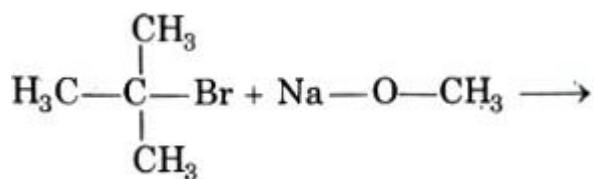


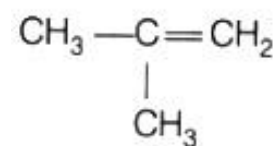
Chemistry

Single correct answer type:

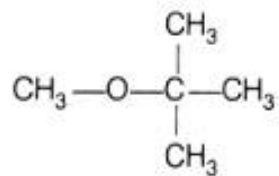
1. What will be the product of the reaction?



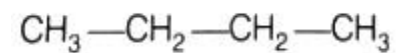
(A)



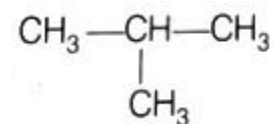
(B)



(C)



(D)



Solution: (A)

When tertiary alkyl halide is treated with sodium alkoxide than elimination reaction competes over substitution reaction because alkoxides are not only nucleophiles but strong base as well. Therefore, alkenes are formed instead of ethers.

2. Which of the following reaction is incorrect regarding Bohr's theory?

(A) Velocity of electron $\propto \frac{1}{n}$

(B) Frequency of revolution $\propto \frac{1}{n^2}$

(C) Radius of orbit $\propto n^2 z$

(D) Force on electron $\propto \frac{1}{n^4}$

Solution: (C)

Radius of orbit is directly proportional to ration of square of principal quantum number and atomic number

i.e., Radius of orbit $\propto \frac{n^2}{Z}$

For H-atom $r_n = \frac{n^2 \times 0.529 \times 10^{-8}}{z} \text{ cm}$

3. Which of the following pair have identical shape?



Solution: (C)

Molecules/compounds and their shape can be arranged as

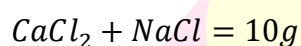
| Compound | Shape |
|----------|-------------------|
| XeF_2 | Linear |
| $ZnCl_2$ | Linear |
| BCl_3 | Triangular planar |
| ClF_3 | T-Shaped |
| CH_4 | Tetrahedral |
| SF_4 | See-saw |

| | |
|--------|--------|
| SO_2 | Bent |
| CO_2 | Linear |

4. 10g of sample of mixture of $CaCl_2$ and $NaCl$ is treated to precipitate all the calcium as $CaCO_3$. This $CaCO_3$ is heated to convert all the Ca to CaO and the final mass of CaO is 1.62g. The percent by mass of $CaCl_2$ in the original mixture is

- (A) 32.1% (B) 16.2% (C) 21.8% (D) 12.0%

Solution: (A)



Let weight of $CaCl_2 = xg$

Particle velocity

$$v_p = \frac{dy}{dt} = \frac{d}{dt} \left[3 \sin \left(25\pi t - \frac{\pi}{2} x \right) \right]$$

$$v_p = 75\pi \cos \left(25\pi t - \frac{\pi}{2} x \right)$$

Maximum particle velocity, $(v_p)_{max} = 75\pi \text{ m/s}$

$$\Rightarrow \frac{(v_p)_{max}}{v} = \frac{75\pi}{50}$$

$$= \frac{3}{2}\pi$$

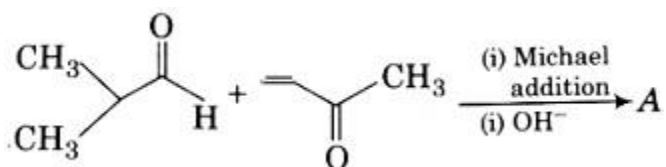
$$\text{Mole of } CaO = \frac{1.62}{56}$$

$$\therefore \frac{x}{111} = \frac{1.62}{56}$$

$$x = 3.21g$$

$$\% \text{ of } CaCl_2 = \frac{3.21}{10} \times 100 = 32.1\%$$

5. How many chiral centre are possible for the product of following reaction?

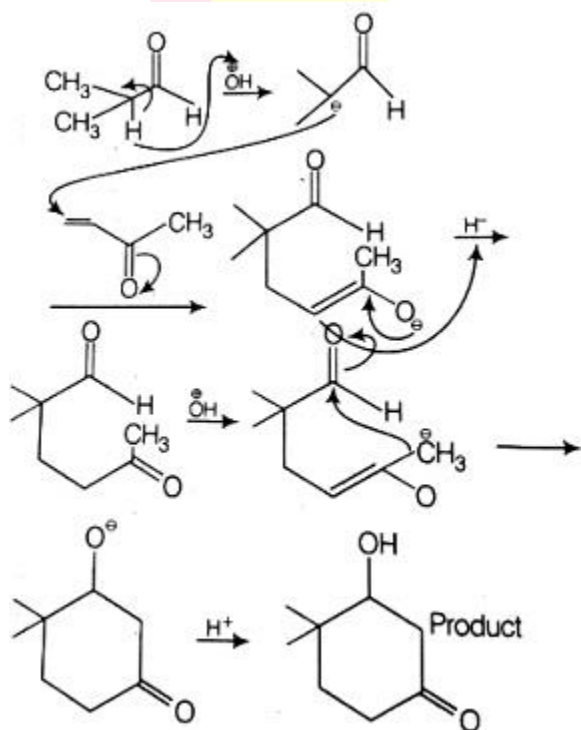


- (A) 1 (B) 0 (C) 3 (D) 2

Solution: (A)

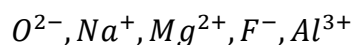
This problem includes conceptual mixing of Michael addition and number of chiral

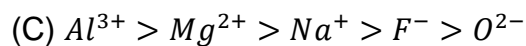
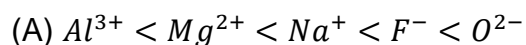
Michael addition. Addition of nucleophile to enone system is done in such a way that the addition looks like addition at 1st and 4th position of enone is known as Michael addition.



The number of chiral centre in product is 1 represented by star (*).

6. Elements/ions having same number of electrons are known as isoelectronic species. Arrange the following elements in correct order of atomic/ionic radii and choose the correct choice from the four choices given below





(D) None of the above

Solution: (A)

Elements/ions having equal number of electrons are known as isoelectronic species. Among isoelectronic species, cations having highest charge are smallest while anion having highest charge are largest.

