

CHEM ACADEMY

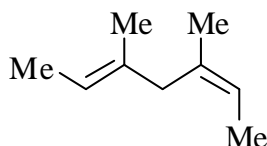
IIT-JAM 2017

SECTION – I

Multiple Choice Type

Section – A contains **Multiple Choice Questions (MCQ)**. Each MCQ type question has four choices out of which only one choice is the correct answer. Questions 1 – 10 carry 1 mark each and Questions 11 – 30 carry 2 marks each.

1. Catalytic hydrogenation of the following compound produces saturated hydrocarbon(s). The number of stereoisomer(s) formed is

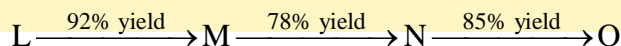


- (a) 1 (b) 2 (c) 3 (d) 4 **Ans. (c)**

2. The number of normal modes of vibration in naphthalene is

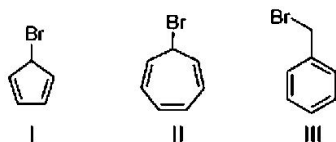
- (a) 55 (b) 54 (c) 48 (d) 49 **Ans. (c)**

3. In the following sequence of reactions, the overall yield (%) of O is



- (a) 61 (b) 85 (c) 74 (d) 68 **Ans. (a)**

4. The correct order of rate of solvolysis for the following compound is

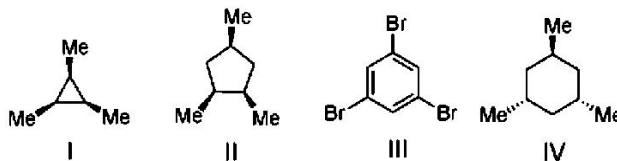


- (a) III > II > I (b) II > I > III (c) III > I > II (d) II > III > I **Ans. (d)**

5. The correct order of the boiling points of the compounds is

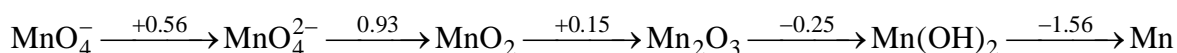
- (a) $\text{CH}_4 > \text{SiH}_4 > \text{SnH}_4 > \text{GeH}_4$ (b) $\text{SiH}_4 > \text{CH}_4 > \text{GeH}_4 > \text{SnH}_4$
(c) $\text{SnH}_4 > \text{GeH}_4 > \text{CH}_4 > \text{SiH}_4$ (d) $\text{SnH}_4 > \text{GeH}_4 > \text{SiH}_4 > \text{CH}_4$ **Ans. (d)**

6. The compounds having C_3 -axis of symmetry are



- (a) I, III and IV (b) I, II and III (c) I and III (d) III and IV **Ans. (c)**

7. In the following Latimer diagram, the species that undergoes disproportionation reaction is



(a) MnO_4^{2-} (b) MnO_4^{3-} (c) Mn_2O_3 (d) Mn(OH)_2 **Ans. (b)**

8. A yellow precipitate is formed upon addition of aqueous AgNO_3 to a solution of

(a) phosphite (b) pyrophosphate (c) metaphosphate (d) orthophosphate **Ans. (d)**

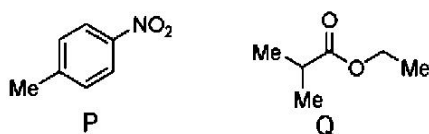
9. A straight line having a slope of $-\Delta U^\circ/R$ is obtained in a plot between

(a) $\ln K_p$ versus T (b) $\ln(K_C)$ versus T (c) $\ln(K_p)$ versus $1/T$ (d) $\ln(K_C)$ versus $1/T$ **Ans. (d)**

