CSIR UGC – NET JRF: December 2017

Chemical Science

***** Question Paper

Section-A

Q.1 A boy holds one end of a rope of length l and the other end is fixed to a thin pole of radius r ($r << l$).
Keeping the rope tight, the boy goes around the pole causing the rope to get wound around the pole. Each
round takes 10 s. What is the speed (in units of s ⁻¹) with which the boy approaches the pole?

(a) $\frac{\pi r}{5}$ (b) $\frac{\pi l}{5}$ (c) $20\pi(r+l)$ (d) $\frac{2\pi(l-r)}{5}$

Q.2 The smallest square floor which can be completely paved with tiles of size 8×6 without breaking any tile, needs n tiles. Find n.

(a) 56 (b) 12 (c) 24 (d) 48

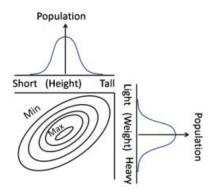
Q.3 A 2 m long ladder is to reach a wall of height 1.75 m. The largest possible horizontal distance of the ladder from the wall could be?

- (a) Slightly less than 1 metre (b) Slightly more than 1 metre
- (c) 1 metre (d) 1.2 metre

Q.4 A rectangular flask of length 11 cm, width 8 cm and height 20 cm has water filled up to height 5 cm. If 21 spherical marbles of radius 1 cm each are dropped in the flask, what would be the rise in water level?

(a) 8.8 cm (b) 10 cm (c) 1 cm (d) 0 cm

Q.5 Contours in the bivariate (weight, height) graph connect regions of approximately equal populations. Which of the following interpretations is correct?



- (a) There is no correlation between height and weight of the population.
- (b) Heavier individuals are likely to be taller than lighter individuals.
- (c) Taller and lighter individuals are more in number than taller and heavier individuals.
- (d) There are no individuals of medium weight and medium height.

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Q.6 A path between points P₁ and P₁₀ on a level ground is shown, and positions of a moving object at 1 second intervals are marked. Which of the following statements is correct?



- (a) The motion is uniform.
- (b) The speed between P_3 and P_4 is greater than that between P_5 and P_6 .
- (c) The speed from P_1 to P_2 increases because of downward slope.
- (d) The section P_3 to P_4 is covered at the slowest speed.
- Q.7 A new tyre can be used for at most 90 km. What is the maximum distance (in km) that can be covered by a three-wheeled vehicle carrying one spare wheel, all four tyres being new?
- (a) 180
- (b) 90

- (c) 120
- (d) 270



Q.8 A plate of 5m × 2m size with uniform thickness, weighing 20 kg, is perforated with 1000 holes of 5cm × 2cm size. What is the weight of the plate (in kg) after perforation? 10 (b) 2 (c) 19.8 (d) 18 (a) Q.9 What is the maximum number of cylindrical pencils of 0.5 cm diameter that can be stood in a square shaped stand of 5 cm × 5 cm inner cross section? (a) 99 (b) 121 (c) 100 (d) 105 Q.10 The sum of two numbers is equal to sum of square of 11 and cube of 9. The larger number is $(5)^2$ less than square of 25. What is the value of the sum of twice of 24 percent of the smaller number and half of the larger number? (a) 415 420 Q.11 What is the volume of soil in an open pit of size 4.0 m^3 (a) 40 m^{3} (info@dalalinstitute.com, www.dalalinsti O.12 For which value of A & B Sin A =(a) A = B = 0(d) $A = \pi/2, B = 0$ Q.13 For which one of the following statements is the converse NOT true? If a patient dies even with excellent medical care, he likely had terminal illness. If a person gets employed, he has good qualifications. (b) If an integer is even, it is divisible by two. (c) If an integer is odd, it is not divisible by two. Q.14 Four small squares of side x are cut out of a square of side 12 cm to make a tray by folding the edges. What is the value *x* of so that the tray has the maximum volume?