Cation < Neutral atom < Anion

Hence, correct choice is $Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-}$

7. The ratio of oxidation states of *Cl* in potassium chloride to that in potassium chlorate is



Solution: (B)

Oxidation state of *Cl* in $KCl = -1$

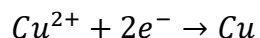
Oxidation state of *Cl* in $KClO_3 = +5$

∴ Ratio of oxidation state of *Cl* = $\frac{-1}{5}$

8. A reaction, $Cu^{2+} + 2e^- \rightarrow Cu$ is given. For this reaction, graph between E_{red} versus $\ln[Cu^{2+}]$ is a straight line of intercept 0.34V, then the electrode oxidation potential of the half cell Cu/Cu^{2+} (0.1M) will be



Solution: (D)



$$E_{Cu^{2+}/Cu} = E_{Cu^{2+}/Cu}^{\circ} - \frac{0.059}{2} \log \frac{1}{[Cu^{2+}]}$$

$$= E_{Cu^{2+}/Cu} - \frac{RT}{2F} \ln [Cu^{2+}]$$

$$\text{Intercept} = 0.34 \Rightarrow E_{Cu^{2+}/Cu} = 0.34$$

$$E_{Cu^{2+}/Cu} = 0.34 + \frac{0.059}{2} \log 0.1 = 0.31V$$

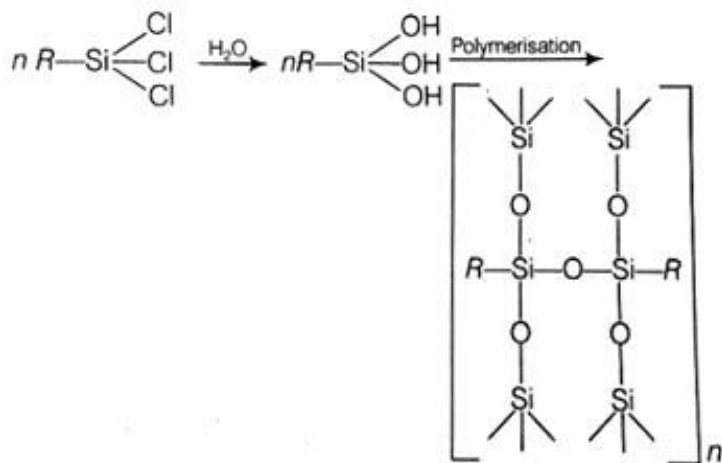
$$E_{Cu/Cu^{2+}} = -E_{Cu^{2+}/Cu} = -0.34 + \frac{0.059}{2} V$$

9. Which one of the following silanes on hydrolysis produces cross linked polymers?

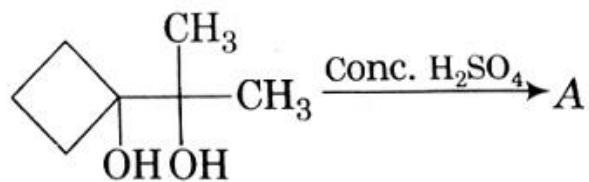
- (A) $RSiCl_3$ (B) R_2SiCl_2
 (C) R_3SiCl (D) R_4Si

Solution: (A)

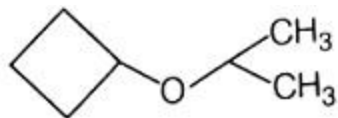
$RSiCl_3$ on hydrolysis produces cross linked polymer.



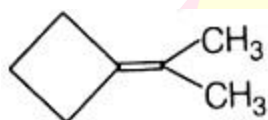
10. Identify the correct product formed during the following reaction.



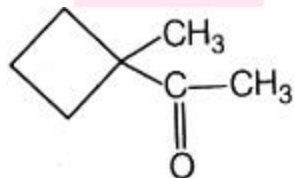
(A)



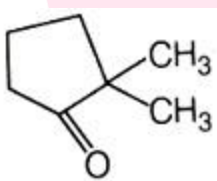
(B)



(C)

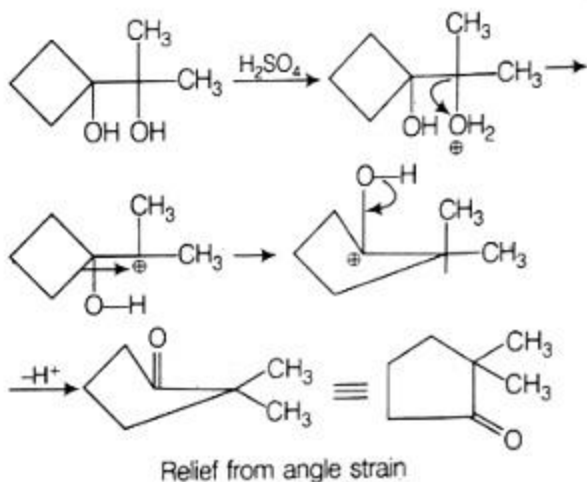


(D)



Solution: (D)

Pinacol-pinacolone rearrangement The diol is converted into α -hydroxy ketone when reacted in presence of acid is believe to proceeds through rearrangement of carbocation as shown.



Basic of carbocationic rearrangement is due to relief from angle strain.

11. Usually, CaCl_2 is preferred over NaCl for cleaning snow on roads particularly in very cold countries. This is because

- (A) NaCl makes the road slippery but CaCl_2 does not
- (B) CaCl_2 is hygroscopic but NaCl is not
- (C) CaCl_2 is less soluble in H_2O than NaCl
- (D) Eutectic mixture of $\text{CaCl}_2/\text{H}_2\text{O}$ freezes at -55°C while that of $\text{NaCl}/\text{H}_2\text{O}$ freeze at -18°C .

Solution: (D)

A mixture of chemical compounds having a single chemical composition, solidifies at a lower temperature than any other composition made up of the same ingredients. This mixture is called eutectic mixture.

Freezing point eutectic mixture of $\text{NaCl}/\text{H}_2\text{O}$ is only -180°C but the ambient temperature of very cold countries is much lower than -180°C . In such situations, NaCl will be ineffective. Thus, for such situations eutectic mixture $\text{CaCl}_2/\text{H}_2\text{O}$ is used because it has freezing point of -55°C which is much lower than NaCl .

This mixture lowers the freezing point of ice that allows street snow or ice to melt at lower temperature.

12. The gold numbers of a few protective colloids are given

| | |
|-----|-------|
| x | 0.005 |
| y | 3.5 |
| z | 40 |

The protective nature of these colloidal solutions follow the order

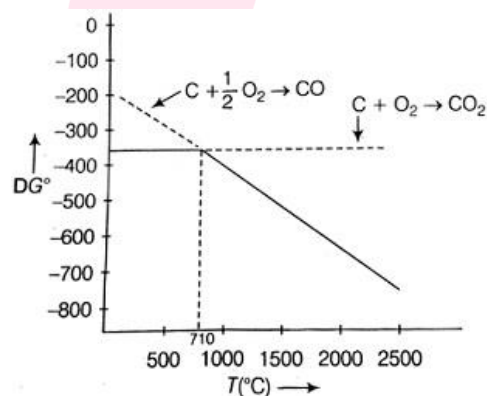
- (A) $z > x > y$ (B) $x < y > z$ (C) $z > y > x$ (D) $x > y > z$

Solution: (D)

Smaller the gold number, greater is its protective power. Hence, the order would be $x > y > z$

Caution Point Gold number is used for calculating the protective powers of lyophilic colloids.

13. Consider the following Ellingham diagram for carbon



Which of the statement is incorrect for the above Ellingham diagram?

- (A) Upto 710°C , the reaction of formation of CO_2 is energetically more favourable but above 710°C , the formation of CO is preferred
- (B) Carbon can be used to reduce any metal oxide at a sufficiently high temperature
- (C) Carbon reduces many oxides at elevated temperature because ΔG° vs temperature line has a negative slope
- (D) $\Delta S^{\circ} \left[\text{C}(s) + \frac{1}{2} \text{O}_2(g) \rightarrow \text{CO}(g) \right] < \Delta S^{\circ} \left[\text{C}(s) + \text{O}_2(g) \rightarrow \text{CO}_2(g) \right]$

Solution: (D)

$$\text{Since, } \Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

Where, ΔG° = standard Gibb's free energy of the reaction

ΔS° = standard entropy of the reaction

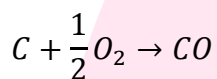
ΔH° = standard enthalpy of the reaction

T = temperature

From, the above equation, it is clear that, ΔG° will be more negative when ΔS° is less negative (or ΔS° is high).

