower energy

**D**

**Sol.** If two orbitals have same value for  $(n + \ell)$ , the orbital with lower value of  $n$  will have lower energy.

**22.** An impure sample of silver (1.5 g) is heated with S to form 0.124 g of  $Ag_2S$ . What was the per cent yield of  $Ag_2S$ ? [At. Wt. of Ag = 108, S = 32]

- a. 21.6%      b. 7.2%      c. 1.7%      d. 24.8%

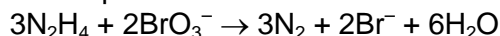
**B**

**Sol.**  $2Ag + S \longrightarrow Ag_2S$   
 $2 \times 108 = 216 \text{ g} \quad \quad \quad 248 \text{ g}$   
 216 g Ag forms 248 g  $Ag_2S$

1.5 g Ag forms  $\frac{248}{216} \times 1.5 = 1.722 \text{ g } Ag_2S$

% yield of  $Ag_2S = \frac{0.124}{1.722} \times 100 = 7.2\%$

**23.** Identify the compounds which are reduced and oxidised in the following reaction:



- a.  $N_2H_4$  is oxidised and  $BrO_3^-$  is reduced      b.  $BrO_3^-$  is reduced and  $N_2H_4$  is oxidised  
 c.  $BrO_3^-$  is both reduced and oxidised      d. This is not a redox reaction.

**A,B**

**Sol.**  $3\overset{-2}{N_2}\overset{+5}{H_4} + 2\overset{0}{Br}\overset{-1}{O_3} \rightarrow 3\overset{0}{N_2} + 2\overset{-1}{Br} + 6H_2O$

**24.**  $pK_a$  of a weak acid is 5.76 and  $pK_b$  of a weak base is 5.25. What will be the pH of the salt formed by the two?

- a. 7.255      b. 7.005      c. 10.225      d. 4.255

**A**

**Sol.**  $pH = \frac{1}{2}[pK_w + pK_a - pK_b]$

$pH = 7 + \frac{1}{2}(5.76 - 5.25) = 7.255$

**25.** Fill in the blanks in the given table with the appropriate choice.

Species	Conjugate acid	Conjugate base
$HCO_3^-$	<u>p</u>	$CO_3^{2-}$
$HSO_4^-$	$H_2SO_4$	<u>q</u>
$NH_3$	<u>r</u>	<u>s</u>
$H_2O$	<u>t</u>	$OH^-$

	p	q	r	s	t
a.	H <sub>2</sub> CO <sub>3</sub>	SO <sub>4</sub> <sup>2-</sup>	NH <sub>4</sub> <sup>+</sup>	NH <sub>2</sub> <sup>-</sup>	H <sub>3</sub> O <sup>+</sup>
b.	HCO <sub>3</sub> <sup>-</sup>	H <sub>2</sub> SO <sub>3</sub>	NH <sub>2</sub> <sup>-</sup>	NH <sub>4</sub> <sup>+</sup>	H <sub>3</sub> O <sup>+</sup>
c.	H <sub>2</sub> CO <sub>3</sub>	HSO <sub>4</sub> <sup>-</sup>	NH <sub>4</sub> <sup>+</sup>	NH <sub>2</sub> <sup>-</sup>	H <sub>2</sub> O
d.	HCO <sub>3</sub> <sup>-</sup>	H <sub>2</sub> SO <sub>4</sub>	NH <sub>2</sub> <sup>+</sup>	NH <sub>2</sub> <sup>-</sup>	OH <sup>-</sup>

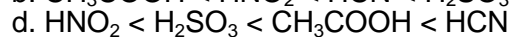
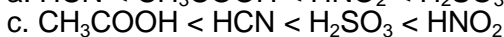
**A**

**Sol. Species**                      **Conjugated acid**                      **Conjugate base**

HCO <sub>3</sub> <sup>-</sup>	H <sub>2</sub> CO <sub>3</sub>	CO <sub>3</sub> <sup>2-</sup>
HSO <sub>4</sub> <sup>-</sup>	H <sub>2</sub> SO <sub>4</sub>	SO <sub>4</sub> <sup>2-</sup>
NH <sub>3</sub>	NH <sub>4</sub> <sup>+</sup>	NH <sub>2</sub> <sup>-</sup>
H <sub>2</sub> O	H <sub>3</sub> O <sup>+</sup>	OH <sup>-</sup>

26. Given below are the dissociation constant values of few acids. Arrange them in order of increasing acidic strength.

$$\text{H}_2\text{SO}_3 = 1.3 \times 10^{-2}, \text{HNO}_2 = 4 \times 10^{-4}, \text{CH}_3\text{COOH} = 1.8 \times 10^{-5}, \text{HCN} = 4 \times 10^{-10}$$



**A**

**Sol.** Acid strength  $\propto \sqrt{K_a}$

27. 5 moles of PCl<sub>5</sub> are heated in a closed vessel of 5 litre capacity. At equilibrium 40% of PCl<sub>5</sub> is found to be dissociated. What is the value of K<sub>c</sub>?

a. 0.266 M

b. 0.133 M

c. 2.5 M

d. 0.20 M

**A**

**Sol.**

	PCl <sub>5(g)</sub>	$\rightleftharpoons$	PCl <sub>3(g)</sub>	+	Cl <sub>2(g)</sub>
Initial conc.	$\frac{5}{5} = 1$		0		0
At equilibrium	1 - 0.4		0.4		0.4

$$K_c = \frac{[\text{PCl}_3][\text{Cl}_2]}{[\text{PCl}_5]} = \frac{0.4\text{M} \times 0.4\text{M}}{0.6\text{M}} = 0.266 \text{ M}$$

28. Given the following data:

$$\Delta H_f(\text{C}_2\text{H}_4) = 12.5 \text{ kcal}$$

$$\text{Heat of atomization of C} = 171 \text{ kcal}$$

$$\text{Bond energy of H}_2 = 104.2 \text{ kcal}$$

$$\text{Bond energy of C - H bond} = 99.3 \text{ kcal}$$

What is C = C bond energy?

a. 140.7 kcal

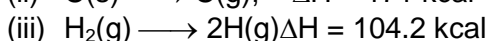
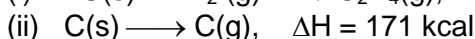
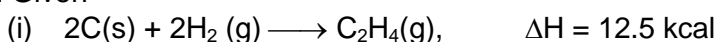
b. 36 kcal

c. 40 kcal

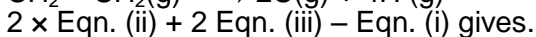
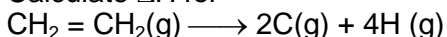
d. 76 kcal

**A**

**Sol.** Given



Calculate  $\Delta H$  for



$$= 171 \times 2 + 104.2 \times 2 - 12.5$$

$$= 342 + 208.4 - 12.5$$

$$\Delta H = 537.9 \text{ kcal}$$

$$\text{BE}_{\text{C}=\text{C}} = 537.9 - 4 \times 99.3$$

$$= 537.9 - 397.2$$

$$= 140.7 \text{ kcal}$$

29. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. The  $\Delta E$  for this process is:

$$(R = 2 \text{ cal mol}^{-1} \text{ K}^{-1})$$

a. 163.7 cal

b. zero

c. 1381.1 cal

d. 9 lit atom



**B**

**Sol.** For isothermal expansion of ideal gas,  $\Delta E = 0$

**30.** A hydrocarbon with five carbon atoms in the molecule, decolourizes alkaline  $\text{KMnO}_4$ , but does not give a precipitate with ammonical  $\text{Cu}_2\text{Cl}_2$  solution. The hydrocarbon is possibly

- a. 1-pentyne                      b. 1, 3-pentadiyne                      c. 2-pentyne                      d. 1, 4-pentadiyne

**C**

**Sol.** It is 2-pentyne,  $\text{CH}_3\text{C} \equiv \text{CCH}_2\text{CH}_3$ , which being a non-terminal alkyne, will not give ppt. with ammonical  $\text{Cu}_2\text{Cl}_2$  solution.

**31.** The IUPAC name of  $\text{CH}_3(\text{CH}_2)_4 \begin{array}{c} \text{CH}_3 \\ | \\ \text{CH} - \text{C} \text{CH}_2\text{CH}_3 \\ | \\ (\text{CH}_2)_2\text{CH}_3 \end{array}$  is

- a. 6, 7-Dimethyl-7-propylnonane                      b. 3, 4-Dimethyl-3-propylnonane  
c. 6, 7-Dimethyl-7-ethyldecane                      d. 4-Ethyl-4, 5-dimethyldecane

**D**

**32.** What will be the uncertainty in velocity of an electron when the uncertainty in its position is  $1000 \text{ \AA}$ ?

