



INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN CHEMISTRY 2019 –20

Date of Examination: November 24, 2019

Time: 11:00 AM to 1:00 PM

Question Paper Code: 31

Student's											
Roll No.:											

Write the question paper code mentioned above on YOUR OMR Answer Sheet (in the space provided), otherwise your Answer Sheet will NOT be assessed. Note that the same Question Paper Code appears on each page of the question paper.

Instructions to Candidates:

1. Use of mobile phones, smart watches, and ipads during examination is **STRICTLY PROHIBITED**.
2. In addition to this question paper, you are given OMR Answers Sheet along with Candidate's copy.
3. On the Answer Sheet, make all the entries carefully in the space provided, **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.

Incomplete/ incorrect/ carelessly filled information may disqualify your candidature.

4. On the OMR Answer Sheet, use only **BLUE** or **BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Your ten-digit roll number and date of birth entered on the OMR Answer Sheet shall remain your login credentials means login id and password respectively for accessing your performance / result in NSE – 2019.
6. Question paper has 80 multiple choice questions. Each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q.No.22 a c d

7. A correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer.
8. Any rough work should be done only in the space provided on the question paper.
9. Use of **non-programmable** scientific calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting your Answer Sheet, take away the Candidate's copy for your reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the answer sheet.

Answer sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED. Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK SIDE OF THE ANSWER SHEET.

Instructions to Candidates (Continued) –

You may read the following instructions after submitting the OMR Answer Sheet.

12. Comments/Inquiries/Grievances regarding this question paper, if any, can be shared on the Inquiry/Grievance column on www.iaptexam.in on the specified format till November 27, 2019.
13. The answers/solutions to this question paper will be available on the website: www.iapt.org.in by December 2, 2019.
14. **CERTIFICATES and AWARDS –**
Following certificates are awarded by IAPT/ACT to students, successful in the NATIONAL STANDARD EXAMINATION IN CHEMISTRY – 2019
- “CENTRE TOP 10 %”
 - “STATE TOP 1 %”
 - “NATIONAL TOP 1%”
 - “GOLD MEDAL & MERIT CERTIFICATE” to all students who attend OCSC – 2020 at HBCSE
15. All these certificates (except Gold Medal) will be sent/dispatched to the centre in-charge by February 1, 2020 along with the result sheet of the centre.
16. List of students (with centre number and roll number only) having score above MAS will be displayed on the web www.iapt.org.in by **December 20, 2019**. See the **Minimum Admissible score Clause** on the Student’s brochure on the web.
17. List of Students eligible for National Chemistry Olympiad (INChO – 2020) shall be displayed on www.iapt.org.in by December 28, 2019. These students have to register/enroll themselves on the website Olympiads.hbcse.tifr.in of HBCSE Mumbai within the specified period.

Useful constants

Charge of electron, $e = 1.602 \times 10^{-19} C$

Mass of electron, $m_e = 9.1 \times 10^{-31} kg$

Planck’s constant, $h = 6.626 \times 10^{-34} Js$

Speed of light, $c = 3.0 \times 10^8 ms^{-1}$

Avogadro constant, $N_A = 6.022 \times 10^{23} mol^{-1}$

Molar gas constant, $R = 0.082 Latm mol^{-1} K^{-1}$
 $= 8.314 J mol^{-1} K^{-1}$

Faraday’s constant, $F = 96487 C mol^{-1}$

**INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN CHEMISTRY
(NSEC 2019-20)**

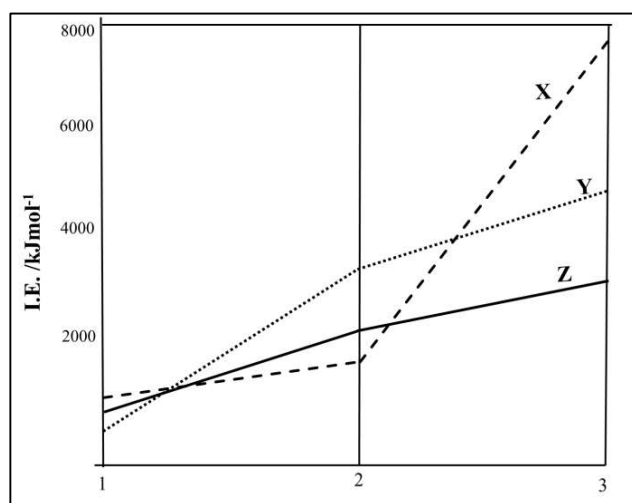
TIME: 120 Minutes

Max. Marks: 240

Attempt All the Eighty Questions

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT

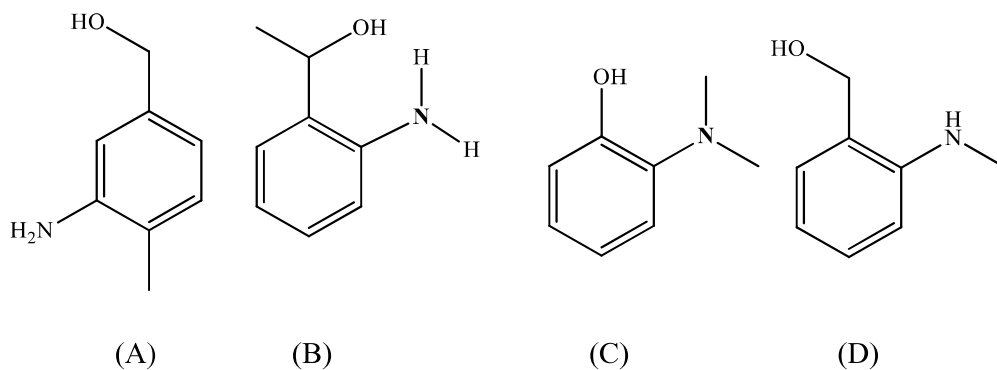
- (1) The following qualitative plots depict the first, second and third ionization energies (I.E.) of Mg, Al and K. Among the following, the correct match of I.E. and the metal is