In the diagram, ΔG° value for $C + \frac{1}{2}O_2 \rightarrow CO$ is less negative, (lower) than that for $C + O_2 \rightarrow CO_2$

Therefore, ΔS° would be higher for

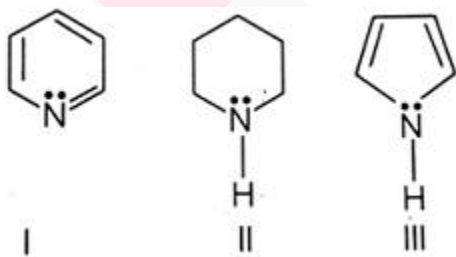


Than that for $C + O_2 \rightarrow CO_2$

Hence,

$$\Delta S^\circ \left[C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g) \right] > \Delta S^\circ [C(s) + O_2(g) \rightarrow CO_2(g)]$$

14. Arrange the following in correct order of basicity



(A) $I > II > III$

(B) $III > II > I$

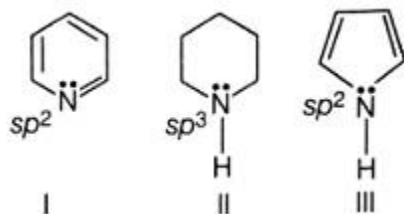
(C) $I > III > II$

Solution: (C)

This problem includes conceptual mixing of basic strength, hybridization of nitrogen atom and extent of conjugation.

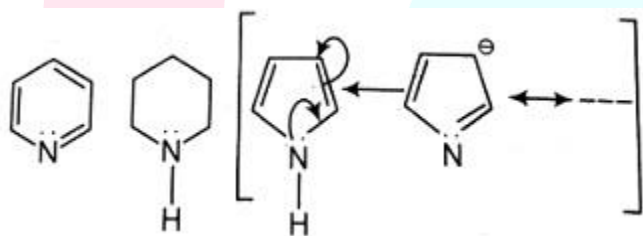
While solving such problem students are advised to draw the structure and mark the type of hybridization on N-atom, then answer the question by using combined concept of hybridization and conjugation.

Hybridization of N-atom in below compounds are sp^2 , sp^3 and sp^2 respectively.



Greater the s-character more will be electronegativity of N-atom and lesser will be its basicity on this basis I is less basic than II.

Conjugation If lone pairs of electron of N is involved in conjugation causes decrease in basicity of compound due to lesser availability of lone pair for donation to show basic nature.



Lone pair involved in formation of aromatic sextet of 6π -electron (least basic).

15. What is the density of Na_2O having antifluorite type crystal structure, if the edge length of the cube is 100pm and what is the effect on density by 0.05% Frenkel defect?

- (A) 823.5 g cm^{-3} , density increases
- (B) 414.16 g cm^{-3} , density decreases
- (C) 823.5 g cm^{-3} , density remains same
- (D) 414.16 g cm^{-3} , density remains same

Solution: (D)

$$\text{As, density } (\rho) = \frac{Z_{eff} \times \text{Molecular weight}}{N_A \times a^3}$$

$$\text{(For antifluorite, } Z_{eff} = \frac{4}{\text{unit cell}})$$

$$\rho = \frac{4 \times (23 \times 2 + 16)}{6 \times 10^{23} \times (100 \text{ pm} \times 10^{-10})^3}$$

$$= 414.16 \text{ g cm}^{-3}$$

$$[1 \text{ picometer} = 10^{-12} \text{ m} = 10^{-10} \text{ cm}]$$

Caution point Frenkel defect is the type of stoichiometric defect in which density of the crystal does not change.

16. A swimmer coming out from a pool is covered with a film of water weighing about 18g. Calculate the internal energy of vaporization at 100°C.

$$[\Delta_{vap} H^\ominus \text{ for water at } 373 \text{ K} = 40.66 \text{ kJ mol}^{-1}]$$

The correct option is

$$(A) 35.67 \text{ kJ mol}^{-1} \quad (B) 37.56 \text{ kJ mol}^{-1}$$

$$(C) 36.57 \text{ kJ mol}^{-1} \quad (D) 38.75 \text{ kJ mol}^{-1}$$

Solution: (B)

We can represent the process of evaporation as



$$\text{Number of moles in } 18 \text{ g } H_2O(l) \text{ is } = \frac{18 \text{ g}}{18 \text{ g mol}^{-1}} = 1 \text{ mole}$$

$$\Delta_{vap} U = \Delta_{vap} H^\ominus - p\Delta V$$

$$= \Delta_{vap} H^\ominus - \Delta n_g RT$$

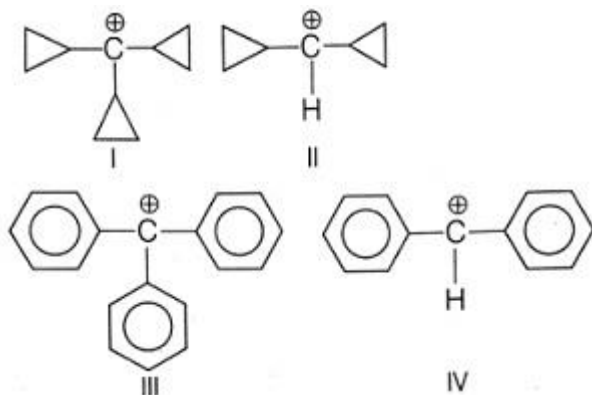
Assume steam behave as an ideal gas.

$$\Delta_{vap} U = (40.66) - (1)(8.314 \times 10^{-3})(373)$$

$$= 40.66 - 3.10$$

$$= 37.56 \text{ kJ mol}^{-1}$$

17. Which of the following is correct order of stability of carbocation?



- (A) $IV > III > II > I$ (B) $I > II > III > IV$
(C) $III > II > I > IV$ (D) $I > III > II > IV$

Solution: (D)

In case of cyclopropyl carbocation, stability of carbocation depends upon conjugation between bent orbitals of cyclopropyl ring and vacant p-orbital of cationic carbon. This type of bonding is known as banana bonding.

18. Mercury is a liquid metal because

- (A) It has a completely filled d-orbital that causes d-d overlapping
(B) It has completely filled d-orbital that prevents d-d overlapping
(C) It has a completely filled s-orbital
(D) It has a small atomic size

Solution: (B)

The electronic configuration of mercury is $[Xe]4f^{10}, 5d^{10}, 6s^2$. Its d-subshell is completely filled, thus, it prevents the overlapping of d-orbitals (d-d overlapping). Hence, it is liquid metal at room temperature.

19. The volume of 10N and 4N HCl required to make 1L of 7N HCl are

- (A) 0.75 L of 10 N HCl and 0.25 L of 4 N HCl

(B) 0.50 L of 10 N HCl and 0.50 L of 4 N HCl

(C) 0.65 L of 10 N HCl and 0.5 L of 4 N HCl

(D) 0.85 L of 10 N HCl and 0.15 L of 4 N HCl

Solution: (B)

Let V litre of 10 N HCl be mixed with (1 - V) litre of 4 N HCl to give (V + 1 - V) = 1 L of 7N HCl

As we know that,

$$N_1V_1 + N_2V_2 = NV$$

$$10V + 4(1 - V) = 7 \times 1$$

$$10V + 4 - 4V = 7$$

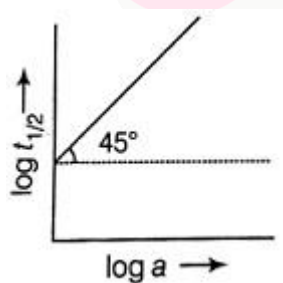
$$6V = 7 - 4$$

$$V = \frac{3}{6} = 0.50L$$

Volume of 10 N HCl = 0.50 L

Volume of 4 N HCl = 1 - 0.50 = 0.50 L

20. Following is the graph between $\log T_{50}$ and $\log a$ (a = initial concentration) for a given reaction at $27^\circ C$. Hence, order is



