राष्ट्रीय प्रौद्योगिकी संस्थान दिल्ली
NATIONAL INSTITUTE OF TECHNOLOGY DELHI
(शिक्षा मंत्रालय, भारत सरकार के अधीन एक स्वायत्त संस्थान)
(An autonomous Institute under the aegis of Ministry of Education (Shiksha Mantralaya), Govt. of India)
Plot No. FA7, Zone P1, GT Karnal Road, Delhi-110036, INDIA
दूरभाष/Tele: +9111-33861000, 1001, 1005 फैक्स/ Fax: +9111-27787503,
वेबसाइट/Website: www.nitdelhi.ac.in

NOTICE

Advt. No. 08/ 2024: Answer Key and Representations Invited for the Domain

Knowledge Tests held on 13.02.2025

Position	**Applied Sciences (Chemistry): Assistant Professor Grade I (Pay Level 12)**
Date	**13.02.2025 (Thursday)**
Examination Time	**4:00 PM – 5:00 PM**

Following is the attached answer key. If any appeared candidate for the domain knowledge test has any representations against the questions, may submit by filling up the following Google Form on or before 16.02.2025 11:59 PM. After that no representations will be considered.

Google Form Link:
https://docs.google.com/forms/d/e/1FAIpQLSdSL0LirlHEwHuM5H3WDc2ls6hztZlKe_SeUZG1XVxWfACQ7Q/viewform?usp=preview

राष्ट्रीय प्रौद्योगिकी संस्थान दिल्ली

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QUESTION PAPER FOR THE POST OF ASSISTANT PROFESSOR CHEMISTRY
(PAY LEVEL 12)

Maximum Marks: 50 **Time: 60 Minutes**

Name of Candidate: _____ **Roll No:** _____

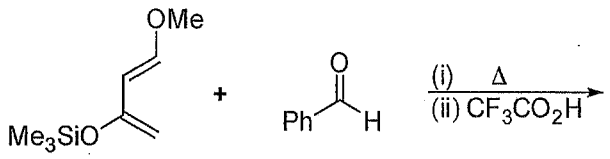
INSTRUCTIONS TO CANDIDATES

1. This question paper has 50 questions. Each question carries one mark. There are four choices for answer (A, B, C, D) to each question. Choose the correct answer (one only) for each question and write the answer in the space provided against each question.
2. Candidate must write Name, Roll No. and sign on each page of this booklet.
3. The candidate should check that the booklet does not have any unprinted or torn or missing pages or questions etc. If so, get it replaced with another question paper, before question paper starts.
4. One (1) mark will be awarded for each correct answer. There will be negative marking and (- ¼) mark will be awarded for each incorrect answer.
5. The unanswered questions will not attract negative marking
6. Return the Question Paper cum Answer Sheet to the invigilator after the examination is over.
7. **Mobile, Electronic Watch** and other **Electronic Gadgets** are prohibited in the examination.
8. There should not be any cutting or overwriting in the Answer.
9. Use of Unfair Means in Examination will lead to cancellation of candidature.

अभ्यर्थियों के लिए अनुदेश

1. इस प्रश्न पत्र में 50 प्रश्न हैं. प्रत्येक प्रश्न एक अंक का है। प्रत्येक प्रश्न के उत्तर के लिए चार विकल्प (A, B, C, D) हैं। प्रत्येक प्रश्न के लिए सही उत्तर (केवल एक) चुनें और प्रत्येक प्रश्न के सामने दिए गए स्थान पर उत्तर लिखें।
2. अभ्यर्थी को इस पुस्तिका के प्रत्येक पृष्ठ पर अपना नाम, रोल नंबर लिखना होगा तथा हस्ताक्षर करना होगा।
3. अभ्यर्थी को यह जांचना चाहिए कि पुस्तिका में कोई भी बिना छपा हुआ या फटा हुआ या गायब पृष्ठ या प्रश्न आदि नहीं है। यदि ऐसा है, तो प्रश्न पत्र शुरू होने से पहले इसे दूसरे प्रश्न पत्र से बदल लें।
4. प्रत्येक सही उत्तर के लिए एक (1) अंक दिया जाएगा। नकारात्मक अंकन होगा और प्रत्येक गलत उत्तर के लिए (- ¼) अंक दिया जाएगा।
5. अनुत्तरित प्रश्न नकारात्मक अंकन को आकर्षित नहीं करेंगे
6. परीक्षा समाप्त होने के बाद प्रश्न पत्र सह उत्तर पुस्तिका पर्यवेक्षक को लौटा दें।
7. मोबाइल, इलेक्ट्रॉनिक घड़ी और अन्य इलेक्ट्रॉनिक गैजेट्स परीक्षा में वर्जित हैं.
8. उत्तर में कोई कटिंग या ओवरराइटिंग नहीं होनी चाहिए.
9. परीक्षा में अनुचित साधनों का प्रयोग करने पर उम्मीदवारी रद्द कर दी जाएगी।