(d)

4 cm

(b) 2 cm

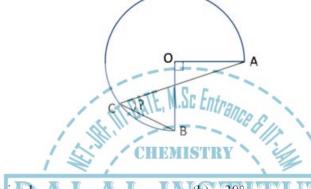
(a) 6 cm

(c) 3 cm

Q.15 Two runners A and B start running from diametrically opposite points on a circular track in the same direction. If A runs at a constant speed of 8 km/h and B at a constant speed of 6 km/h and A catches up with B in 30 minutes, what is the length of the track?

- (a) 1 km
- (b) 4 km
- (c) 3 km
- (d) 2 km

Q.16 Three-quarters of a circle is shown in the figure; OA and OB are two radii perpendicular to each other. C is a point on the circle:



What is angle ACB?

- (a) Cannot be determined
- (c) 60°
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Q.17 If a plant with green leaves is kept in a dark room with only green light ON, which one of the following would we observe?

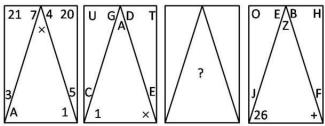
- (a) The plant appears brighter than the surroundings.
- (b) The plant appears darker than the surroundings.
- (c) We cannot distinguish the plant from the surroundings.
- (d) It will have above normal photosynthetic activity.

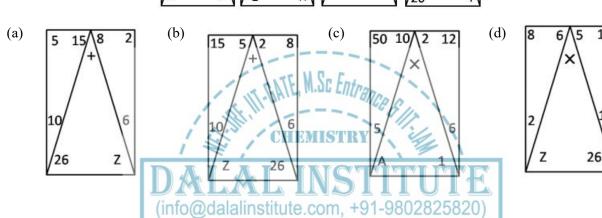
Q.18 A person purchases two chains from a jeweller, one weighing 18 g made of 22 carat gold and another weighing 22 g made of 18 carat gold. Which one of the following statements is correct?

- (a) 22 carat chain contains 2/11 times more gold than 18 carat chain.
- (b) 22 carat chain contains 1/11 times more gold than 18 carat chain.
- (c) Both chains contain the same quantity of gold.



- (d) 18 carat chain contains 2/11 times more gold than 22 carat chain.
- Q.19 Find the missing pattern in the following:





Q.20 There are small and large bacteria of the same species. If S is surface area and V is volume, then which of the following is correct?

- (a) $S_{\text{small}} > S_{\text{large}}$
- (c) $(S/V)_{small} > (S/V)_{large}$

Section-B

- Q.21 Among the following nuclear reactions of thermal neutrons, the cross section is highest for?
- (a) $_{92}U^{235} + _{0}n^{1} \rightarrow _{92}U^{235} + _{0}n^{1}$

(b) $92U^{235} + 0n^1 \rightarrow 92U^{236}$

(c) $_{92}U^{235} + _{0}n^{1} \rightarrow _{90}Th^{232} + _{2}He^{4}$

- (d) $_{92}U^{235} + _{0}n^{1} \rightarrow {}_{36}Kr^{94} + {}_{56}Ba^{140} + 2_{0}n^{1}$
- Q.22 Spectrophotometric monitoring is not suitable to determine the end point of titration of?
- (a) Oxalic acid vs potassium permanganate
- (b) Iron(II) vs 1,10-phenanthroline
- (c) Cobalt(II) vs eriochrome black T
- (d) Nickel(II) vs dimethylglyoxime