- a.  $5.79 \times 10^2 \text{ m s}^{-1}$                       b.  $5.79 \times 10^8 \text{ m s}^{-1}$                       c.  $5.79 \times 10^4 \text{ m s}^{-1}$                       d.  $5.79 \times 10^{-10} \text{ m s}^{-1}$

**A**

**Sol.**  $\Delta x \cdot m \Delta v = \frac{h}{4\pi}$

$$\Delta x = 1000 \text{ \AA} = 1000 \times 10^{-10} \text{ m or } 10^{-7} \text{ m}$$

$$\Delta v = \frac{6.626 \times 10^{-34} \text{ Js}}{4 \times 3.14 \times 9.1 \times 10^{-31} \text{ kg} \times 10^{-7} \text{ m}} = 5.79 \times 10^2 \text{ m/s}$$

**33.** Which of the following expressions represent the value and unit of van der Waals' constant  $a$ ?

- a.  $a = \frac{V}{n}, \text{L mol}^{-1}$                       b.  $a = \frac{PV}{n}, \text{atm L}^2 \text{ mol}^{-1}$   
c.  $a = \frac{PV^2}{n^2}, \text{atm L}^2 \text{ mol}^{-2}$                       d.  $a = \frac{P}{n}, \text{atm mol}^{-1}$

**C**

**Sol.**  $P = \frac{an^2}{V^2}$ ;  $a = \frac{PV^2}{n^2}$ , Unit :  $\text{atm L}^2 \text{ mol}^{-2}$

**34.** Given below are the two reactions of  $\text{H}_2\text{O}_2$ . Mark the correct statement which follows.

- (i)  $2\text{KMnO}_4 + 3\text{H}_2\text{SO}_4 + 5\text{H}_2\text{O}_2 \rightarrow \text{K}_2\text{SO}_4 + 2\text{MnSO}_4 + 8\text{H}_2\text{O} + 5\text{O}_2$   
(ii)  $2\text{Cr}(\text{OH})_3 + 4\text{NaOH} + 3\text{H}_2\text{O}_2 \rightarrow 2\text{Na}_2\text{CrO}_4 + 8\text{H}_2\text{O}$

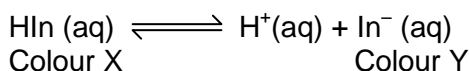
- a. (i) Shows oxidising nature of  $\text{H}_2\text{O}_2$  and (ii) shows reducing nature of  $\text{H}_2\text{O}_2$   
b. In (i)  $\text{H}_2\text{O}_2$  acts as a reducing agent and in (ii) it acts an oxidizing agent.  
c. In both (i) and (ii),  $\text{H}_2\text{O}_2$  acts as an oxidizing agent  
d. In both (i) and (ii),  $\text{H}_2\text{O}_2$  acts as as a reducing agent.

**B**

**Sol.** In (i)  $\text{H}_2\text{O}_2$  reduces  $\text{KMnO}_4$  to  $\text{MnSO}_4$  and is oxidised to  $\text{O}_2$ .

In (ii)  $\text{H}_2\text{O}_2$  oxidises  $\text{Cr}(\text{OH})_3$  to  $\text{Na}_2\text{CrO}_4$  and is reduced to  $\text{H}_2\text{O}$ .

**35.** The colour changes of an indicator HIn in acid base titrations is given below



Which of the following statements is correct?

- (a) In a strong alkaline solution colour Y will be observed  
(b) In a strong acidic solution colour Y will be observed

- (c) Concentration of  $\text{In}^-$  is higher than that of  $\text{HIn}$  at the equivalence point  
(d) In a strong alkaline solution colour X is observed

**A**

**Sol.** It is an acidic indicator therefore will remain in ionized form in strong alkaline solution (opposite ion effect).

- 36.** Which of the following is correct?

A liquid with

- (a) low vapour pressure will have a high surface tension and high boiling point  
(b) high vapour pressure will have high intermolecular forces and high boiling point  
(c) low vapour pressure will have high surface tension and high boiling point  
(d) low vapour pressure will have low surface tension and low boiling point

**A,C**

**Sol.** A liquid with low vapour pressure (less volatile) will have strong interparticle forces and will have a high surface tension and high boiling point

- 37.** Three samples of 100 g of water (samples I, II and III), initially kept at 1 atm pressure and 298 K were given the following treatments.

Sample I was heated to 320 K and cooled to 298 K

Sample II was heated to 300 K, cooled to 273 K and heated to 298 K

Sample III was heated to 373 K and cooled to 298 K

At the end of these processes, the internal energy of

- (a) III is the highest  
(b) II is the highest  
(c) I and III are the same, II is lower than that of I and III  
(d) I, II and III are the same

**D**

**Sol.** Internal energy change is a state function.

- 38.** Which of the following is not a pair of a Lewis acid and a Lewis base ?

- (a)  $\text{H}^+$ ,  $(\text{C}_2\text{H}_5)_2\text{O}$                       (b)  $\text{H}_2\text{O}$ ,  $\text{AlCl}_3$                       (c)  $\text{Fe}^{3+}$ ,  $\text{CO}$                       (d)  $\text{SiF}_4$ ,  $\text{BF}_3$

**D**

**Sol.** Both  $\text{SiF}_4$  &  $\text{BF}_3$  are both Lewis acids

- 39.** A certain gas diffuses from two different vessels A and B. The vessel A has a circular orifice while vessel B has a square orifice of length equal to the radius of the orifice. Calculate the ratio of the rates of diffusion of the gas from vessel A to vessel B, assuming same temperature and pressure is;

- a.  $\pi$                       b. 7 : 22                      c. 1 : 1                      d. 2 : 1

**A**

**Sol.** area of circle =  $\pi r^2$

area of square =  $\ell^2$

$$\frac{r_1}{r_2} = \frac{A_1}{A_2} = \frac{\pi r^2}{\ell^2} = \pi \quad \boxed{\text{as } r = \ell}$$

- 40.** The total charge in coulombs on 19 g of  $\text{PO}_4^{3-}$  ions is: [At. Wt. of P = 31; O = 16]

- a.  $6.02 \times 10^{23}$                       b.  $1.8 \times 10^3$                       c.  $5.79 \times 10^4$                       d. 57.9

**C**

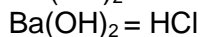
**Sol.** 95 g i.e., 1 mol  $\text{PO}_4^{3-} \equiv 3\text{F charge}$

$$19\text{g } \text{PO}_4^{3-} \equiv \frac{3 \times 19}{95} \times 96500 \text{ C} = 57900 \text{ C} = 5.79 \times 10^4 \text{ C}$$

- 41.** 25 mL of a solution of  $\text{Ba(OH)}_2$  on titration with 0.1 molar solution of hydrochloric acid gave a titre value of 35 mL. The molarity of  $\text{Ba(OH)}_2$  solution was:

- a. 0.07 M                      b. 0.14 M                      c. 0.28 M                      d. 0.35 M

A



$N_1V_1 = N_2V_2$

$x_1M_1V_1 = x_2M_2V_2$

$2 \times M \times 25 = 1 \times 0.1 \times 35$

$M_1 = \frac{1}{2} \times \frac{0.1 \times 35}{25} = 0.07 \text{ M}$

42. A 0.5 M NaOH solution has density  $1.02 \text{ g mL}^{-1}$ . Its molality is:

a. 0.51 m

b. 0.49 m

c. 0.50 m

d. cannot be calculated

C

**Sol.**  $m = \frac{M}{d - M(M_B \text{ kg})}$

$$= \frac{0.5}{1.02 - 0.5 \times \frac{40}{1000}}$$

$$= \frac{0.5}{1.02 - 0.02} = 0.5$$

or mole of NaOH = 0.5

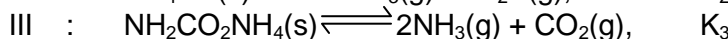
mass NaOH = 20 gm

mass of solution =  $v \times d = 1000 \times 1.02 = 1020 \text{ gm}$

mass of solvent =  $1020 - 20 = 1000 \text{ gm}$

molality = 0.5 m

43. In each of the following total pressure setup at equilibrium is assumed to be equal and is 1 atm with equilibrium constants  $K_p$  given



In the increasing order

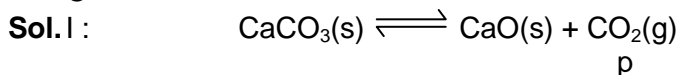
a.  $K_1 = K_2 = K_3$

b.  $K_1 < K_2 < K_3$

c.  $K_3 < K_2 < K_1$

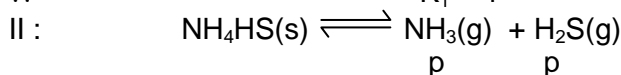
d. None of these

C



$(K_p)_1 = p$

$K_1 = 1$

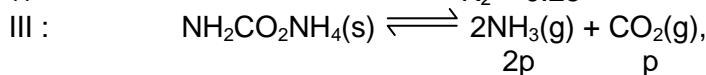


$p + p = 1$

$p = \frac{1}{2}$

$(K_p)_2 = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} = 0.25$

$K_2 = 0.25$



$2p + p = 1$

$p = \frac{1}{3}$

$P_{\text{NH}_3} = \frac{2}{3}$

$P_{\text{CO}_2} = \frac{1}{3}$

$(K_p)_3 = \left(\frac{2}{3}\right)^2 \left(\frac{1}{3}\right) = \frac{4}{27}$

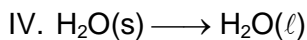
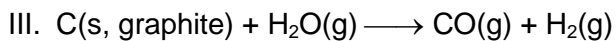
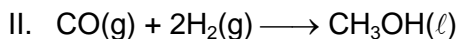
$\therefore$

$K_3 = 0.148$

Thus,

$K_3 < K_2 < K_1$

**44.** Determine which of the following reactions at constant pressure represent surrounding that do work on the system environment



a. III, IV

b. II and III

c. II, IV

d. I and II, IV

**D**

**Sol.**  $w = -P_{\text{ext}} \Delta V = -\Delta n_g RT$  and  $\Delta n_g$  is -ve for I and II

also  $\Delta V = -ve$  for IV (on contraction surrounding does work on surrounding).