(A) 1

(B) 2

(C) 3

(D) 0

Solution: (D)

$$t_{\frac{1}{2}} \propto \left(\frac{1}{a}\right)^{n-1} \text{ or } t_{\frac{1}{2}} = k(a)^{1-n}$$

$$\log t_{\frac{1}{2}} = \log k + (1 - n) \log a$$

(It represents straight line equation; $y = c + mx$)

$$\text{Slope} = (1 - n) = \tan 45^\circ = 1$$

$$\therefore (1 - n) = 1$$

$$\Rightarrow n = 0$$

21. The catalyst used for olefin polymerization is

- (A) Ziegler-Natta catalyst
- (B) Raneynickel catalyst
- (C) Wilkinson catalyst
- (D) Merrified resin

Solution: (A)

Ziegler-Natta catalyst $[TiCl_4 + Al(C_2H_5)_3]$ is used as a catalyst in the polymerization of olefins.

22. Which one of the following is a covalent hydride?

- (A) CaH_2 (B) NaH (C) BH_3 (D) BeH_2

Solution: (C)

Hydrides are binary compounds of hydrogen. These can be classified into four groups

(i) Ionic hydrides : NaH, CaH_2, LiH

(ii) Covalent hydrides: $B_2H_6, NH_3, NaBH_4$

(iii) Polynuclear hydrides : $LiAlH_4, NaBH_4$

(iv) Interstitial hydrides are those in which hydrogen is trapped in the interstitial spaces of transition metals.

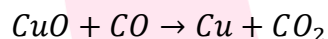
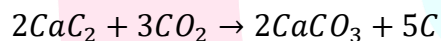
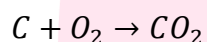
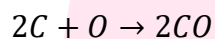
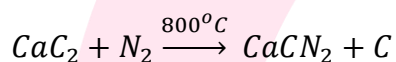
Here, B_2H_6 is a dimeric form of BH_3 . BH_3 covalently combined with another BH_3 molecule to form B_2H_6 . B_2H_6 contain 3 centre $2e^-$ bonds.

23. Which one of the following is used for the separation of noble gas mixture from air?

- (A) Charcoal
- (B) 90% CaC_2 + 10% $CaCl_2$
- (C) Soda lime + potash solution
- (D) 90% $CaCO_3$ + 10% urea

Solution: (B)

The method used to separate noble gas mixture from air is called Fischer-Rings' method. When air free from moisture and CO_2 is passed over a heated mixture ($800^\circ C$) of 90% CaC_2 + 10% $CaCl_2$ in an iron sealed tube, the following reactions take place



CO_2 gas is absorbed by KOH solution. Thus, a mixture of inert gases are obtained.

24. Consider the following statements.

I. NCl_5 does not exist while PCl_5 does.

II. Both O_2^+ and NO are paramagnetic.

III. The three $C - O$ bonds are not equal in carbonate ion.

IV. Head prefers to form tetravalent compound. Which of the above statements are incorrect?

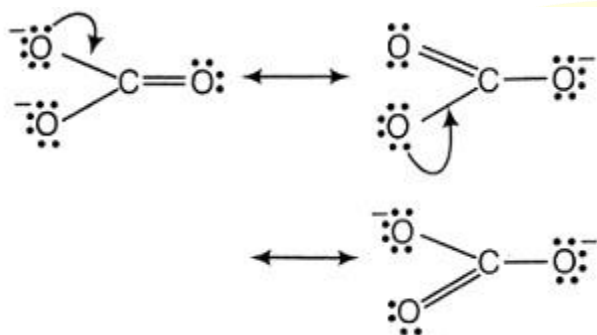
- (A) I and III
- (B) I, III and IV
- (C) II and III
- (D) III and IV

Solution: (D)

I. In nitrogen, d-orbitals are absent, hence, it does not form NCl_5 . Thus, NCl_5 does not exist but PCl_5 does.

II. O_2^+ and NO are isoelectronic and contains one unpaired electron each. Thus, both are paramagnetic.

III. In carbonate ion. CO_3^{2-} all three $C - O$ bonds are identical due to resonance



IV. Pb^{2+} is more stable than Pb^{4+} due to inert pair effect, hence, prefers to form divalent compounds.

Thus, the incorrect statements are III and IV.

25. The liquefied metal that expand on solidification is

- (A) *Al* (B) *Zn* (C) *Ga* (D) *Cu*

Solution: (C)

Gallium, Ga is a soft silvery white metal and is liquid at room temperature. When it solidifies, expands by 3.1%. Thus, it should not be stored in glass or metal containers.

26. Point out the correct statement for the set of characteristics of ZnS crystal.

- (A) Coordination number (4 : 4); ccp; Zn^{2+} ion in the alternate tetrahedral voids
(B) Coordination number (6 : 6); hcp; Zn^{2+} ion in all tetrahedral voids
(C) Coordination number (6 : 4); hcp; Zn^{2+} ion in all octahedral voids
(D) Coordination number (4 : 4); ccp; Zn^{2+} ion in all tetrahedral voids

Solution: (A)

Zns has zinc blende type structure (i.e., ccp structure). The S^{2-} ions are present at the corners of the cube and at the centre of each face. Zinc ions occupy half of the tetrahedral sites. Each zinc ion is surrounded by four sulphide ions which are disposed towards the corner of regular tetrahedron. Similarly, S^{2-} ion is surrounded by four Zn^{2+} ions.

27. Arrange the following compounds in the increasing order of nucleophilic addition reaction.

I. $HCHO$

II. CH_3COCH_3

III. $C_6H_5COCH_3$

IV. $C_3H_5COC_6H_5$

(A) $I < II < III < IV$ (B) $IV < III < II < I$

(C) $IV < II < III < I$ (D) $III < IV < II < I$

Solution: (C)

Reactivity of nucleophilic addition reaction depends upon the electron deficiency of carbonyl group and steric hinderance. Steric hinderance decreases the rate of reaction. This steric hinderance is minimum in methanol and maximum in benzophenone.

28. The heat of combustion of sucrose, $C_{12}H_{22}O_{11}(s)$ at constant volume is $1348.9 \text{ kcal mol}^{-1}$ at $25^\circ C$, then the heat of reaction at constant pressure when steam is produced

(A) -1348.9 kcal

(B) -1342.34 kcal

(C) $+1250 \text{ kcal}$

(D) None of the above

Solution: (B)

The combustion equation of sucrose is $C_{12}H_{22}O_{11}(s) + 12O_2(g) \rightarrow 12CO_2(g) + 11H_2O(g)$

Here, $\Delta n = 12 + 11 - 12 = 11$

As we know,

$$\Delta H = \Delta E + \Delta nRT$$

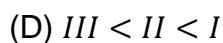
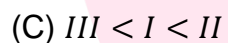
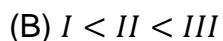
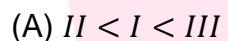
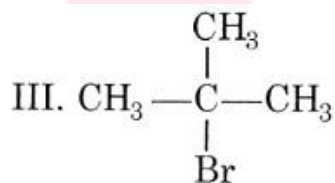
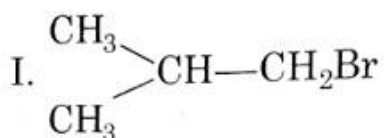
$$\Delta H = (-1348.9 \times 10^3) + 11 \times 2 \times 298$$

$$= -1348900 + 6556$$

$$= -1342344 \text{ cal}$$

$$= -1342.344 \text{ kcal}$$

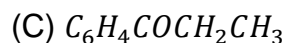
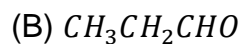
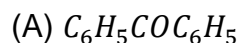
29. Arrange the following compounds in increasing order of their boiling points.