10. The number of degrees of freedom of liquid water in equilibrium with ice is

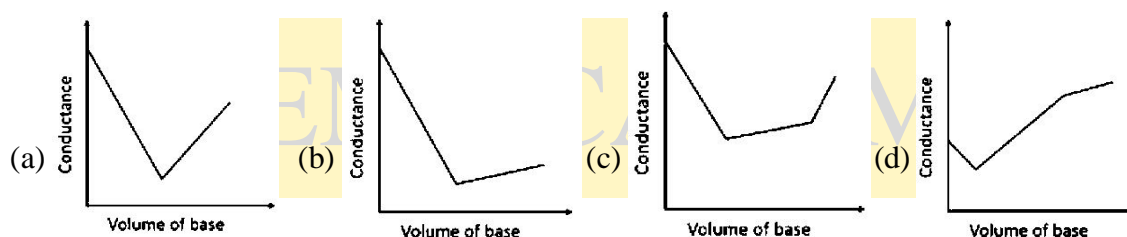
(a) 0 (b) 1 (c) 2 (d) 3 **Ans. (b)**

11. The number of proton NMR signals for the compounds P and Q, respectively, is



(a) 3 and 4 (b) 3 and 5 (c) 4 and 3 (d) 5 and 4 **Ans. (a)**

12. In a typical conductometric titration of a strong acid with a weak base, the curve resembles

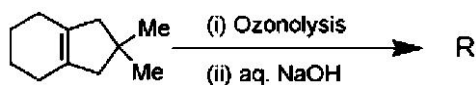


Ans. (b)

13. The correct order of enthalpy of hydration for the transition metal ions is

(a) $\text{Cr}^{2+} > \text{Mn}^{2+} > \text{Co}^{2+} > \text{Ni}^{2+}$ (b) $\text{Ni}^{2+} > \text{Co}^{2+} > \text{Mn}^{2+} > \text{Cr}^{2+}$
 (c) $\text{Ni}^{2+} > \text{Co}^{2+} > \text{Cr}^{2+} > \text{Mn}^{2+}$ (d) $\text{Cr}^{2+} > \text{Mn}^{2+} > \text{Ni}^{2+} > \text{Co}^{2+}$ **Ans. (c)**

14. The product R in the following reaction is



(a) (b) (c) (d) **Ans. (d)**

15. $\frac{dy}{dx} = -\frac{y}{x}$ is a differential equation for a/an

(a) circle (b) ellipse (c) bell-shaped curve (d) hyperbola **Ans. (d)**

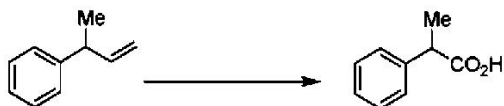
16. The coordination number of Al in crystalline AlCl_3 and liquid AlCl_3 , respectively is

(a) 4 and 4 (b) 6 and 6 (c) 6 and 4 (d) 3 and 6 **Ans. (c)**

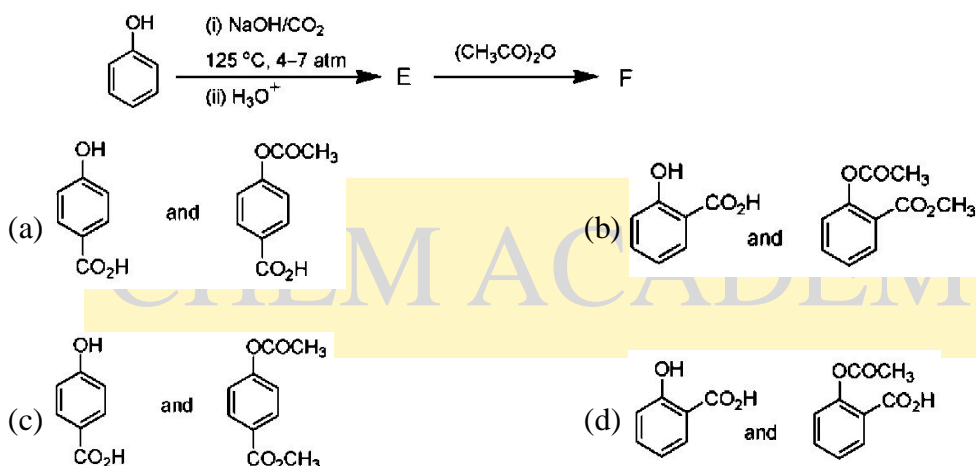
17. For a first order reaction $A(g) \rightarrow 2B(g) + C(g)$, the rate constant is terms of initial pressure (p_0) and pressure at time t (p_t) is given by