Q.1 The major product formed in the following reaction



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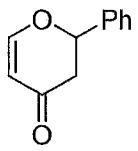

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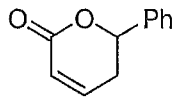

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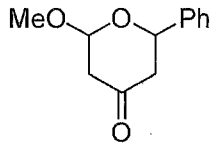

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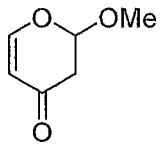
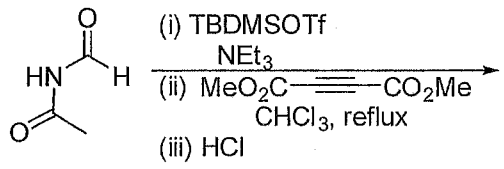


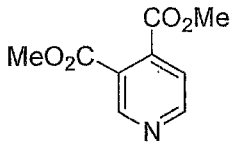
Q.2 The major product formed in the following reaction



TBDMS = t-BuMe$_2$Si

is:

(A)



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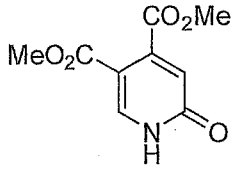

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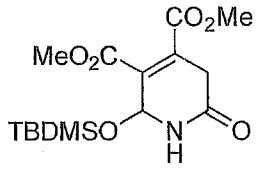

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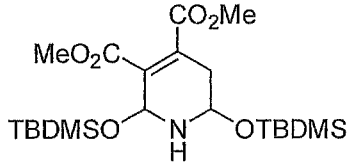
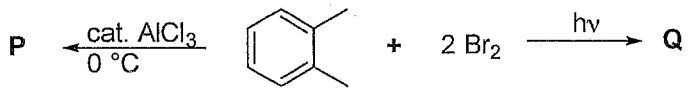
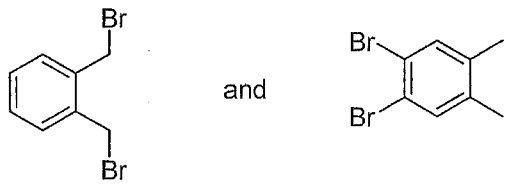


Q.3 The major products P and Q formed in the following reactions



are:

(A)



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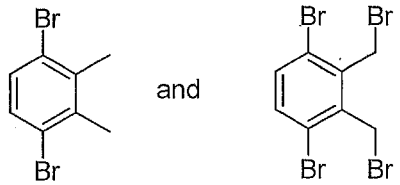
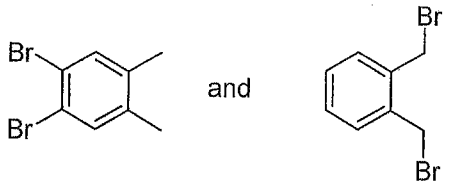


(C)



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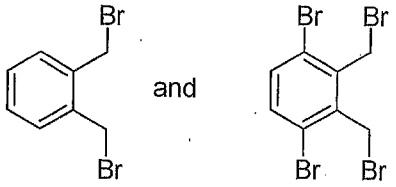
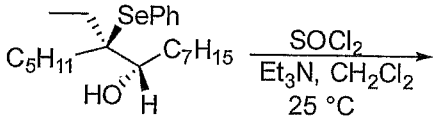


Q.4 The major product formed in the following reaction



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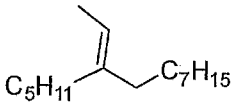
(A)



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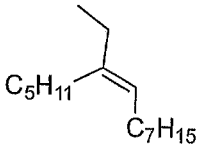

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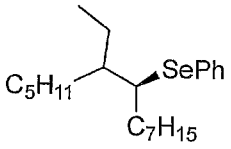

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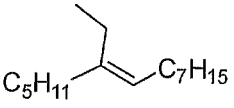
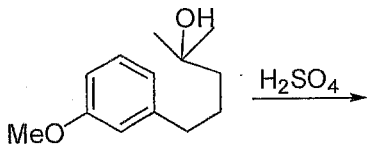
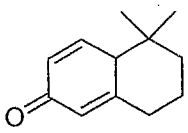


Q.5 The major product formed in the following reaction



is:

(A)



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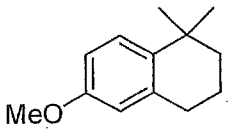