Solution: (C)

Boiling point decreases with increase in branching. Compound (III) has two branches, compound (I) has one branch and compound (II) is a normal alkyl halide with no branch. So, the boiling point is minimum for compound (III) and maximum for compound (II).

30. Which of the following compounds will give positive iodoform test with I_2 and $NaOH$?

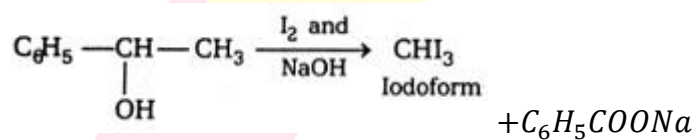


(D)

Solution: (D)

Aldehydes and ketones possess $\begin{matrix} \text{O} \\ || \\ (-\text{C}-\text{CH}_3) \end{matrix}$ group will give positive iodoform test,

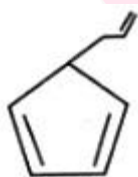
Apart from methylated carbonyl compounds, alcohols with $\begin{matrix} \text{CH}_3-\text{CH}- \\ | \\ \text{OH} \end{matrix}$ group also give positive iodoform test.



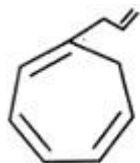
31. What will be the product when most acidic species among following will react with 3-chloroprop-1-ene?



(A)



(B)



(C)



(D)

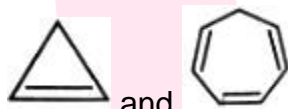


Solution: (A)

This problem includes conceptual mixing of acidic character, aromaticity and nucleophilic substitution reaction.

Students are advised to identify the most stable intermediate obtained among all (after the removal of H^+) keeping in mind the concept of conjugation and aromaticity. Then complete the reaction further using concept of nucleophilic substitution reaction.

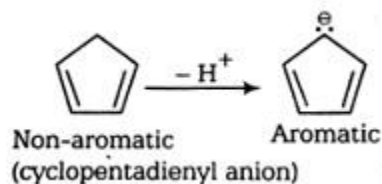
Acidic character The species which easily donate its hydrogen and produces stable conjugate base is acid. The species which produces more stable conjugate base is more stronger acid.



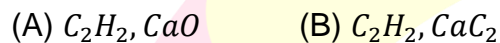
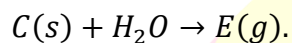
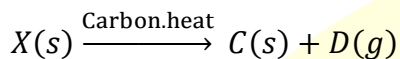
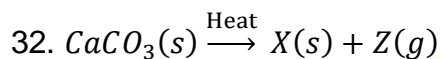
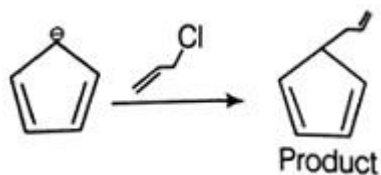
and do not lose H^+ hence are not acidic.



loses the H easily and produces more stable aromatic cyclopentadienyl anion.



Now, cyclopentadienyl anion on reaction with 3-chloro prop-1-ene produces the product via nucleophilic substitution reaction.



Solution: (B)

33. Which of the following will not form optical isomers?



Solution: (B)

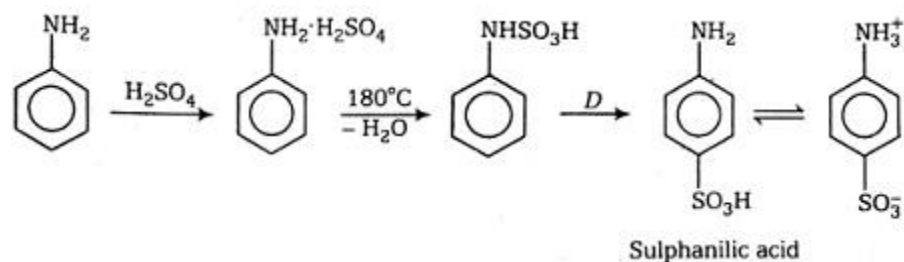
Optical isomerism is shown by only those complexes which lack symmetry. Complex $[Co(NH_3)_3(NO_2)_3]$ shows facial and meridional isomerism. Both isomers of this complex contain plane of symmetry. So, it will not form optical isomers.

34.

The true statement about the product is

- (A) It does not exist as Zwitter ion
- (B) It does not act as inner salt
- (C) $-SO_3$ diminishes the basic character of $-NH_2$
- (D) $-NH_2$ displays a powerful basic character

Solution: (C)



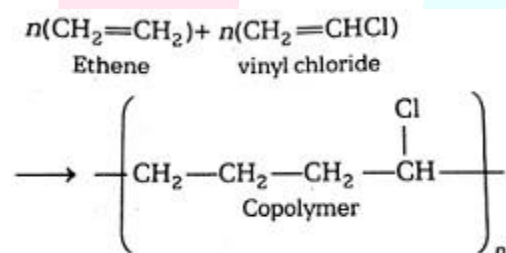
Sulphanilic acid exists as a dipolar ion which has acidic as well as basic groups in the same molecule. Such ions are called Zwitter ions or inner salts.

35. A copolymer of ethene and vinyl chloride contains alternate monomers of each type. What is the mass percentage of vinyl chloride in this copolymer?

- (A) 38% (B) 69% (C) 72% (D) 82%

Solution: (B)

The structure of copolymer of ethene and vinyl chloride is shown below



Molecular weight of ethene (CH_2CH_2) = 28

Molecular weight of vinyl chloride (CH_2CHCl) = 62.5

Empirical formula weight of copolymer = 28 + 62.5 = 90.5

Mass % of vinyl chloride in the copolymer = $\frac{62.5 \times 100}{90.5} = 69.06 \approx 69\%$

36. The number of disulphide linkages present in insulin are

- (A) 1 (B) 2 (C) 3 (D) 4

Solution: (B)

Insulin is composed of two peptide chains referred to chain A and B. Chain A of 21 residues and chain B of 30 residues are cross linked by two disulphide bridges.

37. Which of the following statement is not true about the drug barbital?

- (A) It is used in sleeping pills
- (B) It is a non-hypnotic drug
- (C) It is tranquilizer
- (D) It causes addiction

Solution: (B)

Barbital is a sleep-producing drug, hypnotic tranquillizer. It causes addiction.