Q.23	The first ionization er	nergy	is the lowest for?				
(a)	Br	(b)	Se	(c)	P	(d)	As
Q.24	Among ClO ₃ -, XeO ₃ a	and S	O ₃ , species with pyran	nidal s	shape is/are?		
(a)	ClO ₃ - and XeO ₃	(b)	XeO ₃ and SO ₃	(c)	ClO ₃ - and SO ₃	(d)	SO ₃
Q.25	The role of BF ₃ as an	indus	strial polymerization ca	atalys	t is to generate?		
(a)	Carbanion	(b)	Carbocation	(c)	Organic radical	(d)	Cation radical
Q.26	For the following con	nplex	es, the increasing orde	r of m	agnetic moment (spir	only	value) is?
A. [T	${}^{1}F_{6}$ ${}^{3-}$ B. $[CrF_{6}]^{3-}$ C. [1]	MnF ₆	$[^{3-}$ D. $[\text{CoF}_6]^{3-}$	ISTI	W. W.		
(a)	D < A < B < C	(b)	C < A < D < B	(c) S	$B \sim A \leq D \leq C$	(d)	$A < B < C \sim D$
Q.27	The correct statement	for c	ytochrome e is?! te.co	om, -	+91-9802825820)	
(a)	It is a non-heme pro	tein.	www.dalali	nstii	ute.com		
(b)	The coordination number	mber	of iron in cytochrome	20 <i>c</i> is f	ive.		
(c)	It is a redox protein	and a	n electron carrier.	14 R	ahtak		
(d)	It can store or carry	dioxy	gen.				
Q.28	Geometries of SNF ₃ a	ınd X	eF_2O_2 , respectively, ar	re?			
(a)	Square planar and so	luare	planar	(b)	Tetrahedral and tetra	hedra	.1
(c)	Square planar and tr	igona	l bipyramidal	(d)	Tetrahedral and trigo	onal b	ipyramidal
	The IR spectrum of sted in the spectrum of	,	O) ₄ H shows bands at CO) ₄ D is	2121	, 2062, 2043 and 193	34 cm	The $v_{\text{Co-D}}$ (in cm ⁻¹)
(a)	2111	(b)	1396	(c)	2053	(d)	1910

Q.30 In trigonal prismatic ligand field, the most stabilized d orbital is?

(a) d_z^2

(b) d_{xy}

(c) d_{xz}

(d) d_{yz}

Q.31 The most unstable complex on the basis of electro-neutrality principle among the following is?

- (a) $[Al(OH_2)_6]^{3+}$
- (b) $[Al(NH_3)_6]^{3+}$
- (c) $[AlF_6]^{3-}$
- (d) $[Al(NCCH_3)_6]^{3+}$

Q.32 The band in the electronic spectrum of I₂ appearing at 520 nm will undergo maximum blue shift in?

- (a) Water
- (b) Hexane
- (c) Benzene
- (d) Methanol

Q.33 Mismatch among the following is?

- (a) Sharp transition and fluorescence in lanthanides.
- (b) Broad bands and *d-d* transitions.
- (d) Charge transfer and molar absorptivity of the order of 10⁴ L mol⁻¹cm⁻¹.

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Q.34 Among the following, the compound that gives base peak at m/z 72 in the EI mass spectrum is?

(a)



(b)



(d)



Q.35 The following molecule has:

$$H_{0_2}$$
CO₂H

(a) Plane of symmetry

(b) R configuration

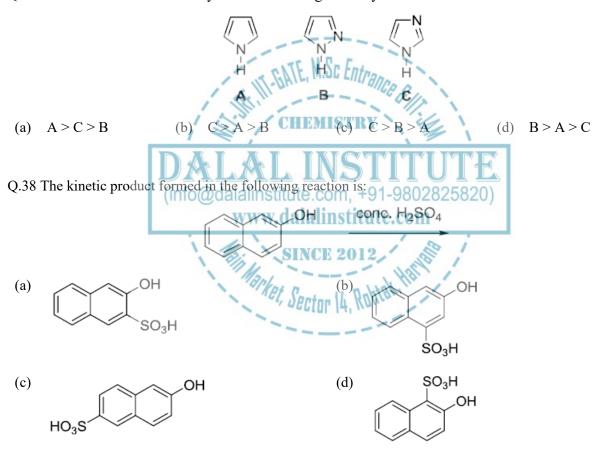
(c) S configuration

(d) Centre of symmetry

Q.36 The following natural product Enterodiol is a?