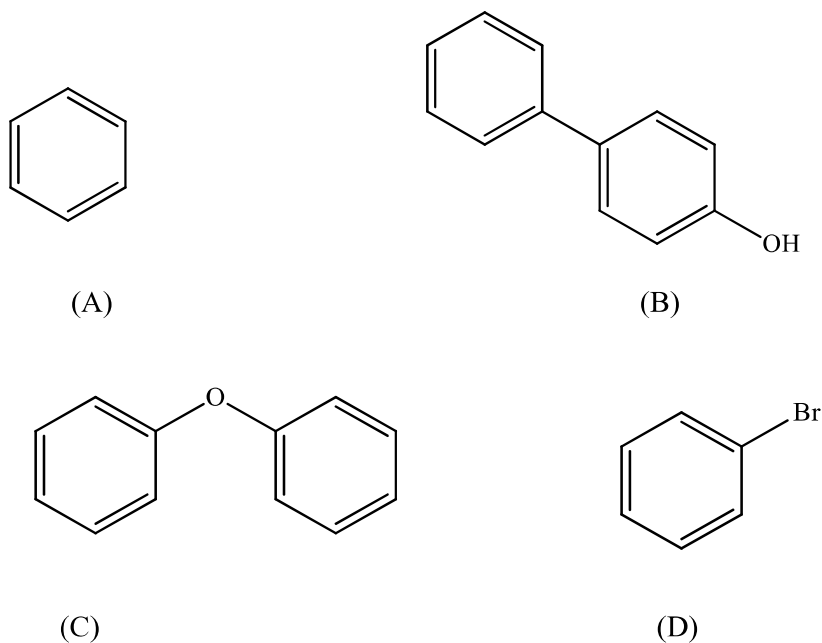
- (A) X-Al ; Y-Mg ; Z-K
(B) X-Mg ; Y-Al ; Z-K
(C) X-Mg ; Y-K ; Z-Al
(D) X-Al ; Y-K ; Z-Mg
- (2) A solid comprises of three types of elements, 'P', 'Q' and 'R'. 'P' forms an FCC lattice in which 'Q' and 'R' occupy all the tetrahedral voids and half the octahedral voids respectively. The molecular formula of the solid is
(A) P₂Q₄R (B) PQ₂R₄ (C) P₄Q₂R (D) P₄QR
- (3) The set in which all the species are diamagnetic is
(A) B₂, O₂, NO (B) O₂, O₂⁺, CO
(C) N₂, O₂⁻, CN⁻ (D) C₂, O₂²⁻, NO⁺

- (4) The structure of compound 'X' ($C_8H_{11}NO$) based on the following tests and observations is

Reagent/s	Observation
Neutral $FeCl_3$	No coloration
Lucas reagent	Turbidity
$NaNO_2/HCl$ at 273 K	Yellow oil

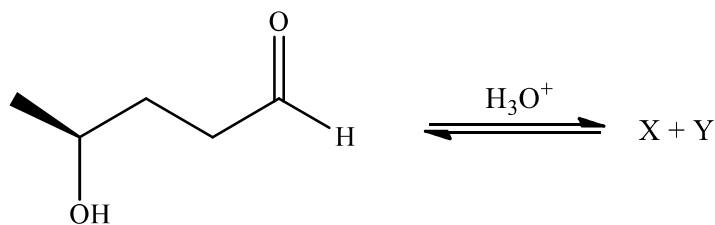


- (5) Reaction of C_6H_5MgBr with phenol gives



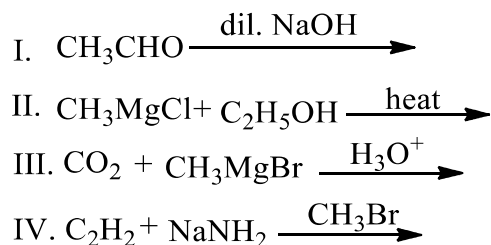
- (6) The work done (kJ) in the irreversible isothermal compression of 2.0 moles of an ideal gas from 1 bar to 100 bar at $25^\circ C$ at constant external pressure of 500 bar is
- (A) 2452 (B) 490 (C) 2486 (D) - 490

- (7) The power and wavelength emitted by a laser pointer commonly used in Power Point presentations are 1.0 mW and 670 nm respectively. Number of photons emitted by this pointer during a presentation of 5 minutes is
 (A) 1.01×10^9 (B) 1.01×10^{21} (C) 1.6×10^{16} (D) 1.01×10^{18}
- (8) The number of stereoisomers is maximum for
 (A) $[\text{Co}(\text{en})_3]^{3+}$ (B) $[\text{Co}(\text{en})_2\text{ClBr}]^+$
 (C) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ (D) $[\text{Co}(\text{NH}_3)_4\text{ClBr}]^+$
- (9) Which of the following is NOT correct about hydrides?
 I. Saline hydrides are stoichiometric and metallic hydrides are non-stoichiometric
 II. BeH_2 is monomeric whereas MgH_2 is polymeric
 III. Hydrides of the elements of Group 13 are electron deficient and those of Group 15 are electron rich
 IV. NaH reacts with water and liberates H_2 whereas B_2H_6 does not react with water
 (A) IV only (B) I and III (C) III only (D) II and IV
- (10) Atropine ($\text{C}_{17}\text{H}_{23}\text{O}_3\text{N}$) is a naturally occurring compound used to treat certain types of poisoning. The degree of unsaturation in atropine is
 (A) 7 (B) 6 (C) 5 (D) 4
- (11) The compounds 'X' and 'Y' formed in the following reaction are



- (A) hemiacetals with identical physical and chemical properties
 (B) acetals with identical physical and chemical properties
 (C) hemiacetals with different physical and chemical properties
 (D) acetals with different physical and chemical properties

(12) In which of the following, is a new C-C bond formed in the product?



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

(13) Aqueous solution of slaked lime, $\text{Ca}(\text{OH})_2$, is extensively used in municipal waste water treatment. Maximum pH possible in an aqueous solution of slaked lime is

(K_{sp} of $\text{Ca}(\text{OH})_2 = 5.5 \times 10^{-6}$)

- (A) 1.66 (B) 8.14 (C) 12.04 (D) 12.34

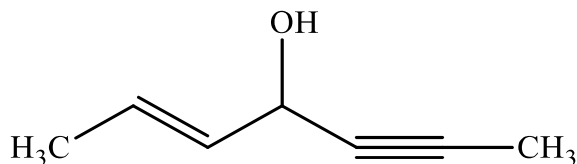
(14) An electron present in the third excited state of a H atom returns to the first excited state and then to the ground state. If λ_1 and λ_2 are the wavelengths of light emitted in these two transitions respectively, $\lambda_1 : \lambda_2$ is

- (A) 4:1 (B) 5:9 (C) 3:1 (D) 2:1

(15) $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ (molar mass = 198 g mol^{-1}) when dissolved in water forms a complex of Mn^{2+} . An aqueous solution containing 0.400 g of $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ was passed through a column of a cation exchange resin and the acid solution coming out was neutralized with 10 mL of 0.20 M NaOH. The formula of the complex formed is

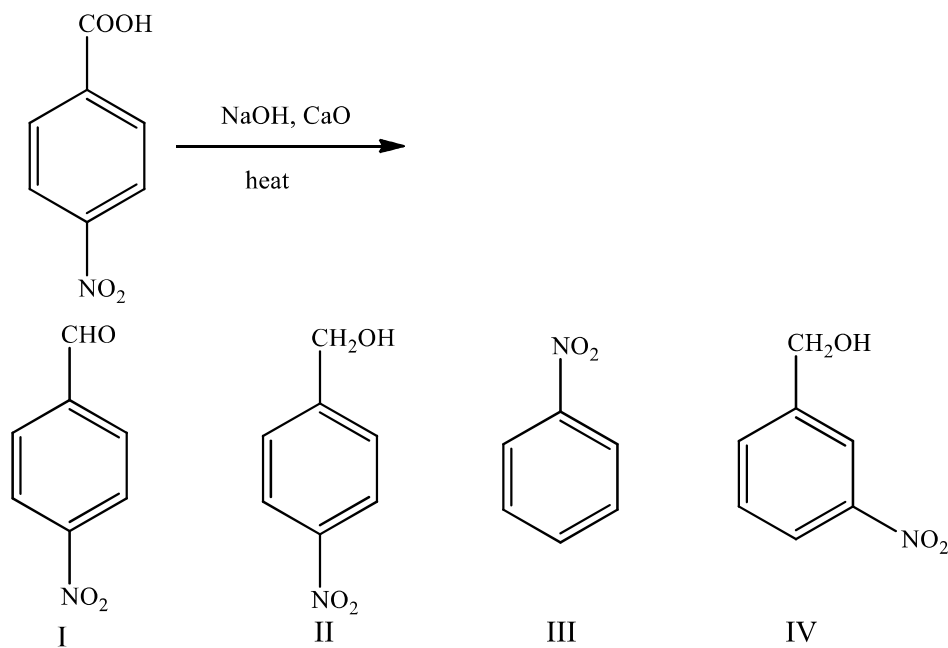
- (A) $[\text{Mn}(\text{H}_2\text{O})_4\text{Cl}_2]$ (B) $[\text{Mn}(\text{H}_2\text{O})_6]\text{Cl}_2$
 (C) $[\text{Mn}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}$ (D) $\text{Na}[\text{Mn}(\text{H}_2\text{O})_3\text{Cl}_3]$

