

PUMDET-2023

Subject : CHEMISTRY

(Booklet Number)



Duration : **90** Minutes

No. of Questions : **50**

Full Marks : **100**

INSTRUCTIONS

1. All questions are of objective type having four answer options for each. Only one option is correct. Correct answer will carry full marks **2**. In case of incorrect answer or any combination of more than one answer, $\frac{1}{2}$ mark will be deducted.
2. Questions must be answered on OMR sheet by darkening the appropriate bubble marked A, B, C or D.
3. Use only **Black/Blue ink ball point pen** to mark the answer by complete filling up of the respective bubbles.
4. Mark the answers only in the space provided. Do not make any stray mark on the OMR.
5. Write question booklet number and your roll number carefully in the specified locations of the **OMR Sheet**. Also fill appropriate bubbles.
6. Write your name (in block letter), name of the examination centre and put your signature (as is appeared in Admit Card) in appropriate boxes in the OMR Sheet.
7. The OMR Sheet is liable to become invalid if there is any mistake in filling the correct bubbles for question booklet number/roll number or if there is any discrepancy in the name/signature of the candidate, name of the examination centre. The OMR Sheet may also become invalid due to folding or putting stray marks on it or any damage to it. The consequence of such invalidation due to incorrect marking or careless handling by the candidate will be sole responsibility of candidate.
8. Candidates are not allowed to carry any written or printed material, calculator, pen, docu-pen, log table, wristwatch, any communication device like mobile phones, bluetooth devices etc. inside the examination hall. Any candidate found with such prohibited items will be **reported against** and his/her candidature will be summarily cancelled.
9. Rough work must be done on the question booklet itself. Additional blank pages are given in the question booklet for rough work.
10. Hand over the OMR Sheet to the invigilator before leaving the Examination Hall.
11. Candidates are allowed to take the Question Booklet after examination is over.

Signature of the Candidate : _____
(as in Admit Card)

Signature of the Invigilator : _____

Chemistry 



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SPACE FOR ROUGH WORK



CHEMISTRY

1. By how much will the potential of half-cell $\text{Cu}^{2+} | \text{Cu}$ change if the solution is diluted to 100 times at 298 K ?
- (A) Increases by 59 mV (B) Decreases by 59 mV
(C) Increases by 29.5 mV (D) Decreases by 29.5 mV
2. In an irreversible process taking place at constant T and P in which P-V work is being done, the change in Gibbs free energy (dG) and change in internal energy (dU) satisfies the criteria.
- (A) $dG_{T,P} < 0, dU_{S,V} < 0$ (B) $dG_{T,P} < 0, dU_{S,V} > 0$
(C) $dG_{T,P} < 0, dU_{S,T} < 0$ (D) $dG_{T,P} < 0, dU_{S,P} < 0$
3. The value of $\Delta_r G - \Delta_r G^0$ of the reaction
- $$\text{N}_2(\text{g}, 0.2 \text{ bar}) + 2\text{O}_2(\text{g}, 0.2 \text{ bar}) \rightarrow 2\text{NO}_2(\text{g}, 0.2 \text{ bar})$$
- at 300 K is (given $\log 0.2 = -0.699$)
- (A) $4015.2 \text{ J mol}^{-1}$ (B) $-6030.2 \text{ J mol}^{-1}$
(C) $8030.4 \text{ J mol}^{-1}$ (D) $-2015.1 \text{ J mol}^{-1}$
4. Under the same reaction condition of $A \rightarrow B$, initial concentration of $1.386 \text{ mol dm}^{-3}$ of a substance becomes half in 40 seconds and 20 seconds through first order and zero order kinetics respectively. Ratio k_1/k_0 of the rate constants for first order (k_1) and zero order (k_0) of the reaction is
- (A) $0.5 \text{ mol}^{-1} \text{ dm}^3$ (B) $1.0 \text{ mol}^{-1} \text{ dm}^3$
(C) $1.5 \text{ mol}^{-1} \text{ dm}^3$ (D) $2.0 \text{ mol}^{-1} \text{ dm}^3$