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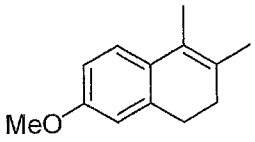

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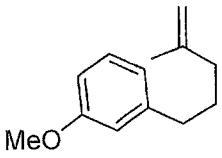
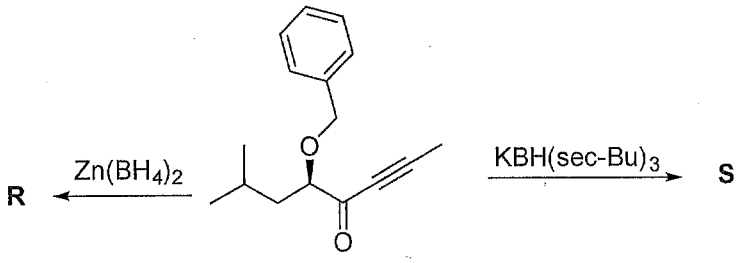


Q.6 The major products R and S formed in the following reactions



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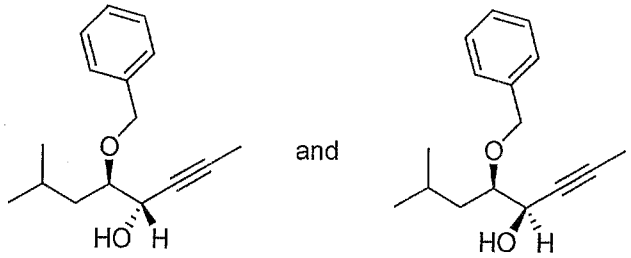
(A)



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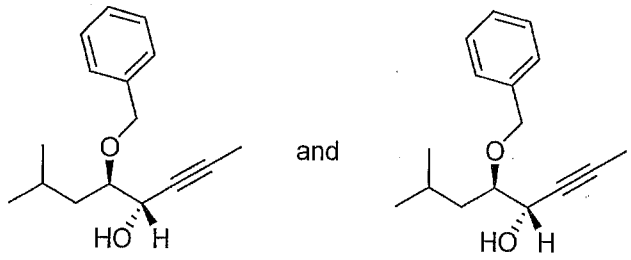

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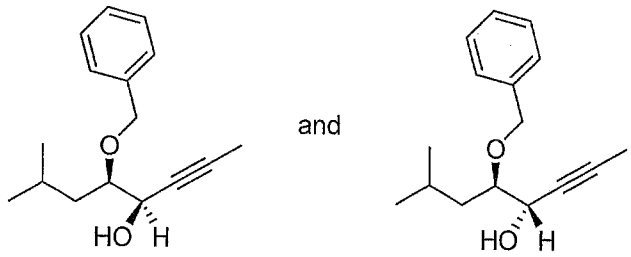

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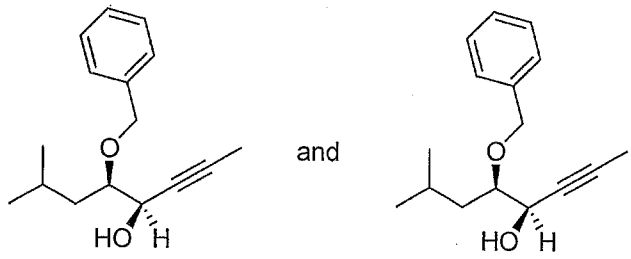
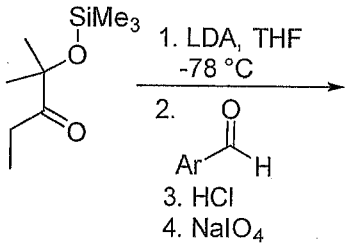
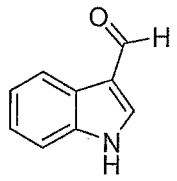


Q.7 The major product formed in the following reaction



Ar =



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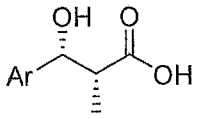
(A)



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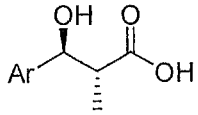

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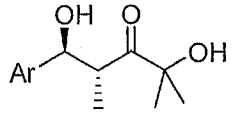

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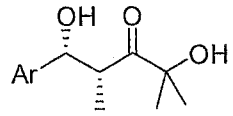
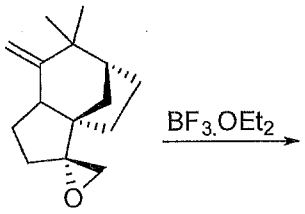