(a) $\frac{1}{t} \ln \frac{p_0}{p_t - p_0}$ (b) $\frac{1}{t} \ln \frac{2p_0}{3p_0 - p_t}$ (c) $\frac{1}{t} \ln \frac{3p_0}{p_t - p_0}$ (d) $\frac{1}{t} \ln \frac{3p_0}{3p_t - p_0}$ **Ans. (b)**

18. The following conversion is carried out using **Ans. (b)**



- (a) hydroboration oxidation followed by Jones oxidation
 (b) Wacker oxidation followed by haloform reaction
 (c) oxymercuration-determination followed by Jones oxidation
 (d) ozonolysis followed by haloform reaction
19. In the following reactions, the major products E and F, respectively are **Ans. (d)**



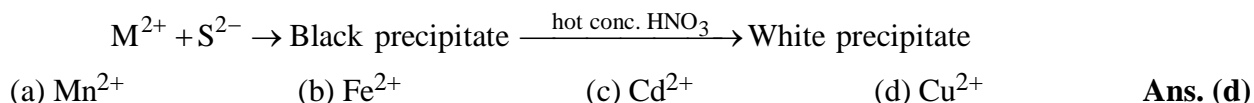
20. For a particle in one-dimensional box of length L with potential energy $V(x) = 0$ for $L > x > 0$ and $V(x) = \infty$ for $x \geq L$ and $x \leq 0$ an acceptable wave function consistent with the boundary conditions is (A, B, C and D are constants)

(a) $A \cos\left(\frac{n\pi x}{L}\right)$ (b) $B(x + x^2)$ (c) $Cx^3(x - L)$ (d) $\frac{D}{\sin\left(\frac{n\pi x}{L}\right)}$ **Ans. (c)**

21. Ionisation energy of hydrogen atom in ground state is 13.6 eV. The energy released (in eV) for third member of Balmer series is

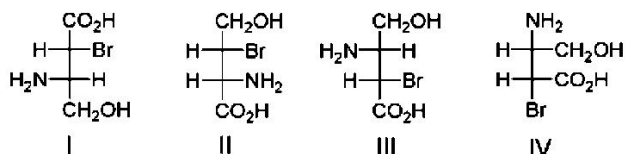
(a) 13.056 (b) 2.856 (c) 0.967 (d) 0.306 **Ans. (b)**

22. The metal ion (M^{2+}) in the following reaction is



23. Among the following compounds, the pair of enantiomers is

Ans. (b)



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

24. Value of the given determinant is

$$\begin{vmatrix} 1 & 3 & 0 \\ 2 & 6 & 4 \\ -1 & 0 & 2 \end{vmatrix}$$

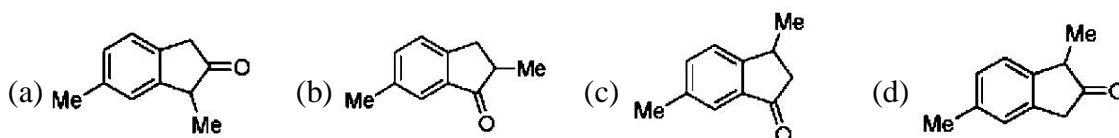
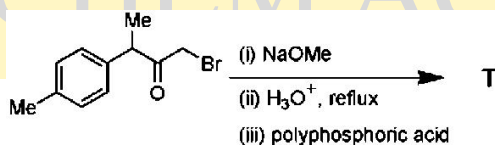
- (a) -12 (b) 0 (c) 6 (d) 12 Ans. (a)

25. The correct order of wavelength of absorption (λ_{\max}) of the Cr-complexes is (en = ethylenediamine)

- (a) $[\text{CrF}_6]^{3-} > [\text{Cr}(\text{H}_2\text{O})_6]^{3+} > [\text{Cr}(\text{en})_3]^{3+} > [\text{Cr}(\text{CN})_6]^{3-}$ Ans. (a)
 (b) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+} > [\text{CrF}_6]^{3-} > [\text{Cr}(\text{en})_3]^{3+} > [\text{Cr}(\text{CN})_6]^{3-}$
 (c) $[\text{Cr}(\text{CN})_6]^{3-} > [\text{Cr}(\text{en})_3]^{3+} > [\text{Cr}(\text{H}_2\text{O})_6]^{3+} > [\text{CrF}_6]^{3-}$
 (d) $[\text{Cr}(\text{en})_3]^{3+} > [\text{Cr}(\text{CN})_6]^{3-} > [\text{Cr}(\text{H}_2\text{O})_6]^{3+} > [\text{CrF}_6]^{3-}$