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5. An aqueous solution of a drug of 0.10 millimolar shows a percentage transmission of 50 in a 1 cm. cell at 250 nm. The molar absorptivity in $\text{L mol}^{-1} \text{cm}^{-1}$ is
- (A) 2020 (B) 3100
(C) 3010 (D) 6990
6. Given that, $E^0_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$ and $E^0_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.77 \text{ V}$ at 298 K. $E^0_{\text{Fe}^{3+}/\text{Fe}}$ is
- (A) -0.036 V (B) 0.036 V
(C) 0.33 V (D) 1.21 V
7. For the equilibrium $\text{NH}_2\text{COONH}_4(\text{s}) \rightleftharpoons 2\text{NH}_3(\text{g}) + \text{CO}_2(\text{g})$
 $p_{\text{CO}_2} = 1 \text{ bar}$ at 100°C . Hence equilibrium constant (K_p) is
(Assume the reaction vessel initially was evacuated)
- (A) 1 (B) 2
(C) 3 (D) 4
8. For an enzyme catalysed reaction obeying Michaelis-Menton equation, the slope and intercept of the plot of $\frac{1}{r_0}$ against $\frac{1}{[s]_0}$ are $3.5 \times 10^2 \text{ s}$ and $5 \times 10^4 \text{ mol}^{-1} \text{ L s}$ respectively, where r_0 and $[s]_0$ are the initial rate and initial substrate concentration. The Michaelis constant (K_M) is
- (A) $142.8 \text{ m mol L}^{-1}$ (B) $17.5 \text{ m mol L}^{-1}$
(C) 7.0 m mol L^{-1} (D) 3.5 m mol L^{-1}



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9. From the kinetic study of a reaction, it is observed that the slope of the plot of $\sqrt{\text{Rate}}$ versus concentration of reactant is 2.0 (where concentration is expressed in mol L^{-1} and time in second). The numerical values of rate constant and order of the reaction are

- (A) 4.0 and 2 (B) $\sqrt{2}$ and 0
(C) 2 and 1 (D) 2 and $\frac{1}{2}$

10. A system at 300 K consists of 10^{24} atoms. Assuming that there is no interatomic energy in the system, its total internal energy will be

- (A) 3.10 kJ (B) 4.56 kJ
(C) 6.21 kJ (D) 9.36 kJ

11. For an adiabatic reversible expansion of an ideal gas, it appears that $P \propto T^3$. The ratio C_p/C_v (i.e. γ) for the gas is

- (A) 3/2 (B) 5/3
(C) 7/5 (D) 9/7

12. The dimension of A that appears in Maxwell's speed distribution equation

$$P(c) = Ac^2 \exp\left(-\frac{mc^2}{2k_B T}\right) \text{ is}$$

- (A) $\text{ML}^{-1}\text{T}^{-1}$ (B) ML^2T^{-2}
(C) $\text{M}^0\text{L}^{-3}\text{T}^3$ (D) $\text{M}^0\text{L}^{-2}\text{T}^2$