Q.8 The major product formed in the following reaction



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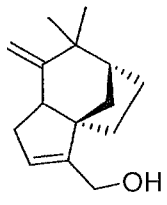
(A)



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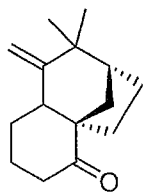

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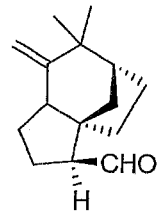
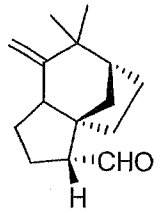
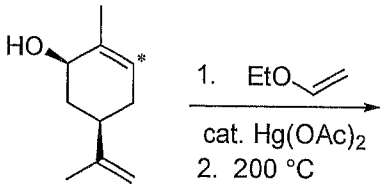


(D)

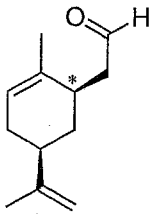


Q.9 The major product formed in the following reaction



is:

(A)



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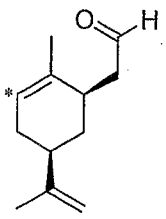
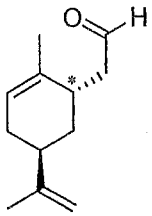
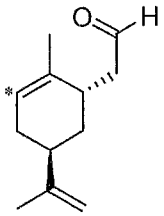


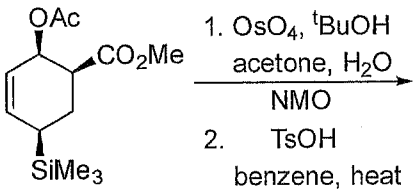
(C)



(D)

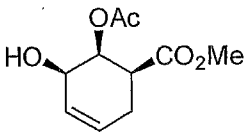


Q.10 The major product formed in the following reaction

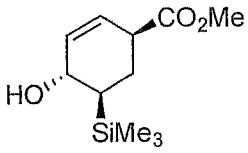


is:

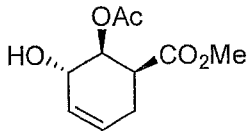
(A)



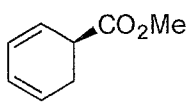
(B)



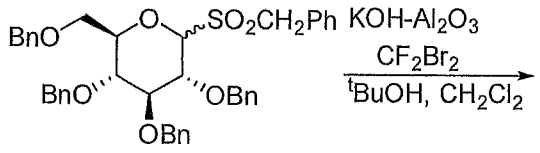
(C)



(D)

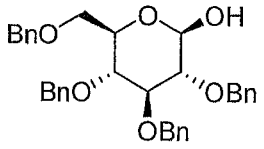


Q.11 The major product formed in the following reaction

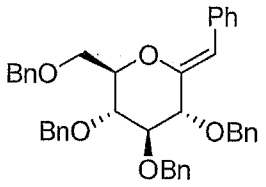


is:

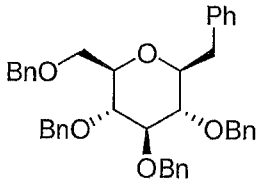
(A)



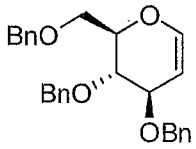
(B)



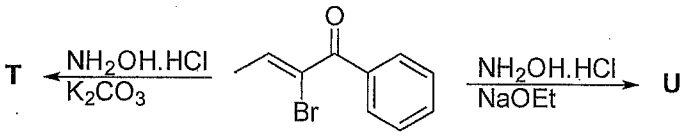
(C)



(D)

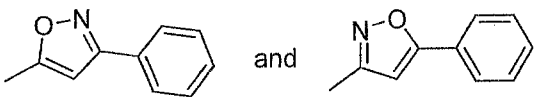


Q.12 The major products T and U formed in the following reactions

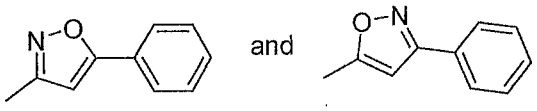


are:

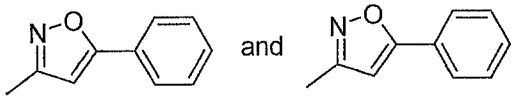
(A)



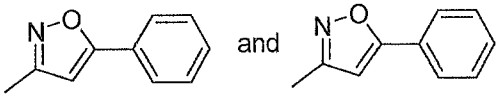
(B)



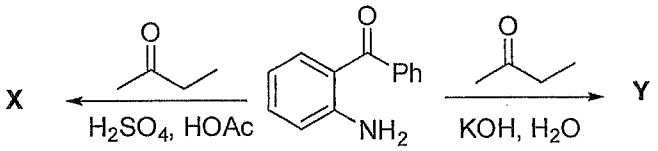
(C)