38. Calculate the pH at the equivalence point during the titration of 0.1M, 25 mL CH_3COOH with 0.05 M $NaOH$ solution. ($K_a(CH_3COOH) = 1.8 \times 10^{-5}$)

- (A) 9.63
- (B) 8.63
- (C) 10.63
- (D) 11.63

Solution: (B)

Since, at equivalence point (for acid) N_1V_1

= N_2V_2 (for base)

\therefore Volume of NaOH required to reach equivalence point = $\frac{0.1 \times 25}{0.05} = 50 \text{ mL}$

\therefore Concentration of salt formed = $\frac{\text{millimoles of acid}}{\text{total volume in mL}} = \frac{25 \times 0.1}{75} = \frac{0.1}{3}$

Since, $[H^+] = \sqrt{\frac{K_w \times K_a}{c}} = \sqrt{\frac{10^{-14} \times 1.8 \times 10^{-5} \times 3}{0.1}}$

$\therefore \text{pH} = 8.63$

39. The temperature $30.98^\circ C$ is called critical temperature (T_c) of carbon dioxide. The critical temperature is the

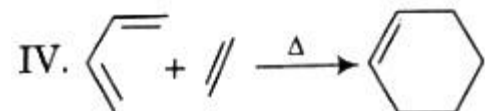
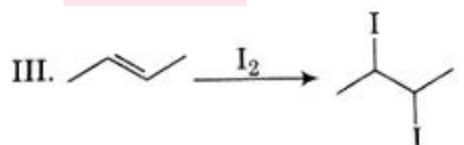
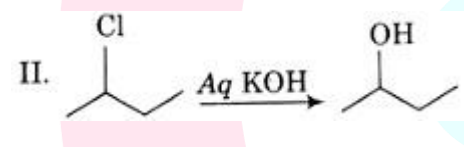
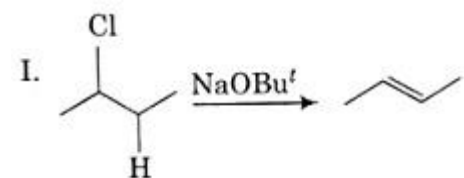
- (A) Lowest temperature at which liquid carbon dioxide is observed

- (B) Highest temperature at which gas carbon
- (C) Highest temperature at which solid carbon dioxide is observed
- (D) Highest temperature at which liquid carbon dioxide is observed

Solution: (D)

Critical temperature of a gas is highest temperature at which liquification of the gas first occurs. The temperature 30.98°C is called critical temperature of carbon dioxide because this is the highest temperature at which liquid carbon dioxide is observed. Above this temperature it is gas.

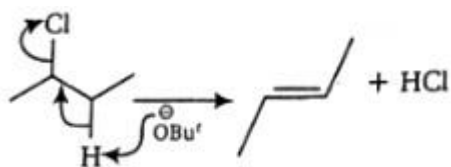
40. The type of reactions for these are



- (A) Elimination, substitution, addition, addition
- (B) Addition, elimination, addition, substitution
- (C) Elimination, addition, substitution, addition
- (D) Substitution, elimination, addition, addition

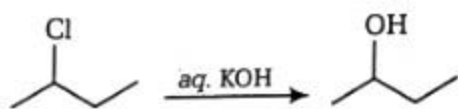
Solution: (A)

I. **Elimination reaction**



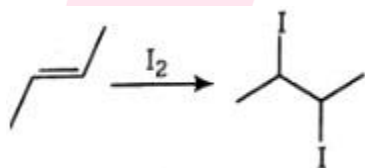
The reaction in which smaller neutral molecules are removed during the reaction is known as elimination reaction.

II. **Substitution reaction** The reaction in which one nucleophilic group is replaced by another nucleophile is known as nucleophilic substitution reaction.

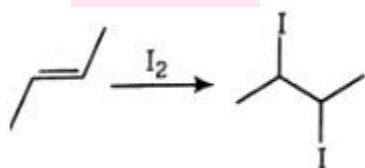


Here, OH replaces Cl.

III. **Addition reaction** The reaction in which reactant undergo addition with reagent to give a single product.



IV. **Addition reaction**



Hence,

English

Single correct answer type:

1. Out of the four alternatives, choose the one which express the right meaning of the word.

Augment

- (A) Increase (B) Decrease
(C) Save (D) Mention

Solution: (A)

Augment means make bigger, so increase is the correct option.

2. Out of the four alternatives, choose the one which express the right meaning of the word.

Consolation

- (A) Comfort (B) Problem
(C) Sadness (D) Solution

Solution: (A)

Consolation means 'comfort received by a person after a loss', so comfort is correct option.

3. Out of the four alternatives, choose the one which express the right meaning of the word.

Auxiliary

- (A) Chief (B) Supplemental
(C) Negligible (D) Separate

Solution: (B)

Auxiliary means 'providing additional help', so supplemental is correct option.

4. Choose the word apposite meaning to the given word.

Auspicious

- (A) Prosperous (B) Unfavourable
(C) Improper (D) New

Solution: (B)

Auspicious means 'favourable', so 'unfavourable' is best opposite word for it.

5. Choose the word apposite meaning to the given word.

Recompense

- (A) Emolument (B) Reward
(C) Payment (D) Penalty

Solution: (D)

Recompense means 'payment', so 'penalty' is the correct opposite word for it.

6. Choose the word apposite meaning to the given word.

Impede

- (A) Block (B) Delay
(C) Push (D) Freeze

Solution: (C)

Impede means 'hinder' or 'obstruct', so 'push' is correct opposite word for it.

7. A part of sentence is underlined. Balance are given alternatives to the underlined part a, b, c and d which many improve the sentence. Choose the correct alternative.

They requested me to follow them

- (A) Ordered (B) Urged
(C) Asked (D) No improvement

Solution: (A)

Here a sense of command is depicted in sentence, so we should use 'ordered' for proper meaning of sentence.

8. A part of sentence is underlined. Balance are given alternatives to the underlined part a, b, c and d which many improve the sentence. Choose the correct alternative.

She did not believed me.

- (A) Believing (B) Believe to
(C) Believe (D) No improvement

Solution: (C)

Sentence is in past tense and V_1 is used in those sentence which contain 'did', so option (believe) is correct.

9. A part of sentence is underlined. Balance are given alternatives to the underlined part a, b, c and d which many improve the sentence. Choose the correct alternative.

I am fine, what about you?

- (A) Your (B) Your's
(C) Yours (D) No improvement

Solution: (D)

No improvements is needed as sentence is right.

10. **Sentence Completion**

They were afraid _____ the lion, so they dropped the idea of hunting in jungle.

- (A) in (B) to (C) from (D) to

Solution: (D)

Afraid agrees with preposition 'of', so option (to) is correct.

11. **Sentence Completion**

Our company signed a profitable _____ last month.

- (A) issue (B) agenda (C) deal (D) paper

Solution: (C)

Normally, company signs a contract or deal, so use of 'deal' is proper here.

12. What is your _____ for tonight?

- (A) Principle (B) Motto (C) Plan (D) Objective

Solution: (C)

The question gives a sense of query about normal routine of some special/specific day, so use of 'plan' is more proper here.

13. **Arrange the following sentences in correct pattern and mark at the correct combination.**

1. Today we live in modern technology era.

P. We have a lot of problems now.

Q. We want to get everything in one day.

R. Ancient time was quite pleasant.

S. We had no problems then.

C. Perhaps greed is the main cause for this.

- (A) *PQRS* (B) *PRSQ* (C) *SRQP* (D) *RPQS*

Solution: (B)

According to the events of sentence, PRSQ is best arrangement.

14. Arrange the following sentences in correct pattern and mark at the correct combination.

1. He is a common man.

P. Yesterday our city saw a brutal crime.

Q. Police is trying to arrest innocent persons.

R. The criminals are well known.

S. Police as well as whole system is corrupt.

C. Police will arrest him as he is an easy target because of being a common man.

(A) *PRSQ*

(B) *PQSR*

(C) *PQRS*

(D) *PSQR*

Solution: (A)

According to events of sentence, PRSQ is best arrangement.

15. Arrange the following sentences in correct pattern and mark at the correct combination.

1. I want to change the room.

P. Last month I got a job.

Q. I had been living there for six months.

R. The office is far from the room.

S. I want to cut expenses of travelling.

C. Hopefully I will do this next week.

(A) *PQRS*

(B) *PRSQ*

(C) *QPRS*

(D) *PQSR*

Solution: (C)

According to sequence of events in the sentence, QPRS best arrangement.