26. In the following reaction, the major product T is

Ans. (c)



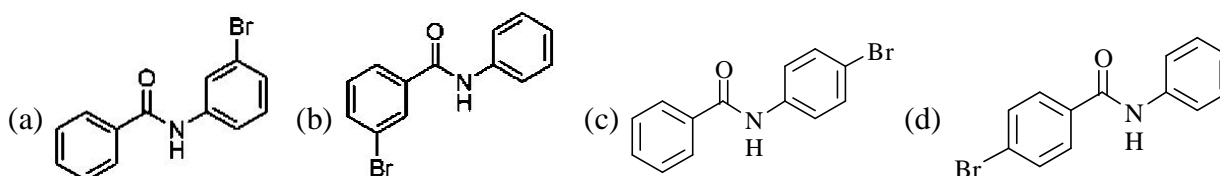
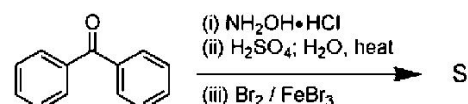
27. The homogeneous catalyst used in water-gas shift reaction is

Ans. (d)

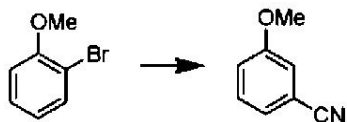
- (a) PdCl_2 (b) Cr_2O_3 (c) $[\text{RhCl}(\text{PPh}_3)_3]$ (d) $[\text{RuCl}_2(\text{bipyridyl})_2]$

28. The major product S of the following reaction is

Ans. (c)



29. Nitrosyl ligand binds to d-metal atoms in linear and bent fashion and behaves, respectively, as
 (a) NO^+ and NO^+ (b) NO^+ and NO^- (c) NO^- and NO^- (d) NO^- and NO^+ **Ans. (b)**
30. The correct set of reagents for the following conversion is **Ans. (a)**



- (a) (i) $\text{NaNH}_2/\text{liq. NH}_3$; (ii) $\text{NaNO}_2/\text{dil. HCl}$; (iii) CuCN , heat
 (b) (i) $\text{HNO}_3/\text{H}_2\text{SO}_4$; (ii) Zn/HCl ; (iii) $\text{NaNO}_2/\text{dil. HCl}$; (iv) CuCN , heat
 (c) (i) $\text{Mg/ether, H}_2\text{O}^+$; (ii) $(\text{EtO})_2\text{CO}$; (iii) NH_4OH ; (iv) PCl_5
 (d) (i) $\text{Mg/ether, H}_2\text{O}^+$; (ii) $\text{HNO}_3/\text{H}_2\text{SO}_4$; (iii) $\text{NaNO}_2/\text{dil. HCl}$; (iv) CuCN , heat

SECTION – II

Multiple Select Type

Section – B contains **Multiple Select Questions (MSQ)**. Each MSQ type question is similar to MCQ but with a difference that there may be one or more than one choice(s) that are correct out of the four given choices. The candidate gets full credit if he/she selects all the correct choices only and no wrong choices. This section has 10 Questions with a total of 20 marks and each question carry 2 marks.

1. The indicator(s) appropriate for determination of end point in the titration of a weak acid with a strong base is/are **Ans. (a,b)**
 (a) Phenolphthalein (b) thymol blue
 (c) bromophenol blue (d) methyl orange
2. IR active molecule(s) is/are **Ans. (a,b,c)**
 (a) CO_2 (b) CS_2 (c) OCS (d) NO_2
3. Among the following the correct statement(s) is/are **Ans. (a,c,d)**
 (a) Guanine is a purine nucleobase (b) Glycine and proline are achiral amino acids
 (c) DNA contains glycosidic bonds and pentose sugars
 (d) Sucrose is a non-reducing sugar
4. Among the following, the species having see-saw shape is/are **Ans. (a,c)**
 (a) SF_4 (b) XeF_4 (c) ClF_4^+ (d) ClF_4^\ominus
5. The following conversion(s) is/are example(s) of **Ans. (b,c,d)**
-
- (a) oxy-Cope rearrangement (b) Sigmatropic rearrangement
 (c) Claisen rearrangement (d) Pericyclic reaction
6. Jahn-Teller distortion is/are observed in octahedral complexes with d-electron configuration of **Ans. (b,c)**
 (a) d^5 -high spin (b) d^5 -low spin (c) d^6 -high spin (d) d^6 -low spin
7. Wave nature of electromagnetic radiation is observed in **Ans. (a,b)**
 (a) diffraction (b) interference (c) photoelectric effect (d) Compton scattering