(D)

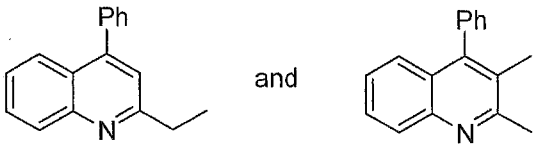


Q.13 The major products T and U formed in the following reactions



are:

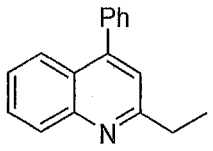
(A)

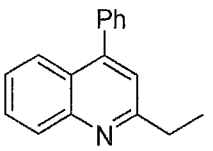


(B)

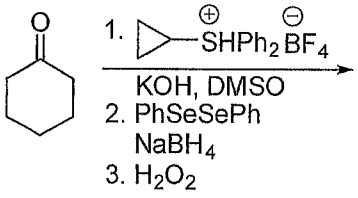
(C)

(D)



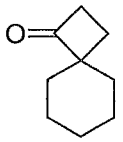
and


Q.14 The major product formed in the following reaction

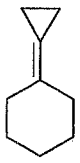


is:

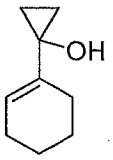
(A)



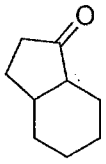
(B)



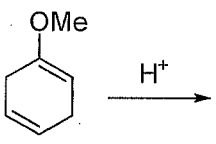
(C)



(D)

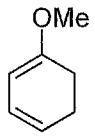


Q.15 The major product formed in the following reaction

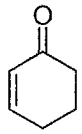


is:

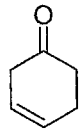
(A)



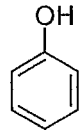
(B)



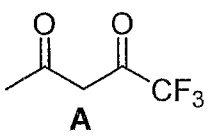
(C)



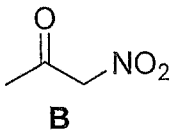
(D)



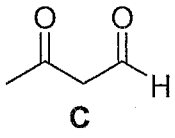
Q.16 The increasing order of the pKa values for the given carbon acids A-D



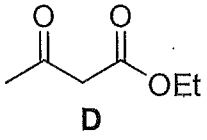
A



B



C



D

is:

(A)

A < B < C < D

(B)

D < C < B < A

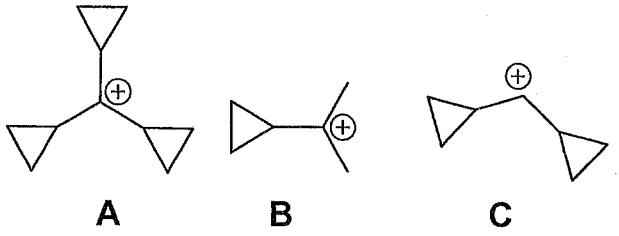
(C)

B < A < C < D

(D)

D < C < A < B

Q.17 The increasing order of stability of cations A-C



is:

(A)

A < B < C

(B)

C < B < A

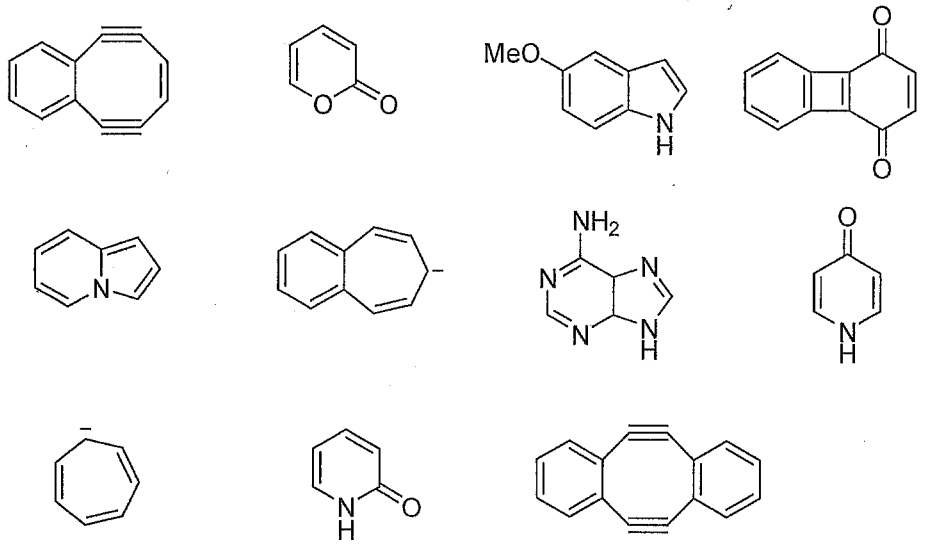
(C)

B < C < A

(D)

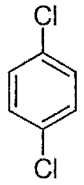
A < C < B

Q.18 The total number of Anti-aromatic compounds is/are _____ ?