13. For $\Psi = A \exp\left(-\frac{x^2}{a^2}\right)$, ($-\infty \leq x \leq \infty$) the expectation value of p_x is

- (A) $-a$ (B) $+a$
(C) 0 (D) undefined



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14. The molar conductivity at infinite dilution for Na_2SO_4 , K_2SO_4 , KCl , HCl and HCOONa at 300 K are 260, 308, 150, 426 and 105 $\text{S cm}^2 \text{mol}^{-1}$ respectively. Hence Λ_m^0 for formic acid in the same unit and at the same temperature is
- (A) 381 (B) 405
(C) 429 (D) 531
15. The crystal $\text{Ca}_x\text{Ti}_y\text{O}_z$, has Ca at the corners, Ti at the body centres and O at the face centres of a cubic unit cell. Find x, y, z and the number of atoms contributed by a 200-plane placed within the crystal.
- (A) 1, 1, 3 and 3 (B) 1, 1, 3 and 1
(C) 4, 1, 6 and 1 (D) 2, 1, 3 and 1.5
16. Which two quantities are same ?
- (A) The transport no. of H^+ in 0.1 N HCl and HNO_3
(B) The transport no. of H^+ in infinitely dilute HCl and HNO_3
(C) The mobility of H^+ in 0.1 N HCl and HNO_3
(D) The mobility of H^+ in infinitely dilute HCl and HNO_3
17. A sparingly soluble salt M_2X ionizes as $\text{M}_2\text{X} \rightleftharpoons 2\text{M}^+ + \text{X}^{2-}$, then K_a (activity solubility product)
- (A) $K_a = S^2\gamma_{\pm}^2$ (B) $K_a = 4S^3\gamma_{\pm}^3$
(C) $K_a = 4S^3\gamma_{\pm}^2$ (D) $K_a = S^3\gamma_{\pm}^3$



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18. Number of radial nodes in 7 g orbital will be
- (A) 1 (B) 2
(C) 6 (D) 7
19. Which one of the following electronic transitions corresponds to the lowest energy band in the absorption spectrum of $\text{Ni}(\text{en})_3^{2+}$?
- (A) ${}^3\text{T}_{2g} \leftarrow {}^3\text{A}_{2g}$ (B) ${}^3\text{T}_{1g} \leftarrow {}^3\text{A}_{2g}$
(C) ${}^4\text{T}_{1g} \leftarrow {}^4\text{A}_{2g}$ (D) ${}^4\text{A}_{2g} \leftarrow {}^4\text{T}_{2g}$
20. For which of the following molecules, the IR active stretching vibrations will be Raman active ?
- (A) cis- N_2F_2 (B) trans- N_2F_2
(C) H_2O (D) Pyridine N-oxide
21. Which of the following is expected to be inert among the following ?
- (A) $\text{Cu}(\text{H}_2\text{O})_6^{2+}$ (B) $\text{Ni}(\text{H}_2\text{O})_6^{2+}$
(C) $\text{Co}(\text{NH}_3)_6^{3+}$ (D) CoF_6^{3-}
22. The self-indicating silica gel (impregnated with cobalt chloride) turns pink on absorbing moisture and becomes blue on heating. The pink and blue colours are respectively due to
- (A) $\text{Co}(\text{H}_2\text{O})_6^{2+}$ and CoCl_4^{2-} (B) $\text{Co}(\text{H}_2\text{O})_6^{2+}$ and Co_2O_3
(C) $\text{Co}(\text{H}_2\text{O})_6^{2+}$ and $\text{Co}(\text{H}_2\text{O})_6^{3+}$ (D) $\text{Co}(\text{H}_2\text{O})_6^{3+}$ and CoCl_4^{2-}



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23. At what pH, $\text{Fe}(\text{OH})_3$ starts to precipitate from a solution of 10^{-5} (M) Fe(III) ? Solubility Product of $\text{Fe}(\text{OH})_3$ is 10^{-38} .
- (A) 3 (B) 11
(C) 5 (D) 9
24. The correct order of the spectrochemical series of the species NO_2^- , NH_3 , en, F^- (en = ethylenediamine) is
- (A) $\text{NO}_2^- > \text{NH}_3 > \text{en} > \text{F}^-$ (B) $\text{en} > \text{NO}_2^- > \text{NH}_3 > \text{F}^-$
(C) $\text{en} > \text{NH}_3 > \text{NO}_2^- > \text{F}^-$ (D) $\text{NO}_2^- > \text{en} > \text{NH}_3 > \text{F}^-$
25. The complex that undergoes oxidative addition reaction in presence of H_2 is
- (A) $[\text{Ru}(\text{bipy})_2(\text{CO})(\text{H}_2\text{O})]^{2+}$ (B) $[\text{Mn}(\text{CO})_5(\text{CH}_3)]$
(C) $[\text{Ir}(\text{CO})\text{Cl}(\text{PPh}_3)_2]$ (D) $[\text{Cr}(\text{CO})_4(\text{PPh}_3)(\text{PBu}_3)]$
26. Number of d-d transitions observed in the visible region in $\text{Cu}(\text{H}_2\text{O})_6^{2+}$ ion is
- (A) 2 (B) 3
(C) 1 (D) 4
27. The total number of the microstates of the term symbol, ${}^3\text{F}$ is
- (A) 3 (B) 21
(C) 9 (D) 6
28. The ground spin state (s) of C_2^{2-} ion is
- (A) 1 (B) $\frac{1}{2}$
(C) 0 (D) 2