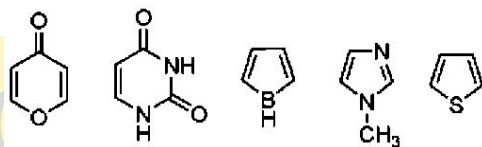
8. The incorrect statement(s) among the following is/are **Ans. (a,d)**
 (a) $[4\pi + 2\pi]$ cycloaddition reactions are carried out in presence of light
 (b) $[2\pi + 2\pi]$ cycloaddition reaction between a keto group and an alkene is photochemically allowed.
 (c) $[4\pi + 2\pi]$ cycloaddition reactions are thermally allowed
 (d) Transoid dienes undergo Diels-alder reactions
9. The "heme" containing protein(s) is/are **Ans. (a,d)**
 (a) cytochrome C (b) hemocyanin (c) hemerythrin (d) myoglobin
10. Intensive variable(s) is/are **Ans. (a,c,d)**
 (a) temperature (b) volume (c) pressure (d) density

SECTION – III

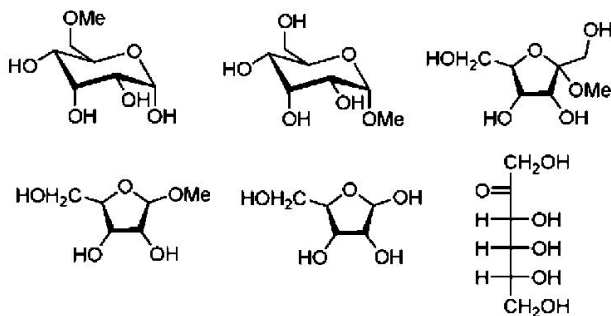
Numerical Answer Type

Section – C contains **Numerical Answer Type (NAT)** questions. For these NAT type questions, the answer is a real number. No choices will be shown for these type of questions. Questions 41 – 50 carry 1 mark each and Questions 51 – 60 carry 2 mark each

1. The number of unpaired electron(s) in K_2NiF_6 is _____ **Ans. (0)**
 2. Among the following, the number of aromatic compound(s) is _____ **Ans. (4)**



3. The maximum number of dipeptides that could be obtained by reaction of phenylalanine with leucine is _____ **Ans. (8 or 2)**
 4. The number of S-S bond(s) in tetrathionate ion is _____ **Ans. (3)**
 5. For a cell reaction, $Pb(s) + Hg_2Cl_2(s) \rightarrow PbCl_2(s) + 2Hg(l)$, $\left(\frac{\partial E^\circ}{\partial T}\right)_p$ is $1.45 \times 10^{-4} \text{ VK}^{-1}$. The entropy change (in $\text{J mol}^{-1} \text{ K}^{-1}$) for the reaction is _____ **Ans. (27.985)**
 [Given: $1F = 96500 \text{ C mol}^{-1}$]
 6. For a reaction $2A + B \rightarrow C + D$, if rate of consumption of A is $0.1 \text{ mol L}^{-1} \text{ s}^{-1}$, the rate of production of C (in $\text{mol L}^{-1} \text{ s}^{-1}$) is _____ **Ans. (0.05)**
 7. The number of isomeric structures of di-substituted borazine ($B_3N_3H_4X_2$) is _____ **Ans. (4)**
 8. At an operating frequency of 350 MHz, the shift (in Hz) of resonance from TMS (tetramethylsilane) of a proton with chemical shift of 2 ppm is _____ **Ans. (700)**
 9. The number of reducing sugars among the following is _____ **Ans. (3)**