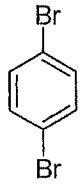


Q.19 An organic compound exhibits the $[M]^+$, $[M+2]^+$ and $[M+4]^+$ peaks in the intensity ratio 1:2:1 in the mass spectrum, and shows a singlet at δ 7.49 in the 1H NMR spectrum in CDCl3. The compound is:

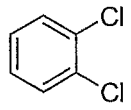
(A)



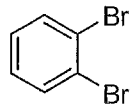
(B)



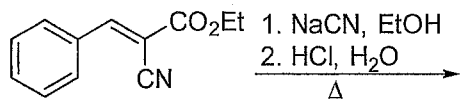
(C)



(D)

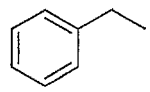


Q.20 The major product formed in the following reaction

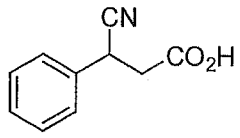


is:

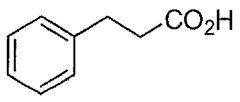
(A)



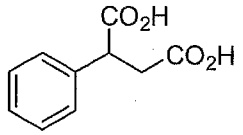
(B)



(C)



(D)



Q.21 Among the following species, one that does not have square pyramidal shape is:

(A) $XeOF_4$

(B) IF_5

(C) $[SF_5]^-$

(D) $[XeF_5]^-$

Q. 22 The calculated magnetic moment (in BM, rounded off to two decimal places) of a Pm^{3+} complex is _____?

(A) **2.66 to 2.68**

(B) **2.86 to 2.88**

(C) **2.96 to 2.98**

(D) **2.76 to 2.78**

Q.23 The rate of the substitution reaction of $[Co(CN)_5Cl]^{3-}$ with OH^- to give $[Co(CN)_5(OH)]^{3-}$

(A) depends on the concentration of $[Co(CN)_5Cl]^{3-}$ only

(B) is directly proportional to the concentration of OH^- only

(C) is inversely proportional to the concentration of OH^-

(D) depends on the concentrations of both $[Co(CN)_5Cl]^{3-}$ and OH^-

Q.24 Assertion (P): The total angular momentum for light atoms (low atomic number) is obtained by Russell-Saunders coupling, whereas *jj*-coupling is used for heavy atoms (high atomic number).

Reasoning (Q): The spin-orbit interactions are weak in light atoms (low atomic number) and strong in heavy atoms (high atomic number).

The correct option is

A) **P** is true but **Q** is false only

(B) **P** is false but **Q** is true

(C) **P** and **Q** are true; and **P** is the correct reason for **Q**

(D) **P** and **Q** are true; but **P** is NOT the correct reason for **Q**

Q.25 Point group of staggered ferrocene is:

(A) D_{5d}

(B) D_{5h}

(C) C_s

(D) C_{5h}

Q.26 Incorrect statement regarding the Wackers process is:

(A) Catalysed by the combination of Pd(II) and Cu(II)

(B) Oxidizes olefins

(C) Homogeneous catalysis

(D) Takes place in basic conditions at high pressure of molecular oxygen

Q.27 Collman's reagent is:

(A) $[Cr(CO)_5]^{2-}$

(B) $Co_2(CO)_8$

(C) $Na_2[Fe(CO)_4]$

(D) $Li[Re(CO)_5]$

Q.28 In linear nitrosyl NOacts as a/an:

(A) One electron donor

(B) Two electron donor

(C) Three electron donor

(D) Four electron donor

Q.29 CO bond order is lowest in:

(A) Unreacted CO

(B) CO bonded to one metal

(C) CO bridging two metals

(D) CO bridging three metals

Q.30 The number of valance electrons provided by $[Ru(CO)_3]$ fragment towards cluster bonding is:

(A) 2

(B) 6

(C) 12

(D) 14

Q.30 The number of valance electrons provided by $[Ru(CO)_3]$ fragment towards cluster bonding is:

(A) 2

(B) 6

(C) 12

(D) 14

Q.31 The correct statement regarding the given halide clusters $[Re_2Cl_8]^{2-}$ and $[Mo_2Cl_8]^{4-}$ is:

(A) Both have staggered conformations

(B) Both have eclipsed conformations

(C) $[Re_2Cl_8]^{2-}$ have staggered conformation while $[Mo_2Cl_8]^{4-}$ have eclipsed conformation