**45.** Which of the following salts shall cause maximum cooling when one mole of the salt is dissolved in the same amount of water: (Integral heat of solution at  $25^\circ\text{C}$  is given below for each solute).

a.  $\text{KNO}_3$  ( $\Delta H = 35.4 \text{ KJ}$ )

b.  $\text{NaCl}$  ( $\Delta H = 5.35 \text{ KJ}$ )

c.  $\text{KOH}$  ( $\Delta H = -55.6 \text{ KJ}$ )

d.  $\text{HBr}$  ( $\Delta H = -83.3 \text{ KJ}$ )

**A**

**Sol.** A salt with maximum  $\Delta H_{\text{solution}}$  will cause maximum cooling

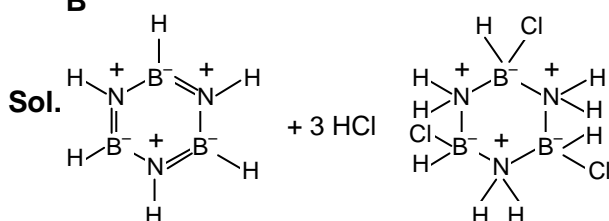
1. Total Questions: 45
2. Time: 1 hour 30 minutes Maximum Marks: 217
3. To be answered on other OMR.

## SECTION – A (Single Correct Choice Type) Negative Marking [-1]

This Section contains 7 multiple choice questions. Each question has four choices A), B), C) and D) out of which **ONLY ONE** is correct. (Mark only One choice) **7 × 4 = 28 Marks**

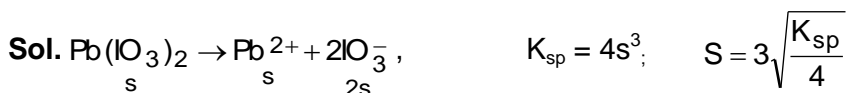
1. Inorganic benzene reacts with HCl to form a compound  $B_3N_3H_9Cl_3$ . The protonation occurs at:

- (a) B-atom (b) N-atom  
(c) First at B-atom then rearranges into N-atom (d) First at N-atom then rearranges into B-atom

**B**

2.  $K_{sp}$  for lead iodate  $[Pb(IO_3)_2]$  is  $3.2 \times 10^{-14}$  at a given temperature. The solubility in  $\text{mol L}^{-1}$  will be

- a.  $2.0 \times 10^{-5}$  b.  $(3.2 \times 10^{-7})^{1/2}$  c.  $(3.8 \times 10^{-7})$  d.  $4.0 \times 10^{-6}$

**A**

$$\text{or } s = (K_{sp/4})^{1/3} = \left(\frac{3.2 \times 10^{-14}}{4}\right)^{1/3}$$

$$= 2 \times 10^{-5} \text{ M}$$

3. For  $A \rightleftharpoons 2B$  at certain temperature  $K_c = 5 \times 10^{-5}$  then find  $K_p$  if at equilibrium total pressure is 4 atm and total concentration is 8 M

- a.  $2.5 \times 10^{-5}$  b.  $25 \times 10^{-5}$  c.  $0.25 \times 10^{-5}$  d.  $10^{-4}$

**A**

**Sol.**  $K_p = K_c (RT)^{\Delta ng}$

$$K_p = K_c \left(\frac{P}{C}\right)^{\Delta ng}$$

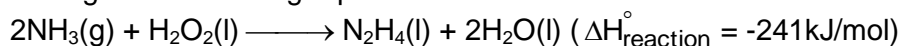
$$K_p = K_c \left(\frac{P}{C}\right)^{\Delta ng}$$

$$\begin{aligned} P &= CRT \\ \frac{P}{C} &= RT \end{aligned}$$

$$K_p = 5 \times 10^{-5} \left(\frac{4}{8}\right)$$

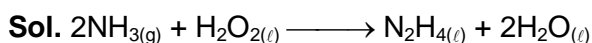
$$K_p = 2.5 \times 10^{-5}$$

4. Hydrazine used in rocket fuels can be obtained by the reaction of ammonia and hydrogen peroxide according to the following equations



If  $\Delta H^\circ$  (formation) of  $NH_3$ ,  $H_2O_2$  and  $H_2O$  are -46.1, -187.8 and -285.8 kJ/mol respectively,  $\Delta H^\circ$  for the decomposition of hydrazine into  $N_2$  and  $H_2$  is

- (a) 50.6 kJ/mol (b) 241 kJ/mol (c) -50.6 kJ/mol (d) 120.5 kJ/mol

**C**

$$\Delta H_{\text{reaction}}^{\circ} = (\Delta H_f^{\circ} \text{N}_2\text{H}_4 + 2 \times \Delta H_f^{\circ} \text{H}_2\text{O}) - (2 \times \Delta H_f^{\circ} (\text{NH}_3) + \Delta H_f^{\circ} (\text{H}_2\text{O}_2))$$

$$-241 = \Delta H_f^{\circ} (\text{N}_2\text{H}_4) + 2 \times (-285.8) - 2 \times (-46.1) + 187.8$$

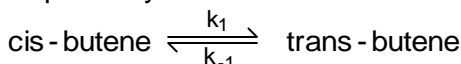
$$\Delta H_f^{\circ} (\text{N}_2\text{H}_4) = -241 + 2 \times 285.8 - 2 \times 46.1 - 187.8$$

$$= -241 + 571.6 - 92.2 - 187.8$$

$$\Rightarrow \Delta H_f^{\circ} (\text{N}_2\text{H}_4) = 50.6 \text{ kJ/mol i.e. } \text{N}_2 + 2\text{H}_2 \longrightarrow \text{N}_2\text{H}_4$$

Therefore, for the decomposition of hydrazine into  $\text{N}_2$  &  $\text{H}_2$  is  $-50.6 \text{ kJ/mol}$ .

5. The equilibrium constant of the following isomerisation reaction at 400K and 298 K are 2.07 and 3.42 respectively.



Which of the following is/are correct ?

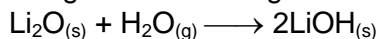
- I. The reaction is exothermic
- II. The reaction is endothermic
- III. At 400K 50% of cis-butene and 50% of trans-butene are present at equilibrium
- IV. Both at 298K and 400K,  $k_1 = k_{-1}$

- (a) I and IV                      (b) II and IV                      (c) I and III                      (d) I only

**D**

**Sol.** As on T increase,  $K_{eq}$  is increasing, Reaction is exothermic.

6. Lithium oxide ( $\text{Li}_2\text{O}$ ; molar mass =  $30 \text{ g mol}^{-1}$ ) is used in space shuttles to remove water vapour according to the following reaction



If 60 kg of water and 45 kg of  $\text{Li}_2\text{O}$  are present in a shuttle

- I. water will be removed completely
- II.  $\text{Li}_2\text{O}$  will be the limiting reagent
- III. 75 kg of  $\text{Li}_2\text{O}$  will be required to completely remove the water present
- IV. 27 kg of water will remain in the shuttle at the end of the reaction

- (a) II only                      (b) II and IV                      (c) III and IV                      (d) II, III

**D**

Sol.	Limiting Reagent	Excess Reagent	
	$\text{Li}_2\text{O}_{(s)}$	$\text{H}_2\text{O}_{(g)}$	$\longrightarrow 2\text{LiOH}_{(s)}$
Initially	$45 \times 10^3$	$60 \times 10^3$	0
	30	18	
	or = $1.5 \times 10^3 \text{ mol}$	= $3.33 \times 10^3 \text{ mol}$	
after reaction	0	$(3.33 - 1.5) \times 10^3$	
		= $1.83 \times 10^3 \text{ mol}$	
	18gm require = 30 gm $\text{Li}_2\text{O}$		
	45gm will require = $\frac{30}{18} \times 45 = 75 \text{ Kg}$		

7.  $S_1$  : Concentrated solution of an alkali metal in liquid ammonia is bronze coloured and diamagnetic.  
 $S_2$  : Increasing stability of the peroxide and super oxide of alkaline earth metal down the group, is due to the stabilization of large anions by large cations through lattice energy effects.  
 $S_3$  : In the vapour phase  $\text{BeCl}_2$  tends to form a chloro – bridged dimer.  
 $S_4$  : Beryllium hydroxide reacts with acid & alkali both to form  $[\text{Be}(\text{H}_2\text{O})_4]\text{Cl}_2$  and  $[\text{Be}(\text{OH})_4]^{2-}$  respectively.