(16) IUPAC name of the following molecule is



- (A) 4-hydroxyhept2-en-5-yne (B) hept-2-en-5-yn-4-ol
 (C) hept-5-en-2-yn-4-ol (D) 4-hydroxyhept-5-en-2-yne

(17) The product/s of the following reaction is/are



(A) I and II

(B) II

(C) III

(D) IV

(18) The percentage dissociation of 0.08 M aqueous acetic acid solution at 25°C is

(K_a of acetic acid at 25°C = 1.8×10^{-5})

(A) 2.92

(B) 1.5

(C) 1.2

(D) 4.8

(19) For which of the following processes, carried out in free space, energy will be absorbed?

I. Separating an electron from an electron

II. Removing an electron from a neutral atom

III. Separating a proton from a proton

IV. Separating an electron from a proton

(A) I only

(B) II and IV

(C) I and III

(D) II only

(20) Decay of radioisotopes follows first order kinetics. Radioisotope U^{238} undergoes decay to a stable isotope, Th^{234} . The ratio of the number of atoms of U^{238} to that of Th^{234} after *three* half lives is

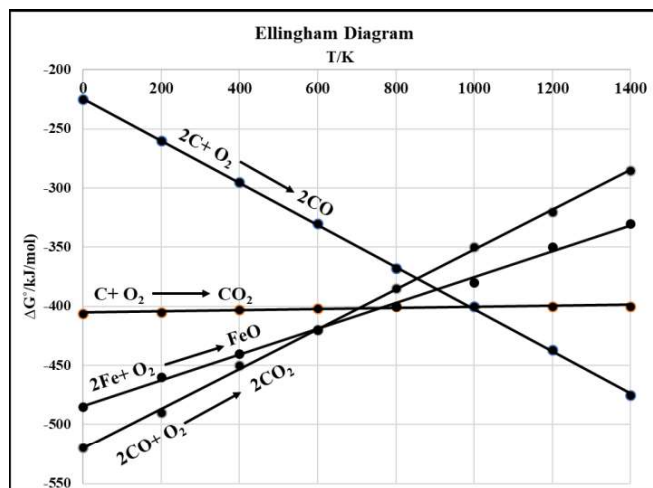
(A) 1/3

(B) 3/4

(C) 1/4

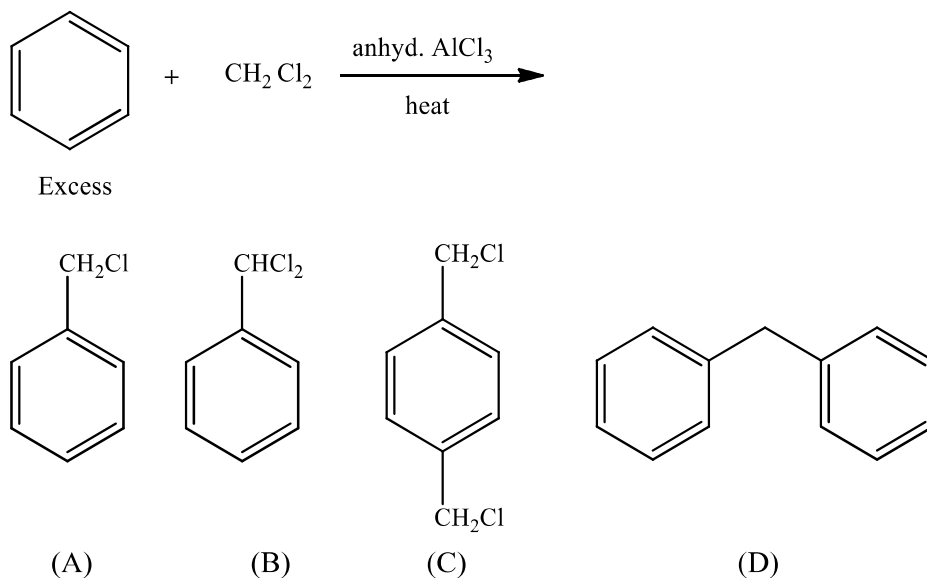
(D) 1/7

- (21) Myoglobin, (Mb), an oxygen storage protein, contains 0.34 % Fe by mass and in each molecule of myoglobin one ion of Fe is present. Molar mass of Mb (g mol^{-1}) is (Molar mass of Fe = $55.845 \text{ g mol}^{-1}$)
 (A) 16407 (B) 164206 (C) 16425 (D) 164250
- (22) The following Ellingham diagram depicts the oxidation of 'C', 'CO' and 'Fe'. Which of the following is correct?



- I. FeO can be reduced by C below 600 K
 II. FeO can be reduced by CO below 600 K
 III. FeO can be reduced by C above 1000 K
 IV. FeO can be reduced by CO above 1000 K
- (A) II and III (B) I and IV (C) I and III (D) II and IV
- (23) N^{3-} , F^- , Na^+ and Mg^{2+} have the same number of electrons. Which of them will have the smallest and the largest ionic radii respectively?
 (A) Mg^{2+} and N^{3-} (B) Mg^{2+} and Na^+
 (C) N^{3-} and Na^+ (D) F^- and N^{3-}
- (24) The reaction of 2,4-hexadiene with *one* equivalent of bromine at 0°C gives a mixture of two compounds 'X' and 'Y'. If 'X' is 4,5-dibromohex-2-ene, 'Y' is
 (A) 2,5-dibromohex-2-ene (B) 2,5-dibromohex-3-ene
 (C) 2,3-dibromohex-3-ene (D) 3,4- dibromohex-3-ene

(25) The major product of the following reaction is



(26) The kinetic energy of the photoelectrons ejected by a metal surface increased from 0.6 eV to 0.9 eV when the energy of the incident photons was increased by 20 %.