(D) $[Re_2Cl_8]^{2-}$ have eclipsed conformation while $[Mo_2Cl_8]^{4-}$ have staggered conformation

Q.32 Considering the quadrupolar nature of M-M bond in $[Re_2Cl_8]^{2-}$, the M-M bond order in $[Re_2Cl_4(PMe_2Ph)_4]^+$ and $[Re_2Cl_4(PMe_2Ph)_4]$ respectively are:

(A) 2.5 and 3.0

(B) 3.0 and 3.5

(C) 3.5 and 3.0

(D) 3.0 and 2.5

Q.33 The following reaction

$$Co(CO)_8 + H_2 \longrightarrow 2[Co(H)(CO)_4]$$

is:

(A) Oxidative addition

(B) reductive elimination

(C) Insertion

(D) addition

Q.34 The reaction between $[PdCl_4]^{2-}$ and ethylene produces a new compound. Compared to free ethylene, the C-C bond order of the product is :

is:

(A) $1 \leq 2$

(B) < 1

(C) No change

(D) > 2

Q.35 The compounds $K_2Ba[Cu(NO_2)_6]$ and $Cs_2Ba[Cu(NO_2)_6]$ will exhibit

(A) tetragonal elongation

(B) tetragonal compression

(C) tetragonal elongation and tetragonal compression, respectively

(D) tetragonal compression and tetragonal elongation, respectively

Q.36 For the conversion of cyclopropane to propene at 25 ^{o}C, the pre-exponential factor 4.3×10^{15} s^{-1}. The entropy of activation (in J K^{-1} mol^{-1}, rounded off to two decimal places) is _____?

(Given: $h = 6.626 \times 10^{-34}$ J s; $k_B = 1.38 \times 10^{-23}$ J K^{-1}; R = 8.314 J K^{-1} mol^{-1})

(A) 46.00 to 46.1
(B) 47.01 to 47.00
(C) 45.00 to 45.1
(D) 48.00 to 48.1

Q.37 Liquid A and liquid B are completely miscible. At 25 °C, the vapor pressures of A and B are 0.198 atm and 0.06 atm, respectively. The mole fractions of A and B in the vapor phase for a solution containing 4 M A and 6 M B, respectively, are:

(A) 0.400 and 0.600

(B) 0.688 and 0.312

(C) 0.600 and 0.400

(D) 0.312 and 0.688

Q.38 2 L of a gas at 1 atm pressure is reversibly heated to reach a final volume of 3.5 L. The absolute value of the work done on the gas (rounded off to the nearest integer) is (__) Joules.

(A)154 to 155
(B) 151 to 153
(C) 155 to 156
(D) 170 to 171

Q.39 A bubble is expanded from a radius of 1.00 cm to a radius of 3.25 cm. The surface tension of water is 71.99 N m^{-1}. How much work is done in increasing the area of the bubble _____?

(A) **- 1.73 J**
(B) **- 1.77 J**
(C) **- 1.75 J**
(D) **- 1.80 J**

Q.40 3.00 mol of liquid mercury is transformed from an initial state characterized by T_i = 300 K and P_i = 1.00 bar to a final state characterized by T_f = 600 K and P_f = 3.00 bar. Calculate ΔS for this process (rounded off to two decimal places); β= 1.81 × 10^{-4} K^{-1}, ρ= 13.54 g cm^{-3}, and $C_{P,m}$ for Hg(*l*) = 27.98 J mol^{-1} K^{-1}.

(A) **59.10 to 59.2 J**
(B) **48.10 to 48.2 J**
(C) **68.10 to 68.2 J**
(D) **58.10 to 58.2 J**

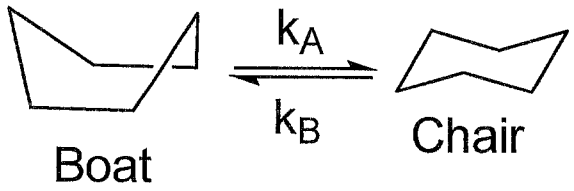
Q.41 The normal boiling temperature of benzene is 353.24 K, and the vapor pressure of liquid benzene is 1.19 × 10^4 Pa at 20.0°C. The enthalpy of fusion is 9.95 kJ mol^{-1}, and the vapor pressure of solid benzene is 137 Pa at -44.3 °C. Calculate the triple point temperature (K).