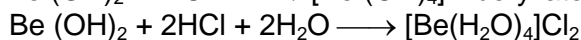
- a. T T T T                      b. F F F F                      c. T F T F                      d. F T F T

**A**

**Sol.**  $S_1$  : In concentrated solution unpaired electrons pair up together and become diamagnetic.

$S_2$  and  $S_3$  are correct statements.

$S_4$  :  $\text{Be}(\text{OH})_2 + 2 \text{OH}^- \longrightarrow [\text{Be}(\text{OH})_4]^{2-}$  beryllate ion



**SECTION – B (Assertion and Reason) Negative Marking [-1]**

This Section contains **10 multiple choice questions**. Each question has four choices A), B), C) and D) out of which **ONLY ONE** is correct. **10 × 4 = 40 Marks)**

- (A) If both Assertion and reason are true and Reason is a correct explanation of Assertion.  
 (B) If both assertion and Reason are true but Reason is not a correct explanation of Assertion.  
 (C) If Assertion is true but Reason is false.  
 (D) If Assertion is false but reason is true.

1. **Assertion:** The energy of an electron is largely determined by its principal quantum number.  
**Reason:** The principal quantum number is a measure of the most probable distance of finding the electrons around the nucleus.

a. (A)                      b. (B)                      c. (C)                      d. (D)

**B**

2. **Assertion (A):** At inversion temperature of a gas Joule – Thomson effect is zero.  
**Reason (R):** At inversion temperature, a real gas obeys Boyle's Law at a wide range of pressure.

a. (A)                      b. (B)                      c. (C)                      d. (D)

**C**

**Sol.** At inversion temperature Joule Thomson effect is zero & at Boyle's temperature it behaves ideal gas.

3. **Assertion (A):** A one molar solution of phosphorous acid is equivalent to its 2 N solution.  
**Reason (R):** Phosphorous acid is dibasic acid.

a. (A)                      b. (B)                      c. (C)                      d. (D)

**A**

**Sol.**  $N = M \times \text{Basicity}$

4. **Assertion (A):** Conversion of  $\text{Cl(g)}$  into  $\text{Cl}^-(\text{g})$  is exothermic while the conversion of  $\text{O(g)}$  into  $\text{O}^{2-}(\text{g})$  is endothermic.  
**Reason (R):** Addition of  $2^{\text{nd}} \text{e}^-$  to  $\text{O}^-$  ion is endothermic due to repulsion between negative charge and  $\text{e}^-$ .

a. (A)                      b. (B)                      c. (C)                      d. (D)

**A**

5. **Assertion (A):** The decreasing Lewis acid character of boron halides is  $\text{BF}_3 > \text{BCl}_3 > \text{BBR}_3$   
**Reason (R):** Back donation of electrons by F to Boron atom is maximum in  $\text{BF}_3$ .

a. (A)                      b. (B)                      c. (C)                      d. (D)

**D**

**Sol.** Lewis's Acid strength is  $\text{BBR}_3 > \text{BCl}_3 > \text{BF}_3$

6. **Assertion (A):** Dipole moment of  $\text{IF}_7$  is zero while that of  $\text{IF}_5$  is not zero.  
**Reason:**  $\text{IF}_5$  has an irregular geometry due to the presence of lone pair of electrons on central iodine atom.

a. (A)                      b. (B)                      c. (C)                      d. (D)

**A**

7. **Assertion (A):**  $\text{NH}_2\text{OH}$  does not give Lasasaigne's test for nitrogen.  
**Reason (R):** It does not contain carbon.

a. (A)                      b. (B)                      c. (C)                      d. (D)

**A**

8. **Assertion (A):** Addition of bromine on trans-2-butene gives meso-2, 3-dibromo butane.  
**Reason (R):**  $\text{Br}_2$  adds on alkene via the formation of carbocation as an intermediate.

a. (A)                      b. (B)                      c. (C)                      d. (D)

**C**

**Sol.** Addition of  $\text{Br}_2$  is anti addition, so Trans-2-butene will give meso.

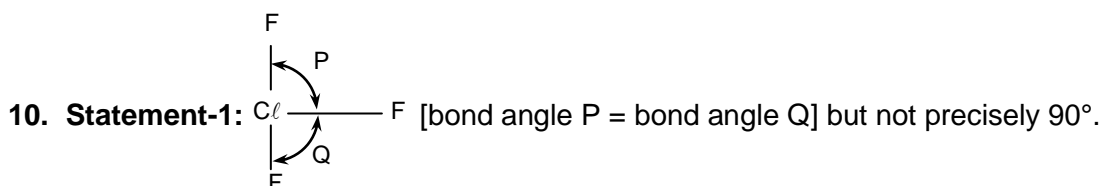
9. **Assertion (A):** In Borax, all the four Boron atoms are  $sp^2$  hybridised.

**Reason (R):** Formula of Borax is  $Na_2[B_4O_5(OH)_4] \cdot 8H_2O$ .

- a. (a)                      b. (b)                      c. (c)                      d. (d)

D

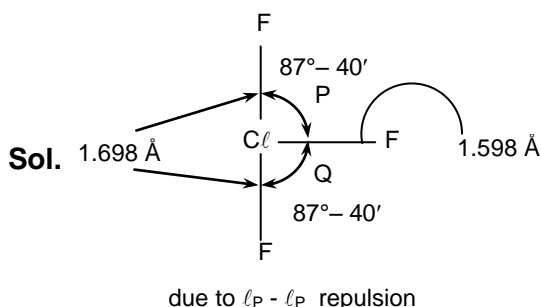
**Sol.** Two Boron are  $sp^2$  & two are  $sp^3$  hybridised.



**Statement-2:** The molecule is slightly bent T-shaped and there is repulsion between lone pairs of electrons.

- a. (A)                      b. (B)                      c. (C)                      d. (D)

A



### SECTION – C (Paragraph Type) Negative Marking [-1]

This Section contains **3 paragraphs**. Each of these questions has four choices A), B), C) and D) out of which **ONLY ONE** is correct. **9 × 5 = 45 Marks**

#### Paragraph – 1

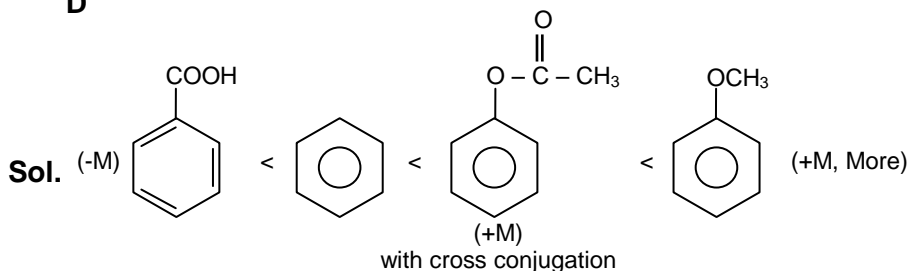
Aromatic compounds have delocalised  $\pi$  electron cloud and behave like Lewis bases. So, electrophiles have the tendency to attack aromatic compounds and substitute  $H^+$  from the aromatic compounds. These types of reactions are called aromatic electrophilic substitution reactions like nitrosation, diazocoupling etc are responded by strongly activated aromatic rings.

In these types of reactions solvent plays an important role. For example, if halogenation. Of a very reactive aromatic compounds takes place in polar solvents, the molecular halogens alone may act as electrophiles but in non-polar solvents, halogenation is catalysed by Lewis acids like  $AlCl_3$  or  $SbCl_5$ .

1. The increasing order of reactivity towards most of the electrophilic substitution reactions among (i) Benzene (ii) Benzoic acid (iii) Methoxybenzene (iv) Phenyl ethanoate

- a. (i) < (ii) < (iii) < (iv)      b. (i) < (ii) < (iv) < (iii)      c. (iv) < (iii) < (ii) < (i)      d. (ii) < (i) < (iv) < (iii)

D

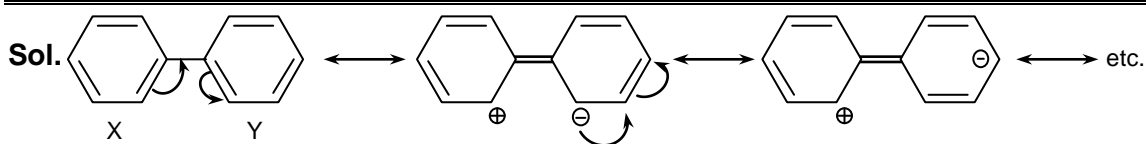


2. In aromatic electrophilic substitution reaction, phenyl group is

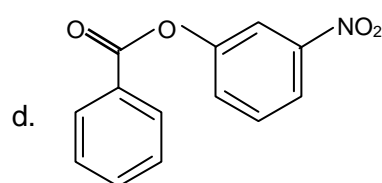
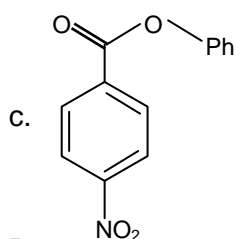
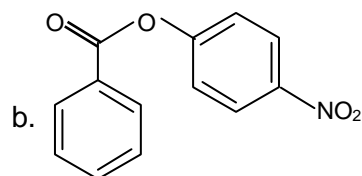
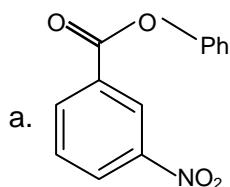
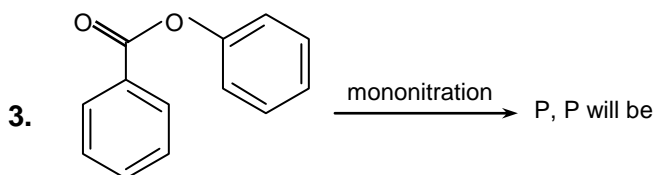
- a. ortho/para directing                      b. meta directing  
c. devoid of any such directing nature      d. only para directing

A





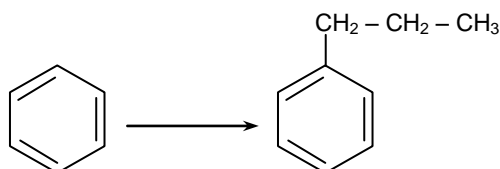
Here, ring X is ortho/para directing for ring Y. So, electrophiles attack at ortho/para position of ring Y.