The work function of the metal is

- (A) 0.66 eV (B) 0.72 eV (C) 0.90 eV (D) 0.30 eV

(27) An electrochemical cell was constructed with Fe^{2+}/Fe and Cd^{2+}/Cd at 25°C with initial concentrations of $[\text{Fe}^{2+}] = 0.800 \text{ M}$ and $[\text{Cd}^{2+}] = 0.250 \text{ M}$. The EMF of the cell when $[\text{Cd}^{2+}]$ becomes 0.100 M is

Half cell	E^0 (V)
$\text{Fe}^{2+}(\text{aq}) / \text{Fe}(\text{s})$	- 0.44
$\text{Cd}^{2+}(\text{aq}) / \text{Cd}(\text{s})$	- 0.40

- (A) 0.013 V (B) 0.011 V (C) 0.051 V (D) 0.022 V

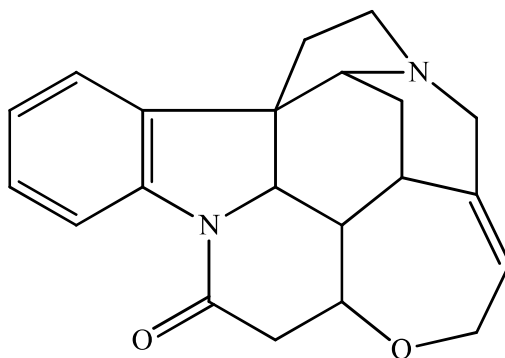
(28) The alkene ligand ($\pi\text{-C}_2\text{R}_4$) is both a ' σ ' donor and a ' π ' acceptor, similar to the CO ligand in metal carbonyls, and exhibits synergic bonding with metals. Correct order of C-C bond length in $\text{K}[\text{PtCl}_3(\pi\text{-C}_2\text{R}_4)]$ complexes in which $\text{R} = \text{H}, \text{F}$ or CN is

- (A) $\text{H} > \text{F} > \text{CN}$ (B) $\text{H} > \text{CN} > \text{F}$
 (C) $\text{CN} > \text{F} > \text{H}$ (D) $\text{F} > \text{H} > \text{CN}$

(29) The correct order of CFSE among $[\text{Zn}(\text{NH}_3)_4]^{2+}$, $[\text{Co}(\text{NH}_3)_6]^{2+}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}$ is

- (A) $[\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Co}(\text{NH}_3)_6]^{2+} > [\text{Zn}(\text{NH}_3)_4]^{2+}$
 (B) $[\text{Zn}(\text{NH}_3)_4]^{2+} > [\text{Co}(\text{NH}_3)_6]^{2+} > [\text{Co}(\text{NH}_3)_6]^{3+}$
 (C) $[\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Zn}(\text{NH}_3)_4]^{2+} > [\text{Co}(\text{NH}_3)_6]^{2+}$
 (D) $[\text{Co}(\text{NH}_3)_6]^{2+} > [\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Zn}(\text{NH}_3)_4]^{2+}$

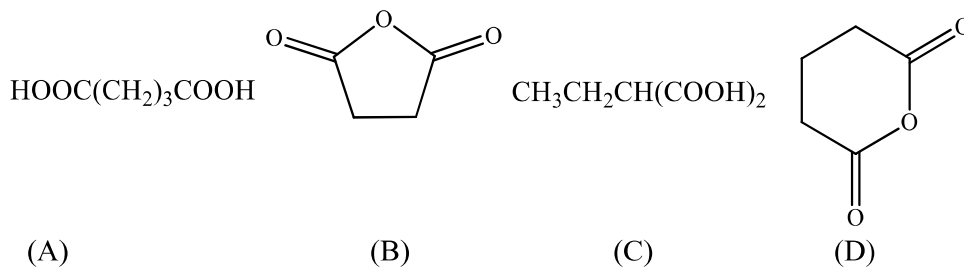
(30) The number of asymmetric carbon atoms in strychnine, whose structure given below is



Strychnine

- (A) 5 (B) 4 (C) 6 (D) 7

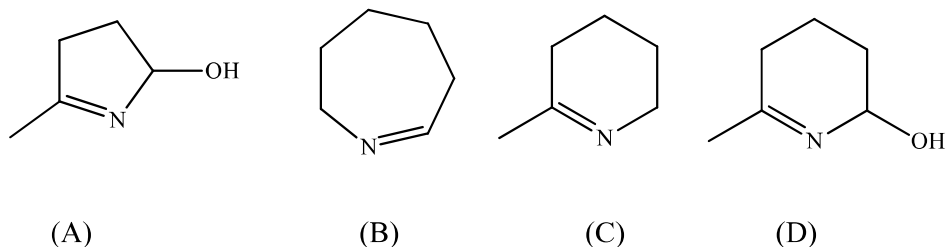
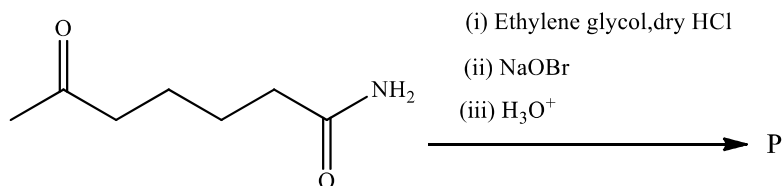
(31) When acid 'X' is heated to 230°C , along with CO_2 and H_2O , a compound 'Y' is formed. If 'X' is $\text{HOOC}(\text{CH}_2)_2\text{CH}(\text{COOH})_2$, the structure of 'Y' is



(32) Number of products formed (ignoring stereoisomerism) in the monochlorination of ethylcyclohexane is

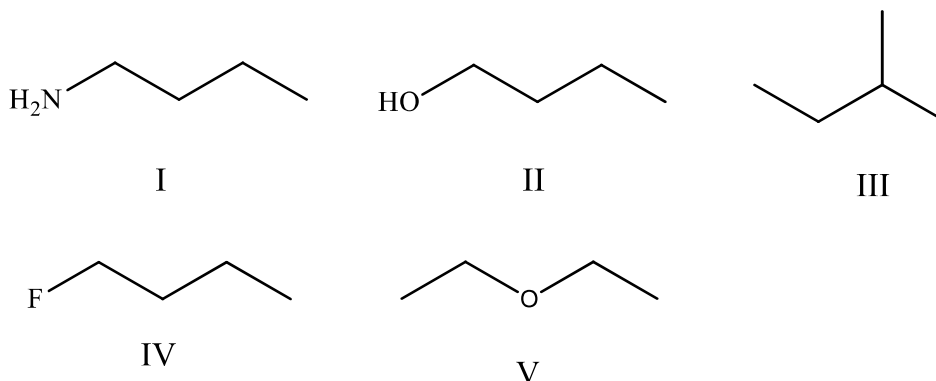
- (A) 6 (B) 8 (C) 5 (D) 4

- (33) Molten NaCl is electrolysed for 35 minutes with a current of 3.50 A at 40°C and 1 bar pressure. Volume of chlorine gas evolved in this electrolysis is
 (A) 0.016 L (B) 0.98 L (C) 9.8 L (D) 1.96 L
- (34) A balance having a precision of 0.001 g was used to measure a mass of a sample of about 15 g. The number of significant figures to be reported in this measurement is
 (A) 2 (B) 3 (C) 5 (D) 1
- (35) Which of the following pairs of compounds can be stable while retaining the identity of each compound in the pair over a period of time?
 I. FeCl₃, SnCl₂ II. HgCl₂, SnCl₂ III. FeCl₂, SnCl₂ IV. FeCl₃, KI
 (A) I only (B) I and III (C) III only (D) II and IV
- (36) Which of the following is correct about the isoelectronic species, Li⁺ and H⁻ ?
 I. H⁻ is larger in size than Li⁺
 II. Li⁺ is a better reducing agent than H⁻
 III. It requires more energy to remove an electron from H⁻ than from Li⁺
 IV. The chemical properties of the two ions are the same
 (A) I only (B) II and III (C) I, II and IV (D) I and II
- (37) The major product 'P' formed in the following sequence of reactions is