(A) 267
(B) 287
(C) 277
(D) 267

Q.42 Calculate the translational partition function (rounded off to two decimal places) for Ar confined to a volume of 1.00 L at 298 K.
(Given; mass of Ar = 6.63×10^{-23} g, $h = 6.626 \times 10^{-34}$ J s; $k_B = 1.38 \times 10^{-23}$ J K^{-1})

(A) 2.43×10^{29} to 2.45×10^{29}
(B) 2.63×10^{29} to 2.65×10^{29}
(C) 2.53×10^{29} to 2.55×10^{29}
(D) 2.33×10^{29} to 2.35×10^{29}

Q.43 Consider the interconversion of the "boat" and "chair" conformations of cyclohexane:



The reaction is first order in each direction, with an equilibrium constant of 10^4. The activation energy for the conversion of the chair conformer to the boat conformer is 42 kJ/mol. Assuming an Arrhenius preexponential factor of 10^{12} s^{-1}, the expected observed reaction rate constant at 298 K if one were to initiate this reaction starting with only the boat conformer is _____ s^{-1}.
(Given: R = 8.314 J K^{-1} mol^{-1})

(A) 5.34×10^8
(B) 4.34×10^8
(C) 6.34×10^8
(D) 7.34×10^8

Q.44 A maximum in the rate constant for electron transfer (~ 2.0×10^9 s^{-1}) occurs when $-\Delta G^o = 1.20$ eV. Given this observation, estimate the rate constant (------s^{-1}) for electron transfer when 2-naphthoquinoyl is employed as the acceptor for which $-\Delta G^o = 1.20$ eV.
(Given; $h = 6.626 \times 10^{-34}$ J s; $k_B = 1.38 \times 10^{-23}$ J K^{-1})

(A) 2.5×10^7 to 2.7×10^7
(B) 3.5×10^7 to 3.7×10^7
(C) 4.5×10^7 to 4.7×10^7
(D) 5.5×10^7 to 5.7×10^7

Q.45 Acceptable wave functions for a quantum particle must be

(A) odd

(B) even

(C) single-valued

(D) multiple-valued

Q. 46 $1s_A$ and $1s_B$ are the normalized eigenfunctions of two hydrogen atoms H_A and H_B, respectively. If $S = \langle 1s_A | 1s_B \rangle$, the correct option is

(A) S = 1

(B) S = 0

(C) S = imaginary constant

(D) $0 \leq S \leq 1$

Q. 47 The packing efficiency (in %) of diamond cubic crystal structure is approximately

(A) 74

(B) 68

(C) 34

(D) 52

Q. 48 Which of the following is correct regarding orthorhombic system

(A) $\alpha = \beta = \gamma = 90\ ^oC$

(B) $\alpha = \beta = 90\ ^oC; \gamma = 120\ ^oC$

(C) $\alpha \neq \beta \neq \gamma \neq 90\ ^oC$

(D) $\beta \neq \alpha = \gamma = 90\ ^{o}C$

Q. 49 A solution containing a metal complex absorb at 480 nm with molar extinction coefficient of 15000 L mol^{-1} cm^{-1}. If the path length of cell is 1.0 cm and transmittance is 20.5%, the concentration (in mol L^{-1}) of metal complex is

(A) 1.4×10^{-5}

(B) 2.3×10^{-5}

(C) 4.6×10^{-5}

(D) 8.8×10^{-5}

Q.50 The temperature dependence of the rate constant for a second-order chemical reaction obeys the Arrhenius equation. The SI unit of the 'pre-exponential factor' is:

(A) s^{-1}

(B) $m^3\ mol^{-1}\ s^{-1}$

(C) $mol\ m^{-3}\ s^{-1}$

(D) $(m^3\ mol^{-1})^2\ s^{-1}$

Answer Key

Written Examination of Faculty Recruitment

Chemistry (Level 12) (UR Category)

1) Q1	A	26) Q26	D
2) Q2	B	27) Q27	C
3) Q3	C	28) Q28	C
4) Q4	D	29) Q29	D
5) Q5	B	30) Q30	D
6) Q6	A	31) Q31	B
7) Q7	A	32) Q32	C
8) Q8	D	33) Q33	A
9) Q9	C	34) Q34	A
10) Q10	C	35) Q35	C
11) Q11	B	36) Q36	A
12) Q12	B	37) Q37	B
13) Q13	A	38) Q38	B
14) Q14	C	39) Q39	A
15) Q15	A	40) Q40	D
16) Q16	A	41) Q41	C
17) Q17	C	42) Q42	A
18) Q18	X	43) Q43	B
19) Q19	C	44) Q44	A
20) Q20	D	45) Q45	C
21) Q21	D	46) Q46	D
22) Q22	A	47) Q47	C
23) Q23	D	48) Q48	A
24) Q24	C	49) Q49	C
25) Q25	A	50) Q50	B