B

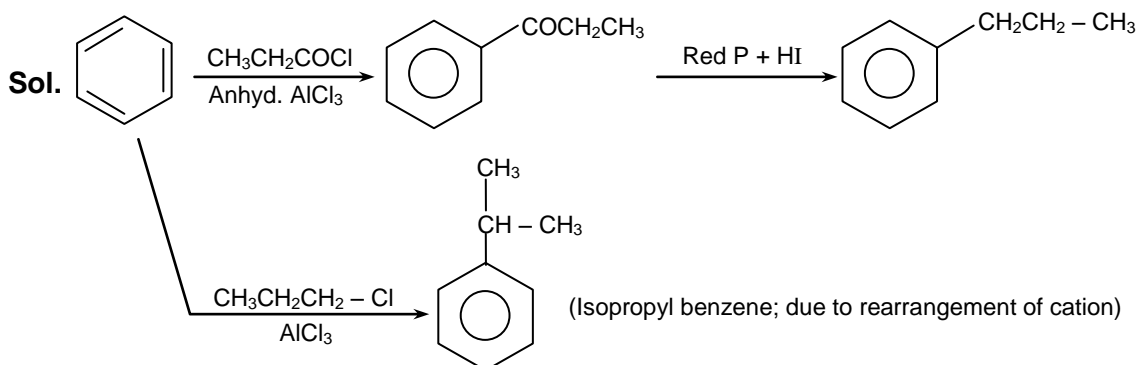
Sol. One ring is activated due to +M effect & will have electrophilic substitution reaction at o & p-position

4. Which of the following is the correct order of reaction for given conversion



- (i)  $\text{CH}_3\text{CH}_2\text{COCl}$ ; Anhydrous  $\text{AlCl}_3$ ; (ii) Red P + HI
- (i)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ ; Anhydrous  $\text{AlCl}_3$
- (i)  $\text{CH}_3\text{CH}_2\text{COCl}$ ; Anhydrous  $\text{AlCl}_3$ ; NaOH
- (i)  $\text{Cl}/\text{Fe}$  (ii) Mg, dry ether (iii)  $\text{CH}_3\text{CH}=\text{CH}_2$

A



## Passage – 2

Molecular orbital theory was put forward by F.Hund and R.S. Mulliken and was later developed by Leonard and Charles Coulson. This theory describes bonding in terms of the combination and arrangement of atomic orbitals to form molecular orbitals that are associated with the molecule as a whole.

The number of molecular orbitals formed is equal to the number of combining atomic orbitals. When two atomic orbitals combine, two molecular orbitals called **bonding molecular orbital** and **antibonding molecular orbital** are formed. The two atomic orbitals so formed by LCAO (Linear

Combination of Atomic orbitals) are in the same phase (bonding molecular orbital) or in different phase (antibonding molecular orbital). The energy of bonding molecular orbital is lower than that of the pure atomic orbital by an amount  $\Delta$ , which is known as **stabilization energy**. The energy associated with antibonding molecular orbital is higher than that associated with pure atomic orbital by an amount,  $\Delta$  which is known as **destabilization energy**. In bonding molecular orbitals the **inter electronic attraction** is present where as in anti-bonding molecular orbital we find an **inter electronic repulsion**.

5. On the basis of m.o. theory which of the following statements is correct?

- The bond length increases with increase in bond order.
- The bond length decreases with increase in bond order.
- The bond length is not affected due to change in bond order.
- The bond length sometimes increases and sometimes decrease with increase in bond order

**B**

**Sol.** As the bond order increases, there occurs a decrease in bond length

6. Which of the following is the correct order of bond lengths

- $O_2^- > O_2 > O_2^+$
- $O_2 > O_2^+ > O_2^-$
- $O_2^+ > O_2^- > O_2$
- $O_2^+ > O_2 > O_2^-$

**A**

**Sol.** The b.o. in  $O_2$ ,  $O_2^+$  and  $O_2^-$  are 2.0, 2.5 and 1.5 respectively  $\left( b.o = \frac{N_b - N_a}{2} \right)$ . The correct order for

bond length is  $O_2^- > O_2 > O_2^+$

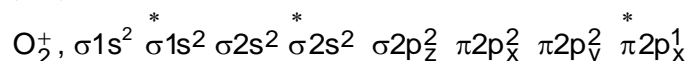
The bond length decreases as bond order increases

7. Select the correct statement about  $O_2^+$ .

- It is paramagnetic and its Bond order is less than that of  $O_2^-$
- It is paramagnetic and its Bond order is more than that of  $O_2^-$
- It is diamagnetic and its Bond order is less than that of  $O_2^-$
- It is diamagnetic and its Bond order is more than that of  $O_2^-$

**B**

**Sol.**  $O_2^+$  is paramagnetic due to presence of unpaired electron and its b.o. (2.5) is more than that of  $O_2^-$  (1.5).



$$b.o. = \frac{10.5}{2} = 2.5$$

### Passage – 3

Pressure of an ideal gas is obtained from kinetic gas equation. The kinetic gas equation is:

$$PV = \frac{1}{3}(mN_0)u^2 = \frac{1}{3}Mu^2$$

Where,  $mN_0 = M$  (Molar mass)

$N_0$  = Avogadro's number

$u$  = root mean square velocity.

Translational kinetic energy of  $n$  moles of a gas

$$\frac{1}{2}Mu^2 = \frac{3}{2}(PV) = \frac{3}{2}(nRT)$$

$$\text{Average translational kinetic energy per molecule} = \frac{3}{2} \left( \frac{RT}{N_0} \right) = \frac{3}{2}(KT)$$

$$u_{rms} = \sqrt{\frac{3PV}{M}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3P}{d}}$$

$$\text{and } u_{av} = \sqrt{\frac{8RT}{\pi M}}$$

8. The mass of one molecule of A is twice the mass of molecule B. the rms speed of A is twice the rms speed of B. If two samples A and B contain same number of molecules, What will be the ratio of pressures of the two samples in two separate containers of equal volume?

- a.  $\frac{P_A}{P_B} = 2$                       b.  $\frac{P_A}{P_B} = 3$                       c.  $\frac{P_A}{P_B} = 4$                       d.  $\frac{P_A}{P_B} = 8$

D

Sol. Given  $m_A = 2m_B$

$\Rightarrow$  mol. Wt. of A = 2 (mol. Wt. of B)

Also no. of molecule of A = no. of molecules B.

$$\text{For gas A, } P_A V_A = \frac{1}{3} M_A (u_{ram})_A^2$$

$$\text{For gas B, } P_B V_B = \frac{1}{3} M_B (u_{ram})_B^2$$

$$\text{So, } \frac{P_A V_A}{P_B V_B} = \frac{M_A}{M_B} \times \frac{(u_{rms})_A^2}{(u_{rms})_B^2} \quad \dots (1)$$

$$\text{Given } V_A = V_B \quad \dots (2)$$

Using all the equations:  $U_{rms}$  of A is double than B

$$\frac{P_A}{P_B} = \frac{2}{1} \times \frac{4}{1}$$

$$\frac{P_A}{P_B} = 8$$

9. Calculate rms speed of  $O_2$  molecules having K.E. of 2K cal/mole

- a. 22.795 m/s                      b. 60 m/s                      c. 32 m/s                      d. 52 m/s

A

$$\text{Sol. K.E.} = \frac{3}{2} RT; \quad rms = \sqrt{\frac{3RT}{M}}; \quad rms = \sqrt{\frac{2 \times KE}{M}} = \sqrt{\frac{2 \times 2 \times 4.2 \times 10^3}{32}} = 22.9 \text{ m/sec.}$$

$$\text{K.E.} = 2 \text{ Kcal} = 2 \times 4.2 \times 10^3 \text{ J}$$

### SECTION - D (More than One Answer) No Negative Marking

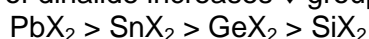
This Section contains 8 questions. Each question has four choices A), B), C) and D) out of which **ONE OR MORE** may be correct. (8 × 5 = 40 Marks)

1. Which of the following is correct as indicated

- a.  $PbX_2 > GeX_2 > SnX_2 > SiX_2$  (stability of dihalide)  
 b.  $SiH_4 > GeH_4 > SnH_4 > PbH_4 > CH_4$  (ease of hydrolysis)  
 c.  $PbCl_4 > SnCl_4 > GeCl_4$  (oxidising power)  
 d.  $Na_2SO_4 > CaSO_4 > BeSO_4$  (thermal stability)

B,C,D

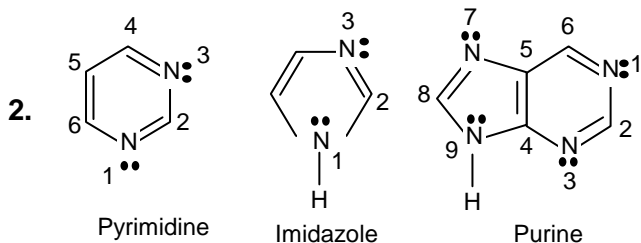
Sol. (A) Stability of dihalide increases  $\downarrow$  group due to inert pair effect.