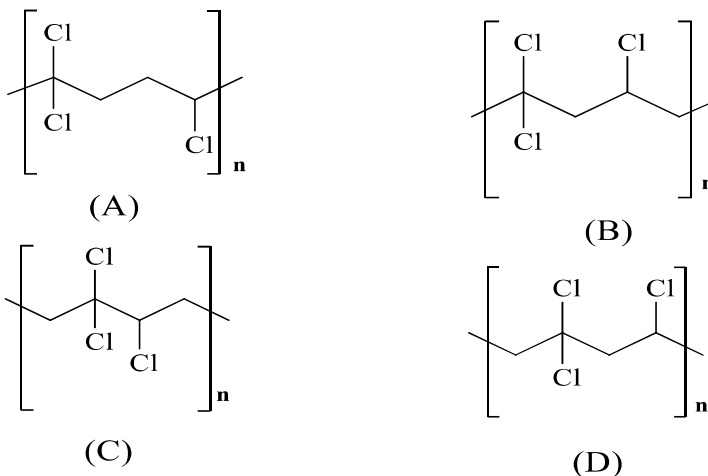
- (38) Sodium lauryl sulphate (SLS) is a surface active agent, which is adsorbed on water surface. The number of molecules of SLS that can be adsorbed on the surface of a spherical water droplet of diameter 3.5 mm is
(effective area of one molecule of SLS = 4.18 nm^2)
(A) 9.20×10^{12} (B) 9.20×10^{18}
(C) 1.15×10^{12} (D) 3.68×10^{13}
- (39) The reaction $xX(g) \rightleftharpoons yY(g) + zZ(g)$ was carried out at a certain temperature with an initial pressure of X = 30 bar. Initially 'Y' and 'Z' were not present. If the equilibrium partial pressures of 'X', 'Y' and 'Z' are 20, 5 and 10 bar respectively x: y: z is
(A) 4:1:2 (B) 2:1:2 (C) 1:2:1 (D) 1:1:2
- (40) The unit of Planck's constant, 'h', is the same as that of
(A) angular momentum (B) energy
(C) wavelength (D) frequency
- (41) A commercial sample of oleum ($\text{H}_2\text{S}_2\text{O}_7$) labeled as '106.5 % oleum' contains 6.5 g of water. The percentage of free SO_3 in this oleum sample is
(A) 2.88 (B) 28.8 (C) 0.029 (D) 0.28
- (42) Among the following, the complex ion/s that will have a magnetic moment of 2.82 B.M. is /are
I. $[\text{Ni}(\text{CO})_4]$ II. $[\text{NiCl}_4]^{2-}$ III. $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ IV. $[\text{Ni}(\text{CN})_4]^{2-}$
(A) I and IV (B) II only (C) II and III (D) II, III and IV
- (43) A suboxide of carbon, C_3O_2 , has a linear structure. Which of the following is correct about C_3O_2 ?
I. Oxidation state of all three C atoms is +2
II. Oxidation state of the central C atom is zero
III. The molecule contains 4 σ and 4 π bonds
IV. Hybridization of the central carbon atom is sp^2
(A) I and IV (B) II and III (C) II and IV (D) III only

- (44) Among the following, the compounds with highest and lowest boiling points respectively are



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

- (45) Saran wrap, a polymer used in food packaging is a copolymer of 1, 1-dichloroethene and vinyl chloride. In the chain initiation step, 1, 1-dichloroethene generates a free radical which reacts with vinyl chloride. Structure of Saran wrap is

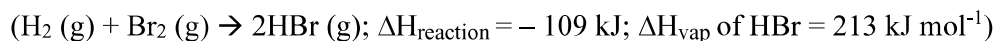


- (46) At 25°C K_a of HPO_4^{2-} and HSO_3^- are 4.8×10^{-13} and 6.3×10^{-8} respectively.

Which of the following is correct?

- (A) HPO_4^{2-} is a stronger acid than HSO_3^- and PO_4^{3-} is a weaker base than SO_3^{2-}
 (B) HPO_4^{2-} is a weaker acid than HSO_3^- and PO_4^{3-} is a weaker base than SO_3^{2-}
 (C) HPO_4^{2-} is a weaker acid than HSO_3^- and PO_4^{3-} is a stronger base than SO_3^{2-}
 (D) HPO_4^{2-} is a stronger acid than HSO_3^- and PO_4^{3-} is a stronger base than SO_3^{2-}

(47) The change in internal energy (ΔU) for the reaction $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{l})$ when 2.0 moles each of $\text{Br}_2(\text{g})$ and $\text{H}_2(\text{g})$ react is



- (A) -644 kJ (B) 644 kJ (C) -322 kJ (D) -1070 kJ

(48) About sea water, which of the following statement/s is/are correct?

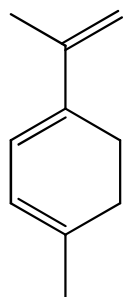
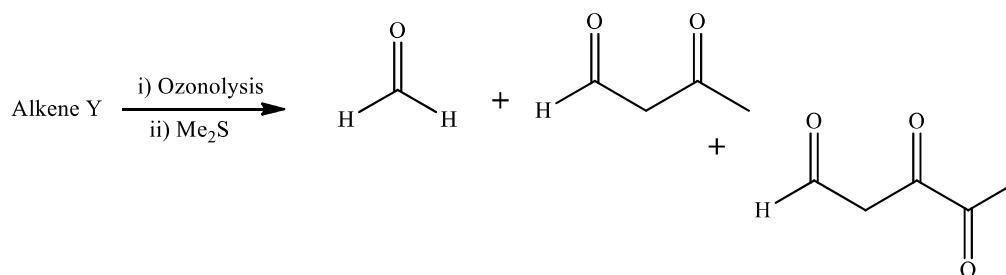
- I. Frozen sea water melts at a lower temperature than pure ice
 II. Boiling point of sea water increases as it evaporates
 III. Sea water boils at a lower temperature than fresh water
 IV. Density of sea water at STP is same as that of fresh water

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

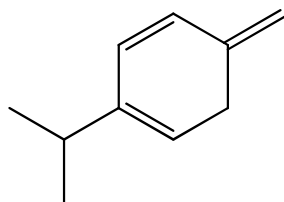
(49) Which of the following species has *one* lone pair of electrons on the central atom?