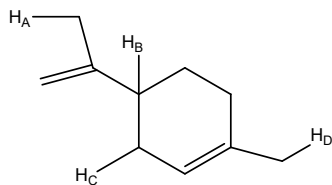
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29. Which of the following statements regarding Haemoglobin (Hb) and Myoglobin (Mb) is incorrect ?
- (A) The active sites of both Hb_4 and Mb contain the heme group in which Fe^{II} is equatorially coordinated by four pyrrole nitrogen atoms of porphyrin.
- (B) Fe^{II} in deoxy- Hb_4 and deoxy-Mb is present in low spin configuration.
- (C) Oxygenation of Hb_4 is autocatalytic due to cooperative interaction but such effects are absent in Mb due to its monomeric nature.
- (D) The successive oxygen binding constants of Hb_4 gradually increases.
30. On the basis of 18 electron rule, identify the first-row transition metal for $[(\eta^4 - \text{C}_8\text{H}_8)\text{M}(\text{CO})_3]$ and $[\text{M}(\text{CO})_3 \text{PPh}_3]^-$
- (A) Mn and Fe (B) Mn and Co
- (C) Fe and Co (D) Fe and Ni
31. The elements A, B, C and D have electronegativities 3.8, 3.3, 2.8 and 1.3 respectively. The correct order of increasing covalent character for the compounds AB, AD, BD and AC will be
- (A) $\text{AC} < \text{AB} < \text{BD} < \text{AD}$ (B) $\text{AD} < \text{BD} < \text{AC} < \text{AB}$
- (C) $\text{AB} < \text{AC} < \text{BD} < \text{AD}$ (D) $\text{BD} < \text{AD} < \text{AC} < \text{AB}$
32. Total number of isomers for $\text{Ma}_2\text{b}_2\text{cd}$ (a, b, c, d represents monodentate ligands) are
- (A) 10 (B) 6
- (C) 8 (D) 4
33. The number of unpaired electron(s) present in $[\text{CoF}_6]^{3-}$ is
- (A) zero (B) two
- (C) four (D) one



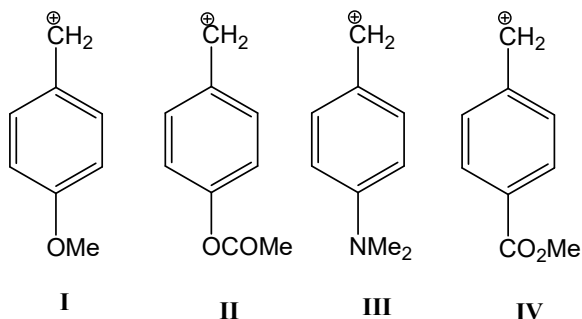
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34. The allylic hydrogen of limonene which is most readily deprotonated, is



- (A) H_A (B) H_B
(C) H_C (D) H_D

35. Correct order of stability of the following carbocations is



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

36. Among the following molecules, the molecule which does not exist in different conformations is

- (A) ammonia (B) hydrogen peroxide
(C) hydroxylamine (D) methanol

37. Which of the following statements is NOT CORRECT ?

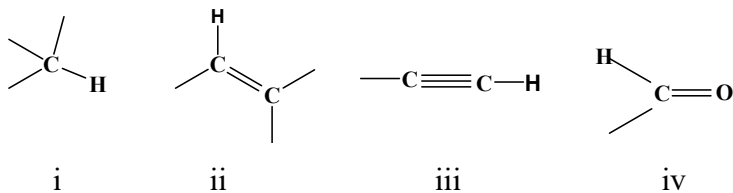
- (A) A molecule with D₂ point group is chiral.
(B) All epimers are diastereomers.
(C) A molecule cannot have both enantiotopic and diastereotopic ligands.
(D) A molecule may be optically inactive although it contains chirality centres.