(B) Ease of hydrolysis will be maximum in 3<sup>rd</sup> period element due to easy octet expansion and  $\downarrow$  group further decreases.  $CH_4$  cannot be hydrolysed due to absence of vacant 'd' orbital.

(C) Down the group a stability of tetrahalide decreases therefore oxidising power increases.

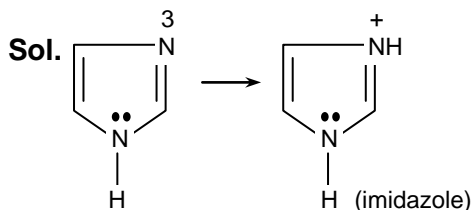
(D) gp I sulphate are more stable & ↓ group stability increases.



Among the following which statements are correct?

- Both N of pyrimidine are of same basic strength
- In imidazole, protonation takes place on N – 3
- Purine has 3 basic N
- Purine, Imidazole and pyrimidine all are aromatic

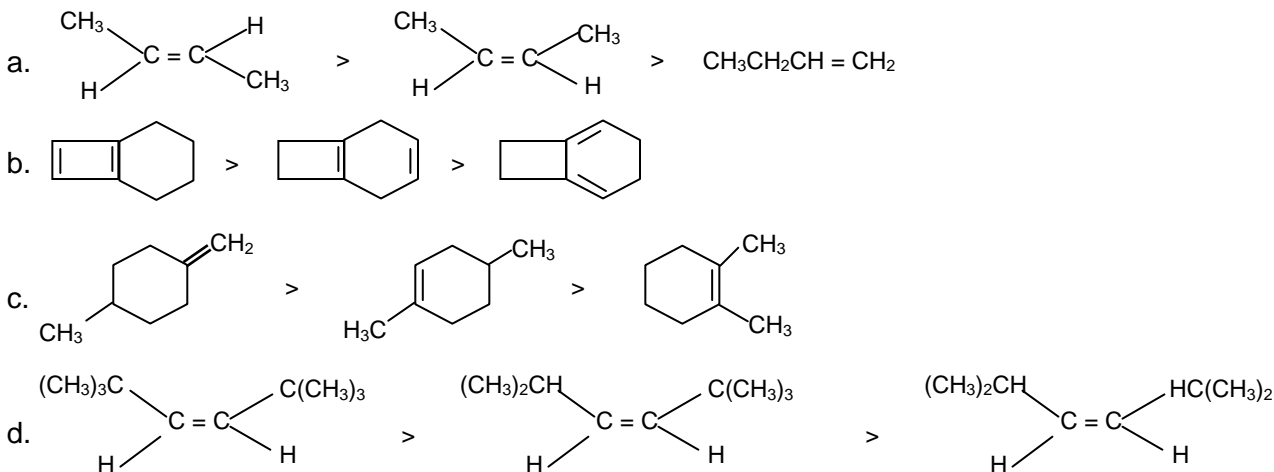
**A,B,C,D**



In purine – NH nitrogen is not basic, as its lone pair is delocalised.

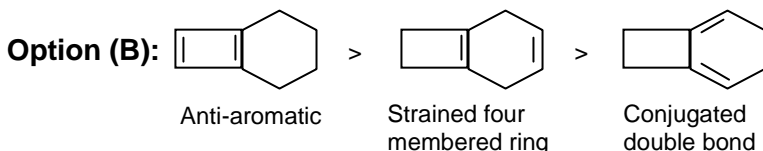
Aromaticity is not lost

3. In which of the following case(s), the heat of hydrogenation is correctly shown?

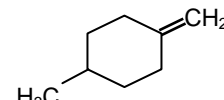


**B,C,D**

Sol. Greater the instability, more is the energy content, more is the heat of hydrogenation. (heat released on hydrogenation)



Option (C)

4 – α hydrogens available in  for hyperconjugation. The following two have 7 and 10 – α – hydrogens respectively.

Option (d): No α-hydrogen > 1 α –hydrogen > 2 α–H

$$\alpha = \frac{1}{1 + 10^{(pK_a - pH)}}$$

4. The pH of the salt solutions are given against each. The correct ones are

- a. 0.1 M  $\text{CH}_3\text{COONa}$ , 8.9 ( $\text{pK}_a$  of  $\text{CH}_3\text{COOH} = 4.8$ )    b. 0.1 M  $\text{NH}_4\text{Cl}$ , 5.1 ( $\text{pK}_b$  of  $\text{NH}_4\text{OH} = 4.8$ )  
 c. 1.0 M  $\text{CH}_3\text{COONH}_4$ , 7.0    d. 1.0 M  $\text{Na}_2\text{SO}_4$ , 0.0 pH

**A,B,C**

**Sol.** (a)  $\text{pH} = 7 + \frac{1}{2} [\text{pK}_a + \log C] = 7 + \frac{1}{2} [4.8 + \log 10^{-1}] = 7 + \frac{1}{2} (3.8) = 8.9$

(b)  $\text{pH} = 7 - \frac{1}{2} [\text{pK}_b - \log C] = 7 - \frac{1}{2} [4.8 - \log 10^{-1}] = 7 - \frac{1}{2} (3.8) = 5.1$

(c)  $\text{pH} = 7 + \frac{1}{2} [\text{pK}_a - \text{pK}_b] = 7$

(d)  $\text{Na}_2\text{SO}_4$  is a salt of strong base and strong acid. The solution is neutral with  $\text{pH} = 7$

5. Which of the following molecules have axial and equatorial bonds of different length?

- a.  $\text{PCl}_5$     b.  $\text{SF}_6$     c.  $\text{IF}_7$     d.  $\text{BF}_3$

**A,C**

**Sol.** A =  $\text{sp}^3\text{d}$ ; (C) =  $\text{sp}^3\text{d}^3$

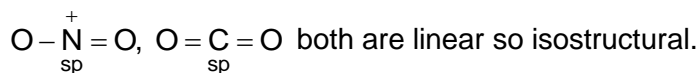
6. Which of the following are isoelectronic and isostructural?

- a.  $\text{NO}_2^+$ ,  $\text{CO}_2$     b.  $\text{NO}_3^-$ ,  $\text{BF}_3$     c.  $\text{NH}_3$ ,  $\text{CH}_3^-$     d.  $\text{N}_2\text{O}$ ,  $\text{CO}_2$

**A,B,C,D**

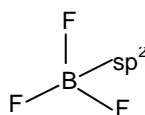
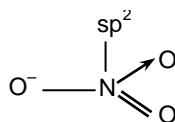
**Sol.** (A)  $\text{NO}_2^+ = 7 + 16 - 1 = 22$ ;  $\text{CO}_2 = 6 + 16 = 22$ .

So isoelectronic (both have 22 electrons in valence shells)



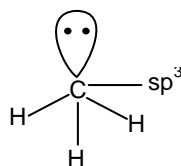
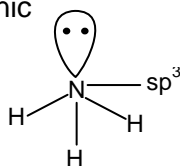
(B)  $\text{NO}_3^- = 7 + 24 + 1 = 32$ ;  $\text{BF}_3 = 5 + 27 = 32$

So isoelectronic and are isostructural as both have trigonal planar structures

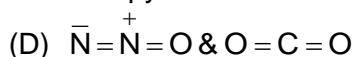


(C)  $\text{NH}_3 = 7 + 3 = 10$ ;  $\text{CH}_3^- = 6 + 3 + 1 = 10$

So isoelectronic



Both are pyramidal so isostructural.