10. At 298 K and 1 atm, the molar enthalpies of combustion of cyclopropane and propene are $-2091 \text{ kJ mol}^{-1}$ and $-2058 \text{ kJ mol}^{-1}$, respectively. The enthalpy change (in kJ mol^{-1}) for the conversion of one mole of propene to one mole of cyclopropane is _____ **Ans. (33)**
11. The standard reduction potentials of $\text{Ce}^{4+}/\text{Ce}^{3+}$ and $\text{Fe}^{3+}/\text{Fe}^{2+}$ are 1.44 and 0.77V, respectively. The $\log_{10} K$ (K is the equilibrium constant) value for the following reaction is _____
(final answer should be rounded off to two decimal places) **Ans. (11.32)**
- $$\text{Ce}^{4+} + \text{Fe}^{2+} \rightleftharpoons \text{Ce}^{3+} + \text{Fe}^{3+}$$
- [Given: $RT / F = 0.0257 \text{ V}$]
12. A radioactive element undergoes 80% radioactive decay in 300 min. The half-life for this species in minutes is _____ **Ans. (129.15)**
13. The amount of bromine (atomic wt. = 80) required (in gram) for the estimation of 42.3 g of phenol (molecular wt. = 94 g mol^{-1}) is _____ **Ans. (216)**
14. The total number of pair of enantiomers possible with molecular formula $\text{C}_5\text{H}_{12}\text{O}$ is _____ **Ans. (4)**
15. Silver crystallizes in a face-centered cubic lattice. The lattice parameter of silver (in picometer) is _____ **Ans. (408.6)**
[Given: Avogadro's number = $6.023 \times 10^{23} \text{ mol}^{-1}$, molar mass of silver = $107.87 \text{ g mol}^{-1}$ and density of crystal = 10.5 g cm^{-3}]
16. A vessel contains a mixture of H_2 and N_2 gas. The density of this gas mixture is 0.2 g L^{-1} at 300 K and 1 atm. Assuming that both the gases behave ideally, the mole fraction of $\text{N}_2(\text{g})$ in the vessel is _____ **Ans. (0.11)**
(final answer should be rounded off to two decimal places)
[Given: $R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$, atomic wt. of hydrogen = 1.0 and atomic wt. of nitrogen = 14.0]
17. Consider an isothermal reversible compression of one mole of an ideal gas in which the pressure of the system is increased from 5 atm to 30 atm at 300 K. The entropy change of the surroundings (in J K^{-1}) is _____ **Ans. (14.89)**
(final answer should be rounded off to two decimal places)
[Given: $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$]
18. In 200 g of water, 0.01 mole of NaCl and 0.02 mole of sucrose are dissolved. Assuming solution to be ideal, the depression in freezing point of water (in $^{\circ}\text{C}$) will be _____ **Ans. (0.372)**
(final answer should be rounded off to two decimal places)
[Given: $K_f(\text{H}_2\text{O}) = 1.86 \text{ K kg mol}^{-1}$]
19. The adsorption of a gas follows the Langmuir isotherm with $K = 1.25 \text{ kPa}^{-1}$ at 25°C . The pressure (in Pa) in which surface coverage is 0.2 is _____ **Ans. (200)**
20. The separation of 123 planes (in nm) in an orthorhombic cell with $a = 0.25 \text{ nm}$, $b = 0.5 \text{ nm}$ and $c = 0.75 \text{ nm}$ is _____ **Ans. (0.144)**
(final answer should be rounded off to two-decimal places)

ANSWER KEY

IIT-JAM 2017

(12.02.17)

Multiple Choice Questions

1. c	2. c	3. a	4. d	5. d	6. c	7. b
8. d	9. d	10. b	11. a	12. b	13. c	14. d
15. d	16. c	17. b	18. b	19. d	20. c	21. b
22. d	23. b	24. a	25. a	26. c	27. d	28. c
29. b	30. a					

Multiple Select Questions

1. a,b	2. a,b,c	3. a,c,d	4. a,c	5. b,c,d	6. b,c	7. a,b
8. a,d	9. a,d	10. a,c,d				

Numerical Answer Type

1. 0	2. 4	3. 8 or 2	4. 3	5. 27.985	6. 0.05	7. 4
8. 700	9. 3	10. 33	11. 11.32	12. 129.15	13. 216	14. 4
15. 408.6	16. 0.11	17. 14.89	18. 0.372	19. 200	20. 0.144	

CHEM ACADEMY