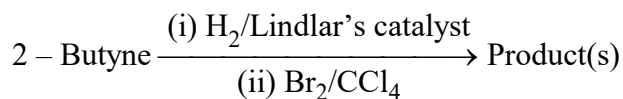
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38. The most stable conformer for the *trans* and the *cis*-isomers of 1, 3-ditert-butylcyclohexane are respectively
- (A) Twist – boat; chair (B) Chair; twist – boat
(C) Chair for both (D) Twist – boat for both
39. The number of different types (non-equivalent) of hydrogen atoms in *cis*-1, 2 – dimethyl cyclopropane is
- (A) six (B) four
(C) three (D) two
40. Among the following molecules, the molecule that records two doublets with coupling constant of about 16 Hz in the ¹H – NMR spectrum is
- (A) (Z) – 1, 2 – dichloroethene (B) (E) – 1, 2 – dibromoethene
(C) (E) – 1- bromo - 2 – chloroethene (D) (Z) – 1- bromo - 2 – chloroethene

41. The correct order of C – H stretching frequency in IR spectroscopy



- (A) iv < i < ii < iii (B) i < ii < iv < iii
(C) i < iv < ii < iii (D) i < ii < iii < iv
42. The final product(s) in the following sequence of reactions is (are)

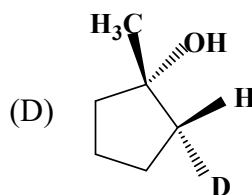
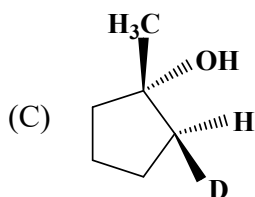
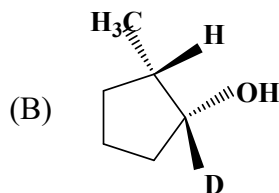
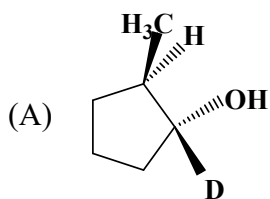
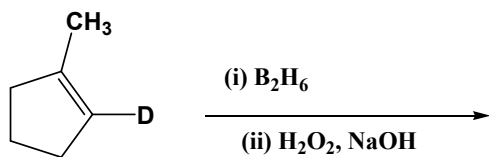


- (A) racemic – 2, 3 – dibromobutane
(B) meso – 2, 3 – dibromobutane
(C) racemic – and meso – 2, 3 – dibromobutane
(D) 2, 2, 3, 3 - tetrabromobutane

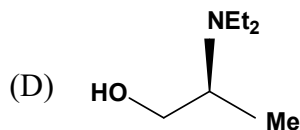
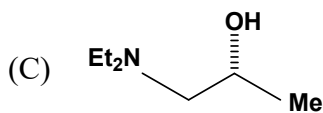
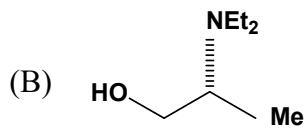
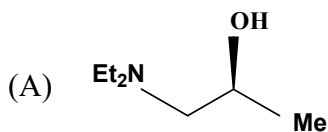
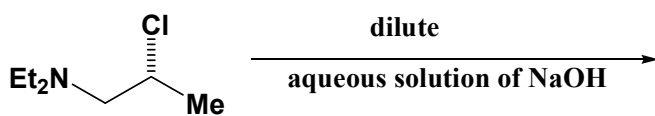