7. Which of the following are correct:

- a. Evaporation is a spontaneous process occurring at all temperatures  
 b. During evaporation, the vapour pressure of the liquid is equal to atmospheric pressure  
 c. Boiling is a non spontaneous process and can occur at the boiling point  
 d. The boiling point is an intensive property

**A,C,D**

8. Which of the following is correct?

- a. A catalyst lowers the activation energy barrier for the forward and reverse reaction  
 b. A catalyst increases the rate of backward and forward reaction  
 c. For endothermic reaction increasing the temperature increase the rate constant of forward reaction more than backward reaction  
 d. For endothermic reaction increasing the temperature increase the rate constant for backward and forward reaction in equal ratio

**A,B,C**

**Sol.** (a), (b) and (c) are correct and (d) is incorrect answer

**SECTION – E (Matrix Type) No Negative Marking**

This Section contains **3 questions**. Each question has four choices (A, B, C and D) given in **Column I** and five statements (p, q, r, and s) in **Column II**. **(3 × 8 = 24 Marks)**

1. Match the conditions (in Column – I) with its expression (in Column – II)

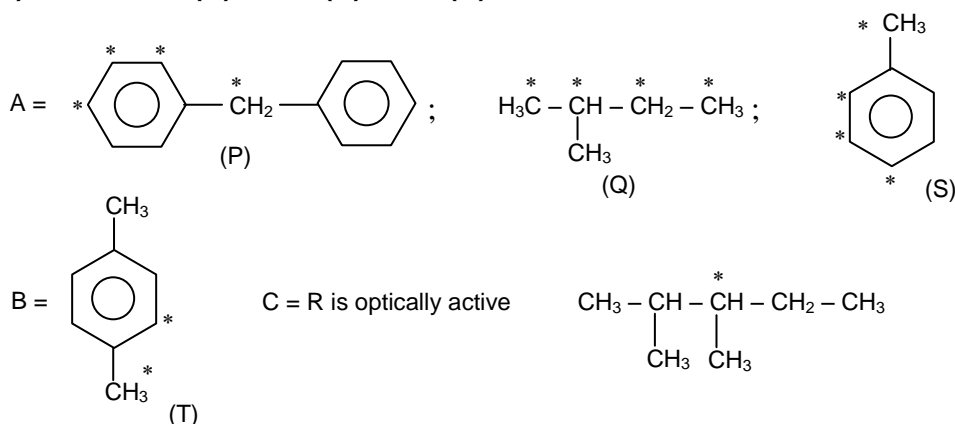
	Column – I		Column – II
(A)	Ion dipole forces	(p)	Interaction energy $\propto 1/r^2$
(B)	Dipole dipole forces in gases	(q)	Interaction energy $\propto 1/r^6$
(C)	Dispersion forces	(r)	SO <sub>2</sub> gas
(D)	Dipole-induced dipole forces	(s)	NaCl Aqueous solution

**Sol. A → p, s; B → q, r; C → q, r; D → q**

2. Match Column – I with Column – II

Column – I		Column – II	
(A)	Compound which form 4 monochloro products (exclude stereoisomer)	(P)	
(B)	Compound which form '2' monochloro products (exclude stereoisomer)	(Q)	
(C)	Compound which rotate Plane polarised light	(R)	
(D)	Compound which can be formed by hydrogenation reaction of corresponding alkene/alkyne	(S)	
		(T)	

**Sol. (A) → P, Q, S ; (B) → T ; (C) → R; (D) → Q,R**



3. Match Column – I with Column – II

Column – I		Column – II	
(A)	Reversible cooling of an ideal gas at constant volume	(P)	$w = 0$ ; $q < 0$ ; $\Delta U < 0$
(B)	Reversible isothermal expansion of an ideal gas	(Q)	$w < 0$ ; $q > 0$ ; $\Delta U > 0$
(C)	Adiabatic expansion of non-deal gas into vacuum	(R)	$w = 0$ ; $q = 0$ ; $\Delta U = 0$
(D)	Reversible melting of sulphur at normal melting point	(S)	$w < 0$ ; $q > 0$ ; $\Delta U = 0$

Sol. (A)  $\rightarrow$  P; (B)  $\rightarrow$  S; (C)  $\rightarrow$  R; (D)  $\rightarrow$  Q

(A) = at constant volume  $w = 0$

Heat is given out =  $Q = -ve < 0$

$\Delta U = \text{decrease} (< 0)$

(B) expansion  $w = - (< 0)$ ; Heat absorbed  $q > 0$

$\Delta U = 0$  (isothermal)

(C)  $w = 0$  (free expansion);  $q = 0$  (adiabatic);

$\Delta U = 0$ ; but  $\Delta S = +ve$  (due to increase in volume)

(D) on melting, expansion ( $w = -ve$ ;  $< 0$ )

endothermic process  $\Delta U = +ve > 0$

Heat absorbed  $Q = +ve > 0$

**SECTION – F (Integer Type) No Negative Marking**

This Section contains **8 Questions**. The answer to each question is a **Single Digit Integer** ranging from 0 to 10. **8  $\times$  5 = 40 Marks**

1. The combustion of sodium in excess air yields a higher oxide. What is the oxidation state of the oxygen in the product. Neglect the negative sign.

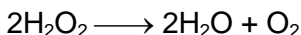
Sol.1



It exists as  $2\text{Na}^+$  and  $\text{O}_2^{2-}$ . So oxidation state of O is  $-1$

2. Commercial 11.2 volume  $\text{H}_2\text{O}_2$  solution has a molarity of

Sol.1

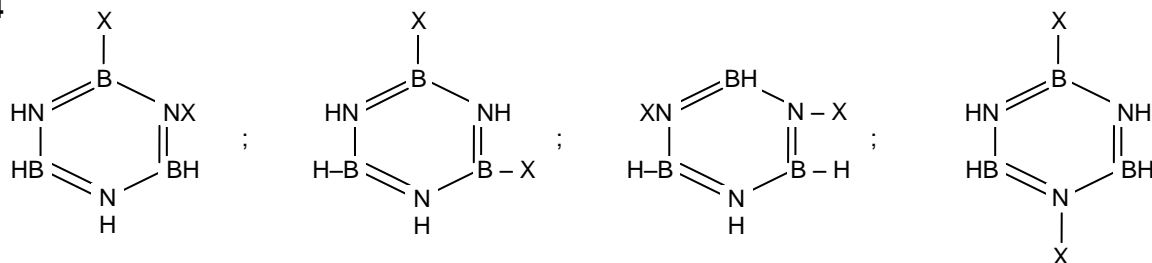


$$\text{Volume strength} = 11.2 \times \text{Molarity} \quad \text{or} \quad \text{Molarity} = \frac{68}{22.4} \times \frac{\text{Volume strength}}{\text{M.Wt.}} = \frac{68}{22.4} \times \frac{11.2}{34} = 1\text{M}$$

$$\text{Molarity} = \frac{\text{Volume strength}}{11.2} = \frac{11.2}{11.2} = 1$$

3. How many disubstituted Isomer are possible for Inorganic benzene Borazine

Sol.4



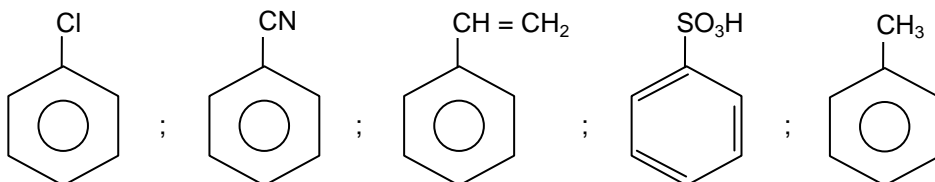
4. How many of the following are Amphoteric oxides

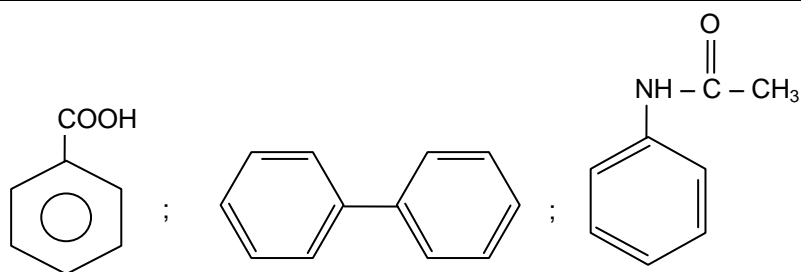
$\text{Al}_2\text{O}_3$ ;  $\text{BeO}$ ;  $\text{GeO}$ ;  $\text{SnO}_2$ ;  $\text{PbO}_2$ ;  $\text{PbO}$ ;  $\text{CaO}$ ;  $\text{SiO}_2$ ;  $\text{B}_2\text{O}_3$ ;  $\text{CO}$ ;  $\text{MgO}$ ;  $\text{Li}_2\text{O}$

Sol.6

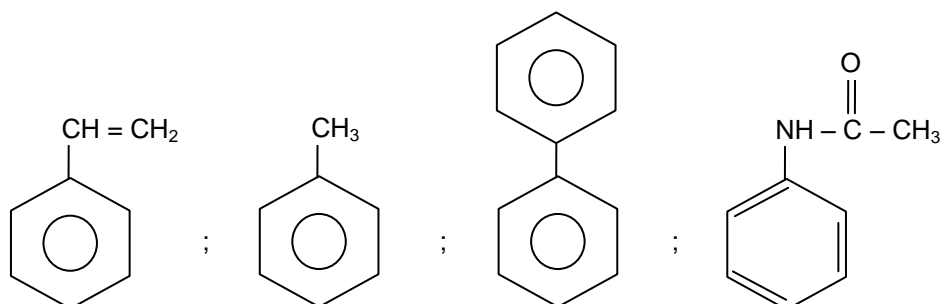
$\text{Al}_2\text{O}_3$ ;  $\text{BeO}$ ;  $\text{GeO}$ ;  $\text{SnO}_2$ ;  $\text{PbO}_2$ ;  $\text{PbO}$