- (A) ClF_3 (B) I_3^- (C) I_3^+ (D) SF_4

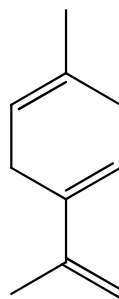
(50) The alkene 'Y' in the following reaction is



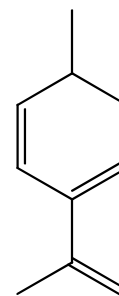
(A)



(B)

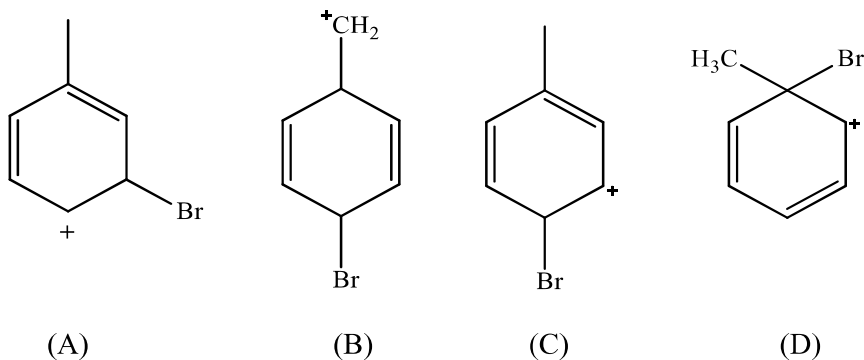


(C)

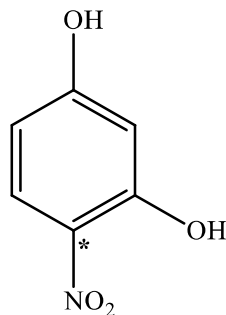
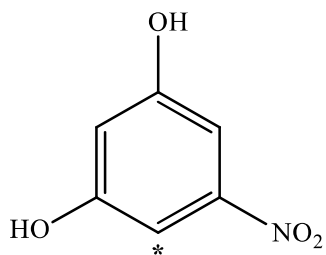
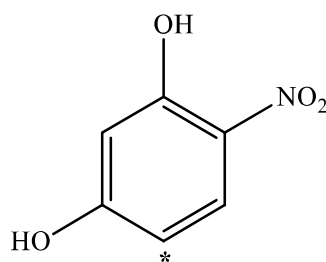
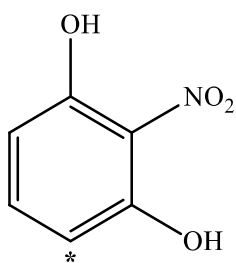
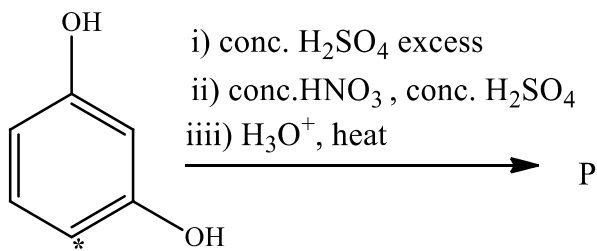


(D)

- (51) The structure that represents the major intermediate formed in the bromination of toluene is



- (52) The major product 'P' formed in the following reaction is (* denotes radioactive carbon)



(53) If the standard electrode potentials of Fe^{3+}/Fe and Fe^{2+}/Fe are -0.04V and -0.44V respectively, then that of $\text{Fe}^{3+}/\text{Fe}^{2+}$ is

- (A) 0.76V (B) -0.76V (C) 0.40V (D) -0.40V

(54) Given below is the data for the reaction $2\text{NO}(\text{g}) \rightleftharpoons \text{N}_2(\text{g}) + \text{O}_2(\text{g})$

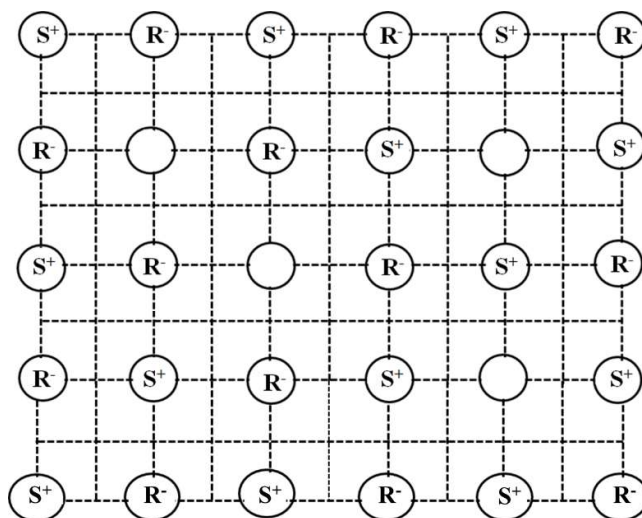
where ' k_f ' and ' k_b ' are rate constants of the forward and reverse reactions respectively

Temperature (K)	$k_f(\text{mol}^{-1} \text{dm}^3 \text{s}^{-1})$	$k_b(\text{mol}^{-1} \text{dm}^3 \text{s}^{-1})$
1400	0.20	1.1×10^{-6}
1500	1.3	1.4×10^{-5}

The reaction is

- (A) exothermic and K_{eq} at $1400\text{K} = 3.79 \times 10^{-6}$
 (B) endothermic and K_{eq} at $1400\text{K} = 2.63 \times 10^{-5}$
 (C) exothermic and K_{eq} at $1400\text{K} = 1.8 \times 10^5$
 (D) endothermic and K_{eq} at $1500\text{K} = 9.28 \times 10^{-4}$

(55) The crystal defect indicated in the diagram below is

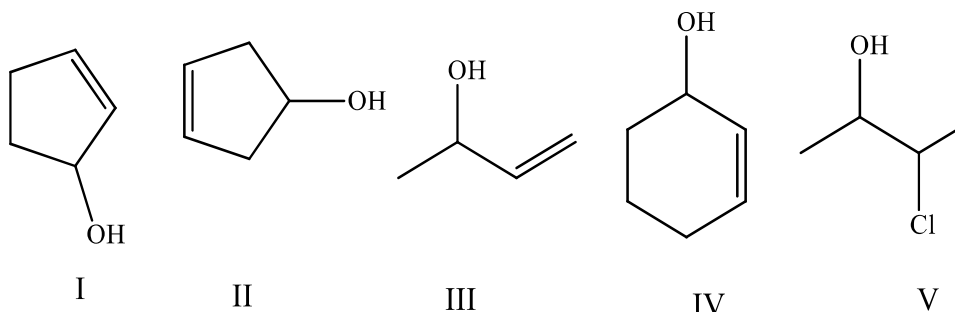


- (A) Frenkel defect (B) Schottky defect
 (C) Frenkel and Schottky defects (D) Interstitial defect

(56) In solid state, PCl_5 exists as $[\text{PCl}_4]^+ [\text{PCl}_6]^-$. The hybridization of P atoms in this solid is/are

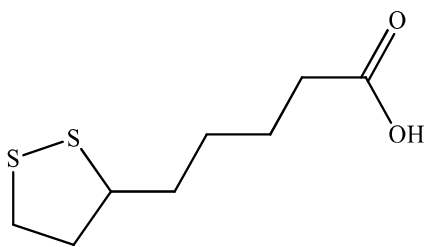
- (A) sp^3d ($d = d_{x^2-y^2}$) (B) sp^3d ($d = d_z^2$)
 (C) sp^3 and sp^3d^2 ($d = d_{x^2-y^2}, d_z^2$) (D) sp^3d and dsp^3 ($d = d_z^2$)

(57) Which of the following compounds have chiral carbon atom/s?