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43. Major product in the following reaction will be

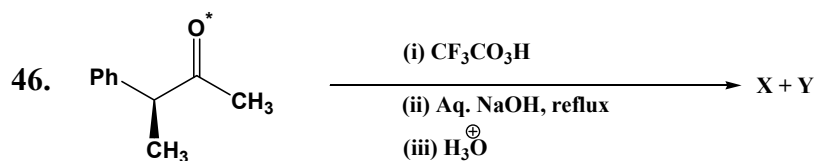
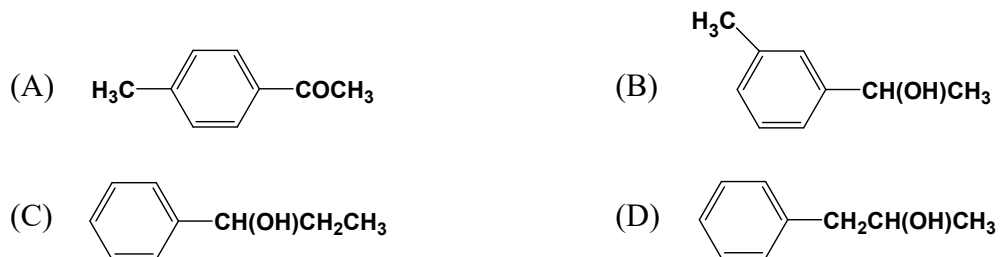


44. The major product of the following reaction is

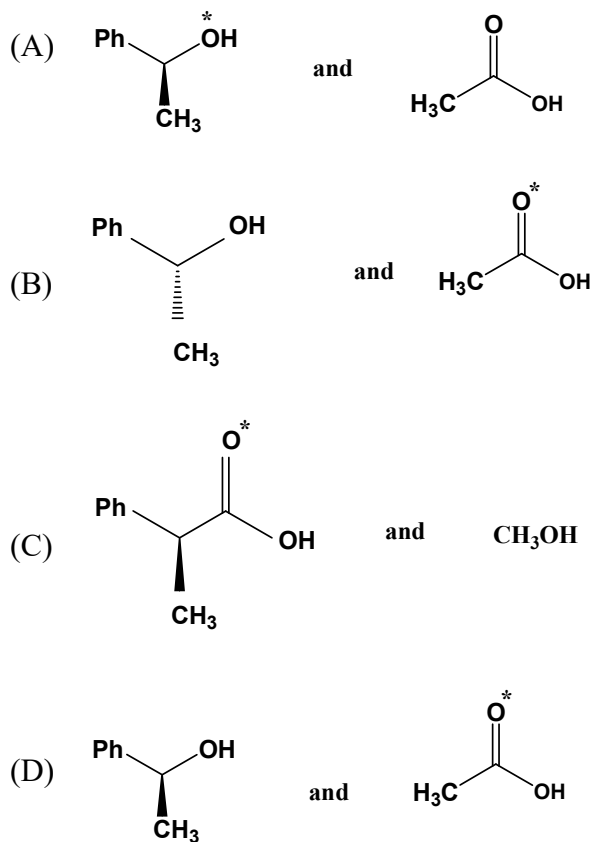


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45. Among the following molecules, the molecule which responds to iodoform test and forms benzoic acid on strong oxidation is