5. How many of the following compounds are more reactive than Benzene in electrophilic substitution reaction.





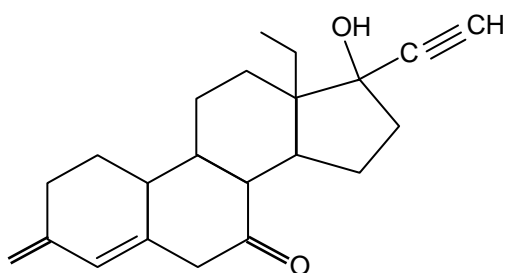
Sol.4



6. A gas is found to have the formula  $(C_3O_2)_n$ . Its vapour density is 34. The value of n will be:

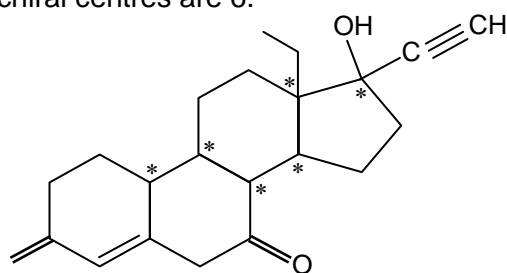
Sol.1 (Molecular weight =  $2 \times$  Vapour density)

7. Levonorgestrel is a commonly used contraceptive. The number of chiral centres present in this molecule is :



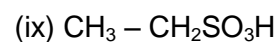
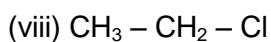
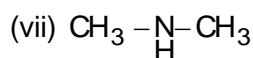
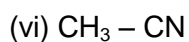
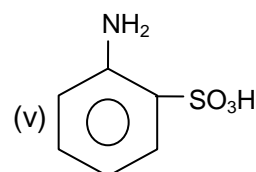
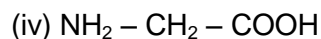
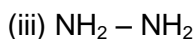
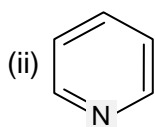
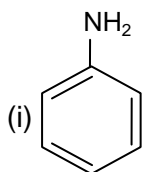
Sol.6

Number of chiral centres are 6.



Levonorgestrel

8. How many of the following compound will form Prussian blue in Lassaigne's test of Organic compound.



Sol.5; (i), (ii), (iv), (vi), (vii)

(a) If both N & S are present in organic compound, red ppt. appear in L.S. Test due to  $Fe(SCN)_3$

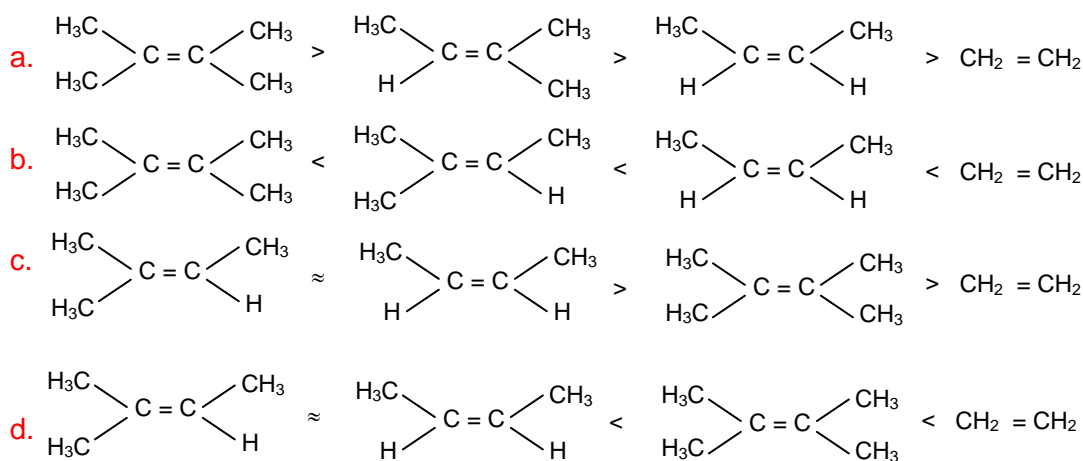
(b) (iii) is not an organic compound (do not have carbon so will not form NaCN)

(c) Nitrogen & carbon must be present in organic compound for Prussian blue Test.



Extra

46. The correct order of reactivity of following alkenes for the reaction with  $H_2$  gas is:



B

47. CO gas can be detected by which of the following methods?

- a. It turns lime water milky. b. It burns with a colorless flame.  
 c. It turns the  $PdCl_2$  solution black. d. It reduces  $Fe_2O_3$  to Fe

C

48. Which of the following statements is correct in the context of silicones?

- a. They are more stable to heat than other polymers.  
 b. They are strong water repellents and good electrical insulators, and have nonsticking and antifoaming properties.  
 c. The strength and inertness of the silicones are due to a stable silica like skeleton of  $Si - O - Si - O - Si$  and very high bond energy of  $Si - O$  bonds.  
 d. All of these

D

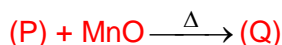
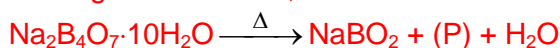
49. The alkali metal which can emit its outermost electron under the influence of even candle light is:

- a. Na b. Rb c. K d. Cs

D

**Sol.** Cs because of its low IE emits electron under the influence of even candle light.

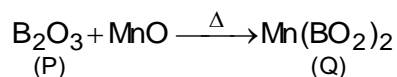
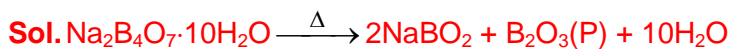
**50.** In the given reactions,



(P) and (Q) are respectively

- a.  $\text{Na}_3\text{BO}_3$ ,  $\text{Mn}_3(\text{BO}_3)_2$     b.  $\text{Na}_2(\text{BO}_2)_2$ ,  $\text{Mn}(\text{BO}_2)_2$     c.  $\text{B}_2\text{O}_3$ ,  $\text{Mn}(\text{BO}_2)_2$     d. None of the above

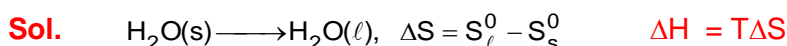
**C**



**51.** 1 mole of ice is converted to liquid at 273 K;  $\text{H}_2\text{O}(\text{s})$  and  $\text{H}_2\text{O}(\ell)$  have entropies 38.20 and 60.03 J  $\text{mol}^{-1} \text{deg}^{-1}$ , Enthalpy change in the conversion will be:

- a. 59.59 J/mol    b. 595.95 J/mol    c. 5959.5 J/mol    d. 595959.0 J/mol

**C**



$$= 60.03 - 38.20 = 21.83 \text{ JK}^{-1} \text{ mol}^{-1} \quad = 273 \times 21.83 \text{ J/mol}$$

**8.** Which of the following relationships between partial pressure, volume and temperature is correct?

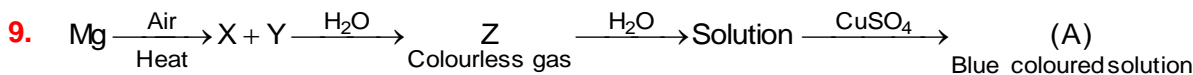
(i)  $P = \frac{nRT}{V}$

(ii)  $P_{\text{total}} = p_1 + p_2 + p_3$

(iii)  $P_{\text{total}} = (n_1 + n_2 + n_3) \frac{RT}{V}$

- a. (i) and (ii)    b. (i) and (iii)    c. (ii) and (iii)    d. (i), (ii) and (iii)

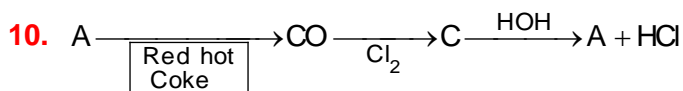
**D**



Substances, X, Y, Z and A are respectively:

- a.  $\text{Mg}_3\text{N}_2$ ,  $\text{MgO}$ ,  $\text{NH}_3$ ,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$     b.  $\text{Mg}(\text{NO}_3)_2$ ,  $\text{MgO}$ ,  $\text{H}_2$ ,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$   
c.  $\text{MgO}$ ,  $\text{Mg}_3\text{N}_2$ ,  $\text{NH}_3$ ,  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$     d.  $\text{Mg}(\text{NO}_3)_2$ ,  $\text{MgO}_2$ ,  $\text{H}_2\text{O}_2$ ,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

**C**



What are A & C

- a. C,  $\text{CO}_2$     b.  $\text{CO}_2$ ,  $\text{COCl}_2$     c.  $\text{CO}_2$ ,  $\text{CCl}_4$     d.  $\text{CO}_2$ , CO

**B**