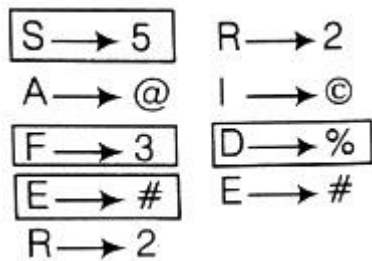
16. In a certain code language, 'SAFER' is written as '5@3#2' and 'RIDE' is written as '2©%#', how would 'FEDS' be written in that code?

- (A) 3#©5 (B) 3©%5 (C) 3#%5 (D) 3#%2

Solution: (C)

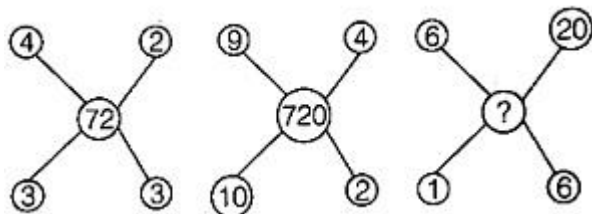
Given,

SAFER = 5@3#2 and RIDE = 2©%#



∴ Code for FEDS = 3#%5

17. Find the missing number from the given response.



- (A) 72 (B) 720 (C) 7200 (D) 38

Solution: (B)

From the given responses,

$$4 \times 2 \times 3 \times 3 = 72$$

$$9 \times 4 \times 2 \times 10 = 720$$

Similarly, $6 \times 20 \times 1 \times 6 = 720$

18. If the first and second letters in the word DEPRESSION were interchanged, also the third and fourth letters, the fifth and the sixth letters and so on, then which of the following would be seventh letter from the right.

- (A) O (B) P (C) R (D) S

Solution: (B)

Since, consecutive two letters are interchanged. Therefore,

DE PR ES SI ON
↓ ↓ ↓ ↓ ↓
ED R P SE IS NO ← On counting

Now, on counting from right hand side P is the 7th letter from right.

19. Today is Thursday, The day after 59 days will be

- (A) Sunday (B) Monday (C) Tuesday (D) Wednesday

Solution: (A)

Every day of week repeats after seven days.

Hence, $59 = 7 \times 8 + 3 = 56 + 3$

∴ It will be Thursday after 56 days.

∴ 57th day = Thursday \Rightarrow 58th day = Friday

59th day = Saturday \Rightarrow 60th day = Sunday

∴ It will be Sunday after 59 days.

20. Which of the following represents coal mines, factories and fields?

(A)



(B)



(C)

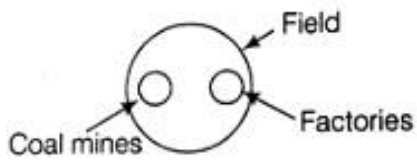


(D)



Solution: (D)

Both coal mines and factories are located in the fields.



21. Find out the missing term in the series.

1, 8, 27, ?, 125, 216

(A) 52 (B) 58 (C) 64 (D) 65

Solution: (C)

From the given series,

$$1^3 \longrightarrow 1$$

$$2^3 \longrightarrow 8$$

$$3^3 \longrightarrow 27$$

$$\boxed{4^3 \longrightarrow 64}$$

$$5^3 \longrightarrow 125$$

$$6^3 \longrightarrow 216$$

Therefore, 64 will come in place of questions mark.

22. If '+' means '×', '-' means '+', '×' means '÷' and '÷' means '-', then
 $6 - 9 + 8 \times 3 \div 20 = ?$

- (A) -2 (B) 6 (C) 10 (D) 12

Solution: (C)

Interchanging the symbols as given in the above question, the above equation becomes

$$6 + 9 \times 8 \div 3 - 20 = 6 + 9 \times \frac{8}{3} - 20$$
$$= 6 + 24 - 20 = 10$$

23. What is the water image of



(A)



(B)



(C)



(D)



Solution: (B)

Water image is the reflection of image in water.

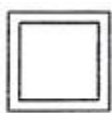


Actual image

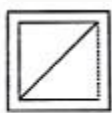


Water image

24. A piece of paper is folded and punched as shown in the figure below



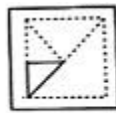
(a)



(b)



(c)



(d)

How will it appear when unfolded?

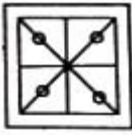
(A)



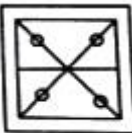
(B)



(C)



(D)



Solution: (B)

On unfolding layer 1,



On unfolding layer 2,



On unfolding layer 3,



25. Here are some words translated from an artificial language.

mallon piml means blue light

mallon tift means blue berry

arpan tift means rasp berry

Which word could mean 'light house'?

- (A) tiftmallon (B) pimlarpan (C) mallonarpan (D)
pimldoken

Solution: (D)

mallon **p**iml = **b**lue **l**ight
mallon **t**ift = **b**lue **b**erry
arpan **t**ift = **r**asp **b**erry

∴ From the above analysis, we see codes as

Blue = Mallon

Light = Piml

berry = tift

rasp = arpan

∴ Light i.e., piml is given in two options (b) and (d) but in option (b) other code given is of rasp, hence it cannot be the code of house. So, option (d) is correct.

Mathematics

Single correct answer type:

1. If p, q, r and s are positive real numbers such that $p + q + r + s = 2$, then $M = (p + q)(r + s)$ satisfies the relation

- (A) $0 < M \leq 1$ (B) $1 \leq M \leq 2$
(C) $2 \leq M \leq 3$ (D) $3 \leq M \leq 4$

Solution: (A)

Since, $AM \geq GM$, then

$$\frac{(p + q) + (r + s)}{2} \geq \sqrt{(p + q)(r + s)}$$

$$\Rightarrow \frac{2}{2} \geq \sqrt{M} \Rightarrow \sqrt{M} \leq 1 \Rightarrow M \leq 1$$

Also, $(p + q)(r + s) > 0$ ($\because p, q, r, s > 0$)

$\therefore M > 0$

Hence, $0 < M \leq 1$

2. The complex number $z = x + iy$ which satisfies the equation $\left| \frac{z-3i}{z+3i} \right| = 1$, lie on

- (A) The X-axis (B) The straight line $y = 3$
(C) A circle passing through origin (D) None of the above

Solution: (A)

$$\text{Given, } \left| \frac{z-3i}{z+3i} \right| = 1 \Rightarrow |z - 3i| = |z + 3i|$$

(if $|z - z_1| = |z - z_2|$, then it is a perpendicular bisector of z_1 and z_2)

Hence, perpendicular bisector of $(0, 3)$ and $(0, -3)$ is X-axis.