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

(58) Lipoic acid with the following structure is a growth factor required by many organisms. Percentages of 'S' and 'O' in lipoic acid respectively are (atomic masses of 'S' and 'O' are $32.065 \text{ g mol}^{-1}$ and $15.999 \text{ g mol}^{-1}$ respectively)



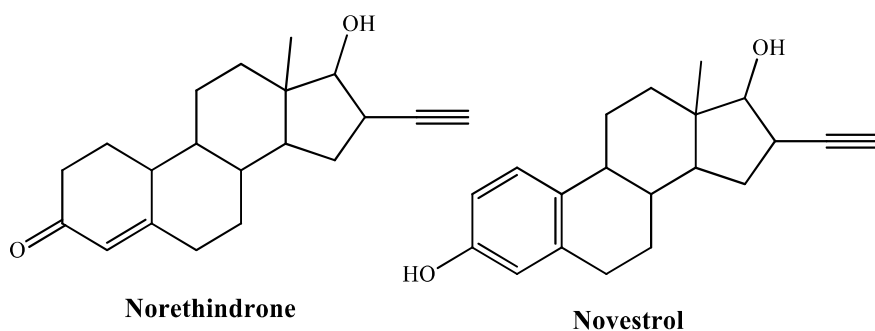
Lipoic acid

- (A) 33.03, 16.48 (B) 31.11, 18.24
 (C) 31.11, 15.52 (D) 31.42, 15.68

(59) Among the halides NCl_3 (I), PCl_3 (II) and AsCl_3 (III), more than one type of acid in aqueous solution is formed with

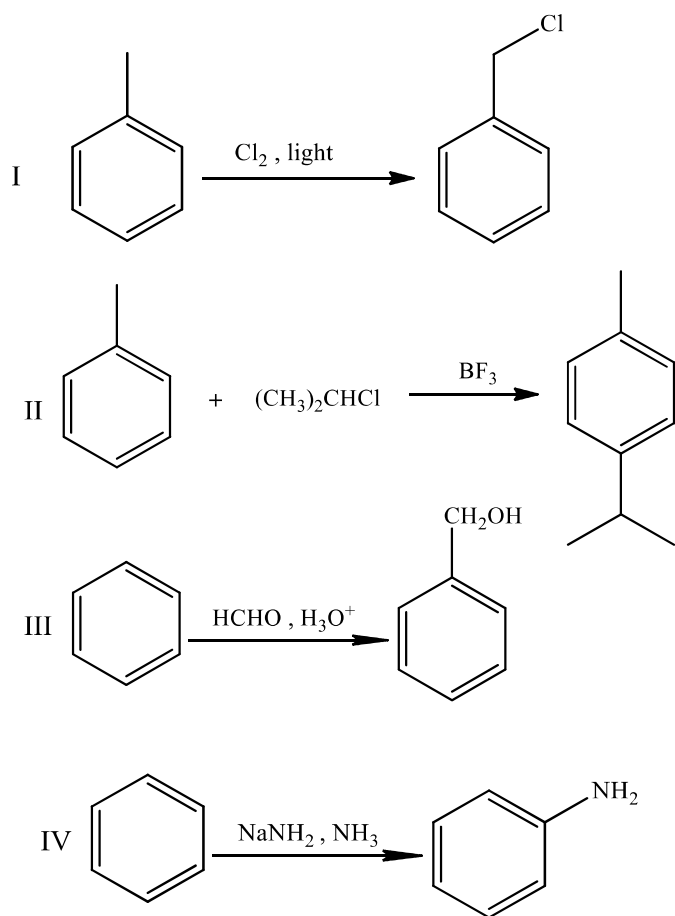
- (A) I, II and III (B) II only (C) I and II (D) II and III

- (60) A helium cylinder in which the volume of gas = 2.24 L at STP (1 atm, 273 K) developed a leak and when the leak was plugged the pressure in the cylinder was seen to have dropped to 550 mm of Hg. The number of moles of He gas that had escaped due to this leak is
 (A) 0.028 (B) 0.072 (C) 0.972 (D) 0.099
- (61) The anhydride of HNO_3 is
 (A) NO (B) NO_2 (C) N_2O (D) N_2O_5
- (62) An excess of aqueous ammonia is added to three different flasks (F_1 , F_2 , F_3) containing aqueous solutions of CuSO_4 , $\text{Fe}_2(\text{SO}_4)_3$ and NiSO_4 respectively. Which of the following is correct about this addition?
 I. A precipitate will be formed in all three flasks
 II. Ammonia acts as a base as well as a ligand exchange reagent in F_1 and F_3
 III. A soluble complex of NH_3 and the metal ion is formed in F_1 and F_3
 IV. A precipitate will be formed only in F_2
 (A) I only (B) IV only (C) II and IV (D) II, III and IV
- (63) The mass (g) of NaCl that has to be dissolved to reduce the vapour pressure of 100 g of water by 10 % (Molar mass of NaCl = 58.5 g mol^{-1}) is
 (A) 36.11 g (B) 17.54 g (C) 81.25 g (D) 3.61 g
- (64) The reagent/s that can be used to separate norethindrone and novestrol from their mixture is/are



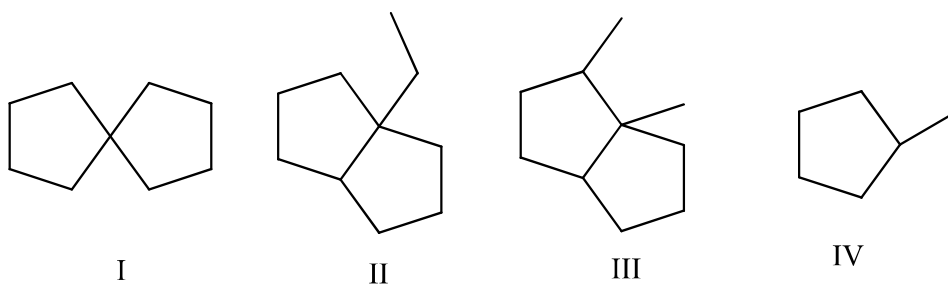
- I. HCl II. NaOH III. NaHCO_3 IV. NaNH_2
 (A) III (B) I and IV (C) I,II and III (D) II

(65) Which of the following is/are electrophilic aromatic substitution reaction/s?



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

(66) All *four* types of carbon (1° , 2° , 3° and 4°) are present in



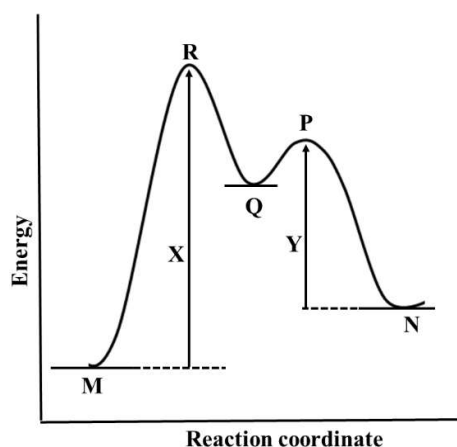
- (A) I, II and III (B) II, III and IV
(C) I, II and IV (D) II and III

(67) The normal boiling point and ΔH_{vap} of a liquid 'X' are 400 K and 40 kJ mol⁻¹ respectively. Assuming ΔH_{vap} to be constant, which of the following is correct?