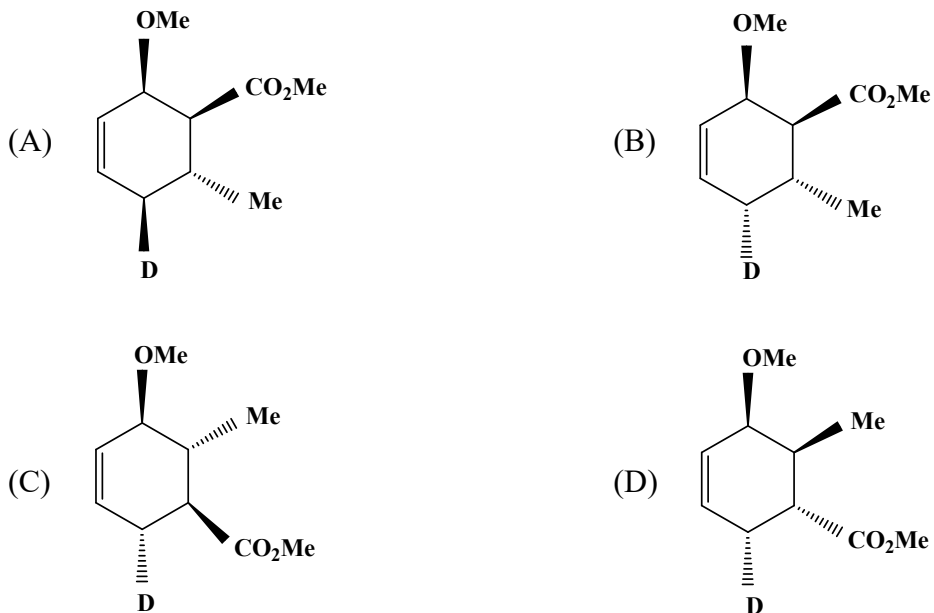
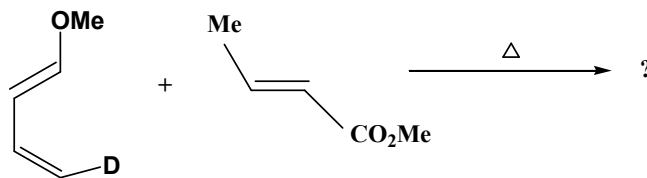


Structure of X and Y are –



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47. Identify the major product in the following reaction.



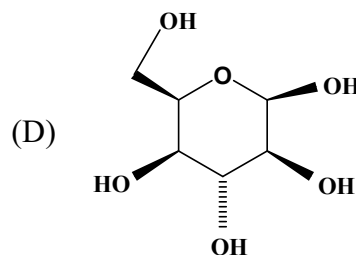
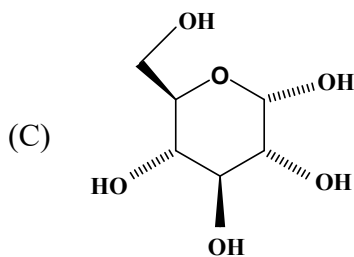
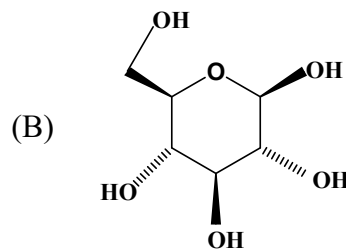
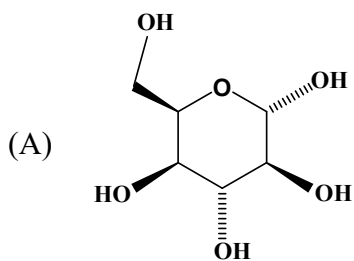
48. An electric current is passed through an aqueous solution (buffered at pH 6.0) of alanine, glutamic acid and arginine. The isoelectric points of alanine, glutamic acid and arginine are 6.0, 3.2 and 10.7 respectively. The correct statement among the following is

- (A) Glutamic acid is present as an anion in this solution.
- (B) Arginine is present as an anion in this solution.
- (C) Alanine is present as an anion in this solution.
- (D) Alanine migrates to cathode in this solution.



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49. Which of the given options represents α – D-glucopyranose ?



50. Which of the following statement(s) is/are CORRECT ?

(I) Sucrose exhibits mutarotation.

(II) Naturally occurring cysteine has S configuration.

(III) Thymine is not an RNA base.

(IV) D-Glucose and D-galactose yield the same osazone.

(A) (I) only

(B) (III) only

(C) (II) and (III)

(D) (II) and (IV)



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