3. If $f(x)$ is an odd periodic function with period 2, then $f(4)$ equal to

- (A) -4 (B) 4 (C) 2 (D) 0

Solution: (D)

Since, $f(x)$ is an odd periodic function with period 2.

$$\therefore f(-x) = -f(x) \text{ and } f(x+2) = f(x)$$

$$\therefore f(2) = f(0+2) = f(0)$$

$$\text{and } f(-2) = f(-2+2) = f(0)$$

$$\text{Now, } f(0) = f(-2) = -f(2) = -f(0)$$

$$\Rightarrow 2f(0) = 0, \text{ i.e., } f(0) = 0$$

$$\therefore f(4) = f(2+2) = f(2) = f(0) = 0$$

Thus, $f(4) = 0$

4. The solution of the differential equation

$$\frac{x + \frac{x^3}{3!} + \frac{x^5}{5!} + \dots}{1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \dots} = \frac{dx - dy}{dx + dy} \text{ is}$$

(A) $2ye^{2x} = Ce^{2x} + 1$ (B) $2ye^{2x} = Ce^{2x} - 1$

(C) $ye^{2x} = Ce^{2x} + 2$ (D) None of these

Solution: (B)

$$\text{We have, } \frac{x + \frac{x^3}{3!} + \frac{x^5}{5!} + \dots}{1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \dots} = \frac{dx - dy}{dx + dy}$$

On applying componendo and dividend, we get

$$\frac{\left(x + \frac{x^3}{3!} + \frac{x^5}{5!} + \dots\right) + \left(1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \dots\right)}{\left(x + \frac{x^3}{3!} + \frac{x^5}{5!} + \dots\right) - \left(1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \dots\right)}$$

$$= \frac{(dx - dy) + (dx + dy)}{(dx - dy) - (dx + dy)}$$

$$\Rightarrow \frac{\left(1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots\right)}{-\left(1 - x + \frac{x^2}{2!} - \frac{x^3}{3!} + \dots\right)} = \frac{2dx}{-2dy}$$

$$\Rightarrow \frac{e^x}{-e^{-x}} = -\frac{dx}{dy}$$

$$\Rightarrow \frac{dy}{dx} = \frac{e^{-x}}{e^x} \Rightarrow \frac{dy}{dx} = e^{-2x} \Rightarrow dy = e^{-2x} dx$$

On integrating both sides, we get

$$y = \frac{e^{-2x}}{(-2)} + C_1 \Rightarrow 2y = -e^{-2x} + 2C_1$$

$$\Rightarrow 2y = -e^{-2x} + C \quad (\text{where, } C = 2C_1)$$

$$\Rightarrow 2ye^{2x} = -1 + e^{2x} C \Rightarrow 2ye^{2x} = Ce^{2x} - 1$$

5. The value of k such that the lines $2x - 3y + k = 0$, $3x - 4y - 13 = 0$ and $8x - 11y - 33 = 0$ are concurrent, is

- (A) 20 (B) -7 (C) 7 (D) -20

Solution: (B)

Given lines are concurrent,

$$\text{So, } \begin{vmatrix} 2 & -3 & k \\ 3 & -4 & -13 \\ 8 & -11 & -33 \end{vmatrix} = 0$$

$$\Rightarrow 2(132 - 143) + 3(-99 + 104) + k(-33 + 32) = 0$$

$$\Rightarrow -22 + 15 - k = 0 \Rightarrow k = -7$$

6. Two lines, whose equations are $\frac{x-3}{2} = \frac{y-2}{3} = \frac{z-1}{\lambda}$ and $\frac{x-2}{3} = \frac{y-3}{2} = \frac{z-2}{3}$ lie in the same plane. Then, the value of $\sin^{-1} \sin \lambda$ is equal to

- (A) 3 (B) $\pi - 3$ (C) 4 (D) $\pi - 4$

Solution: (D)

Given lines are $\frac{x-3}{2} = \frac{y-2}{3} = \frac{z-1}{\lambda}$ (i)

and $\frac{x-2}{3} = \frac{y-3}{2} = \frac{z-2}{3}$ (ii)

These lines lie in the same plane, So, both are coplanar.

$$\therefore \begin{vmatrix} 2 & 3 & \lambda \\ 3 & 2 & 3 \\ 1 & -1 & -1 \end{vmatrix} = 0$$

$$\Rightarrow 2(-2 + 3) - 3(-3 - 3) + \lambda(-3 - 2) = 0$$

$$\Rightarrow 2 + 18 - 5\lambda = 0 \Rightarrow 5\lambda = 20 \Rightarrow \lambda = 4$$

$$\therefore \sin^{-1} \sin \lambda = \sin^{-1} \sin 4$$

$$= \sin^{-1} \sin(\pi - 4)$$

$$= \pi - 4$$

7. If $\frac{e^x}{1-x} = B_0 + B_1x + B_2x^2 + \dots + B_nx^n + \dots$, then the value of $B_n - B_{n-1}$ is

- (A) 1 (B) $\frac{1}{n}$ (C) $\frac{1}{n!}$ (D) None of these

Solution: (C)

We have,

$$e^x = (1 - x) (B_0 + B_1x + B_2x^2 + \dots + B_{n-1}x^{n-1} + B_nx^n + \dots)$$

By the expansion of e^x , we get

$$1 + \frac{x}{1!} + \frac{x^2}{2!} + \dots + \frac{x^n}{n!} + \dots$$

$$= (1 - x) (B_0 + B_1x + B_2x^2 + \dots + B_{n-1}x^{n-1} + B_nx^n + \dots)$$

Equating the coefficient of x^n on both sides, we get

$$B_n - B_{n-1} = \frac{1}{n!}$$

8. $2^{3n} - 7n - 1$ is divisible by

- (A) 64 (B) 36 (C) 49 (D) 25

Solution: (C)

$$\text{Let } P(n) = 2^{3n} - 7n - 1 \Rightarrow P(1) = 0, P(2) = 49$$

$P(1)$ and $P(2)$ are divisible by 49.

$$\text{Let } P(k) = 2^{3k} - 7k - 1 = 49I$$

$$P(k+1) = 2^{3k+3} - 7k - 8$$

$$= 8(49I + 7k + 1) - 7k - 8$$

$$= 49(8I) + 49k = 49\lambda$$

(where, $\lambda = 8I + k$, which is an integer.)

9. If $\int_0^{25} e^{x-[x]} dx = k(e-1)$, then the value of k is equal to

- (A) 12 (B) 25 (C) 23 (D) 24

Solution: (B)

We know that, $x - [x]$ is periodic function with period one.

$\therefore e^{x-[x]}$ has period one

Since, $f(x)$ is periodic with period T, then

$$\int_0^{nT} f(x) dx = n \int_0^T f(x) dx$$

$$\therefore \int_0^{25 \times 1} e^{x-[x]} dx = 25 \int_0^1 e^{x-[x]} dx$$

$$= 25 \int_0^1 e^{x-0} dx$$

$$= 25 [e^x]_0^1 = 25 [e - 1]$$

$$\therefore 25(e - 1) = k(e - 1)$$

Hence, $k = 25$

10. A variable chord PQ of the parabola $y^2 = 4ax$ subtends a right angle at the vertex, then the locus of the points of intersection of the normal at P and Q is

- (A) A parabola (B) A hyperbola (C) A circle (D) None of these

Solution: (A)

Let P be $(at_1^2, 2at_1)$ and Q be $(at_2^2, 2at_2)$. Since, PQ subtends a right angle at the vertex (0,0).

$$\text{Hence, } t_1 t_2 = -4 \quad \dots\text{(i)}$$

If (h, k) is the point of intersection of normal at P and Q, then

$$h = 2a + a(t_1^2 + t_2^2 + t_1 t_2) \quad \dots\text{(ii)}$$

$$\text{and } k = -at_1 t_2 (t_1 + t_2) \quad \dots\text{(iii)}$$

In order to find the locus of (h, k), we have to eliminate t_1 and t_2 between equations (i), (ii) and (iii),

$$k = 4a(t_1 + t_2) \quad \dots\text{(iv)}$$

[from equations (i) and (iii)]

$$\text{and } h - 2a = a[(t_1 + t_2)^2 - t_1 t_2]$$

$$\Rightarrow h - 2a = a \left[\frac{k^2}{16a^2} + 4 \right] \quad \text{[from equation (iv)]}$$

$$\Rightarrow h - 6a = \frac{k^2}{16a}$$

Hence, the required locus is $y^2 = 16a(x - 6a)$.