- I. $\Delta S_{\text{vap}} > 100 \text{ J K}^{-1} \text{ mol}^{-1}$ at 400 K and 0.5 atm
- II. $\Delta S_{\text{vap}} < 100 \text{ J K}^{-1} \text{ mol}^{-1}$ at 400 K and 1 atm
- III. $\Delta S_{\text{vap}} < 100 \text{ J K}^{-1} \text{ mol}^{-1}$ at 400 K and 2 atm
- IV. $\Delta S_{\text{vap}} = 100 \text{ J K}^{-1} \text{ mol}^{-1}$ at 400 K and 1 atm

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

(68) About the energy level diagram given below, which of the following statement/s is/are correct?



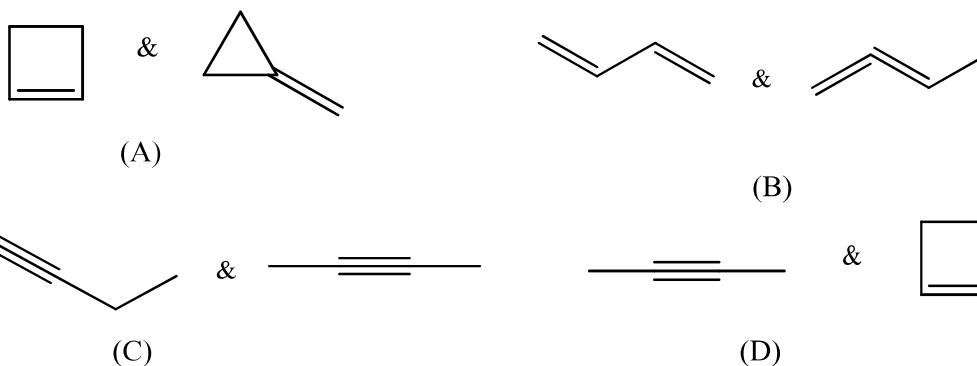
- I. The reaction is of two steps and 'R' is an intermediate
- II. The reaction is exothermic and step 2 is rate determining
- III. 'Q' is an intermediate and 'R' is the transition state for the reaction $M \rightarrow Q$
- IV. 'P' is the transition state for the reaction $Q \rightarrow N$

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

(69) Mercury is highly hazardous and hence its concentration is expressed in the units of ppb (micrograms of Hg present in 1 L of water). Permissible level of Hg in drinking water is 0.0335 ppb. Which of the following is an alternate representation of this concentration?

- (A) $3.35 \times 10^{-2} \text{ mg dm}^{-3}$
- (B) $3.35 \times 10^{-5} \text{ mg dm}^{-3}$
- (C) $3.35 \times 10^{-5} \text{ mg m}^{-3}$
- (D) $3.35 \times 10^{-4} \text{ g L}^{-1}$

- (70) Which of the following is correct?
 I. Sodium (Na) is present as metal in nature
 II. Na_2O_2 is paramagnetic
 III. NaO_2 is paramagnetic
 IV. Na reacts with N_2 to form Na_3N
- (A) III only (B) II and IV (C) I, III and IV (D) II, III and IV
- (71) The F–X–F bond angle is the smallest in (X is the central atom)
 (A) CF_4 (B) NF_3 (C) OF_2 (D) XeF_5^-
- (72) The correct sequence of reactions which will yield 4-nitrobenzoic acid from benzene is
 (A) CH_3Cl ; $\text{HNO}_3/\text{H}_2\text{SO}_4$; $\text{KMnO}_4/\text{OH}^-$
 (B) $\text{HNO}_3/\text{H}_2\text{SO}_4$; $\text{CH}_3\text{Cl}/\text{AlCl}_3$; $\text{KMnO}_4/\text{OH}^-$
 (C) $\text{CH}_3\text{Cl}/\text{AlCl}_3$; $\text{KMnO}_4/\text{OH}^-$; $\text{HNO}_3/\text{H}_2\text{SO}_4$
 (D) $\text{CH}_3\text{Cl}/\text{AlCl}_3$; $\text{HNO}_3/\text{H}_2\text{SO}_4$; $\text{KMnO}_4/\text{OH}^-$
- (73) Two isomeric hydrocarbons 'X' and 'Y' (C_4H_6), give the same product ($\text{C}_4\text{H}_8\text{O}$) on catalytic hydration with dilute acid. However, they form different products but with same molecular formula ($\text{C}_4\text{H}_6\text{Br}_4$) when treated with excess bromine.
 'X' and 'Y' are



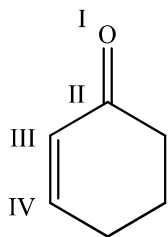
(74) Morphine, a pain killer is basic with the molecular formula $C_{17}H_{19}NO_3$. The conjugate acid of morphine is

- (A) $C_{17}H_{19}NO_3^+$ (B) $C_{17}H_{18}NO_3$ (C) $C_{17}H_{19}NO_3^-$ (D) $C_{17}H_{20}NO_3^+$

(75) The correct IUPAC name of the compound, $[Pt(py)_4][Pt(Br)_4]$ is

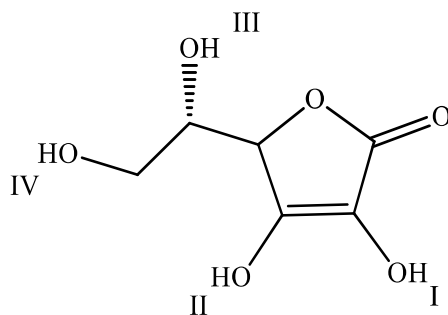
- (A) tetrapyridineplatinum(II) tetrabromidoplatinate(II)
 (B) tetrabromidoplatinum(IV) tetrapyridineplatinate(II)
 (C) tetrabromidoplatinate(II) tetrapyridineplatinum(II)
 (D) tetrapyridineplatinum(IV) tetrabromidoplatinate(IV)

(76) Which atom/s will have a δ^+ charge in the following molecule?



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

(77) The most acidic hydrogen in the following molecule is



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

(78) In which of the following species the octet rule is NOT obeyed?

- I. I_3^- II. N_2O III. OF_2 IV. NO^+

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

(79) The volume of *one* drop of aqueous solution from an eyedropper is approximately 0.05 mL. One such drop of 0.2 M HCl is added to 100 mL of distilled water. The pH of the resulting solution will be

- (A) 4.0 (B) 7.0 (C) 3.0 (D) 5.5

(80) 2.0 moles of an ideal gas expands isothermally (27°C) and reversibly from a pressure of 1 bar to 10 bar. The heaviest mass that can be lifted through a height of 10 m by the work of this expansion is

- (A) 50.8 kg (B) 50.8 g (C) 117.1 kg (D) 117.1 g

Rough Work

Rough Work