- (a) Terpene
- (b) Steroid
- (c) Lignan
- (d) Alkaloid

Q.37 The correct order of basicity for the following heterocycles is:



Q.39 Among the structures given below, the one that corresponds to the most stable conformation of compound A is:

(a) OH

(b) Me \bigcirc OH

Me O O H

(d) Me

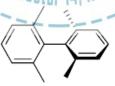
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Q.40 According to Frontier Molecular Orbital (FMO) Theory, the Highest Occupied Molecular Orbital (HOMO) of hexatriene in the following reaction is:

(c)



Q.41 The number of signals observed in the proton decoupled ¹³C NMR spectrum of the following compound is:



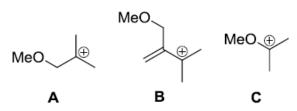
(a) 5

(b) 6

(c) 10

(d) 13

Q.42 The correct order of stability of the following carbocations is:



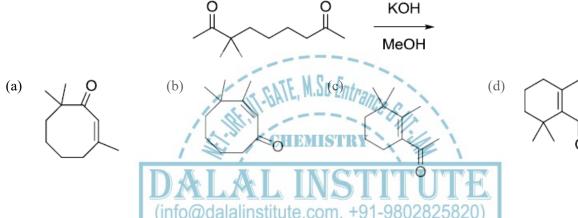
- A > C > B(a)
- (b) B > C > A
- (c) C > A > B
- (d) C > B > A

Q.43 An optically pure organic compound has specific rotation of +40°. The optical purity of the sample that exhibits specific rotation of +32° is

(a) 8%

- (b) 12%
- 20%
- (d) 80%

Q.44 The major product formed in the following reaction is:



Q.45 Correct match of the compounds in Column P with the IR stretching frequencies (cm⁻¹) in Column Q is:

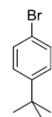
13	4	Column P	201	Column Q	>
	I M		A	1865	1
1		Section 1	4 R	ahtak, i.	•
	П	*	B	1770	
		0		1770	
	III	0 > 0 > 0	C	1745	
	III	0 0	C	1745	

- $(a) \quad I-B; II-C; III-A \quad (b) \quad I-C; II-A; III-B \quad (c) \quad I-C; II-B; III-A \quad (d) \quad I-A; II-C; III-B$

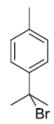
Q.46 The organic compound that displays following data is:

¹H NMR (400 MHz): δ 7.38 (d), 7.25 (d), 1.29 (s) ppm

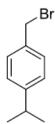
(a)



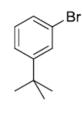
(b)



(c)



(d)



Q.47 The molecule with a C_2 axis of symmetry among the following is?

- (a) BH₂Cl
- (b) CH₃Cl
- (c) NH₂Cl
- (d) HOCl

Q.48 The molecule that will show Raman spectrum, but not IR spectrum, among the following is?

(a) H₂

- (b) H@1
- (c) BrCl
- (d) CS_2

Q.49 Boron in BCl₃ has?

(a) sp hybridization

(c) sp^3 hybridization

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 sp^2 hybridization

(d) No hybridizatio

Q.50 The number of degenerate spatial orbitals of a hydrogen-like atom with principal quantum number n = 6 is?

(a) 12

(b) 6

- (c) 72
- (d) 36

Q.51 If $[\hat{A}, \hat{B}] = 0$ & $[\hat{A}, \hat{C}] = 0$, then which of the following necessarily holds?

- (a) $\left[\hat{B},\hat{C}\right] = 0$
- (b) $\left[\widehat{A},\widehat{BC}\right] = 0$
- $\widehat{[B,AC]} = 0$
- (d) $\left[\widehat{C}, \widehat{AB}\right] = 0$

Q.52 The correct statement among the following is $(\hat{A} \text{ is a Hermitian operator})$?

- (a) The eigen values of $\widehat{A^2}$ can be negative.
- (b) The eigen values of $\widehat{A^2}$ are always positive.
- (c) No eigen function of \hat{A} is an eigen function of \hat{A}^2 .

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(d)	The eigen values of $\widehat{A^2}$ can be complex.
(4)	The eigen values of A can be complex.

Q.53 If the atoms/ions in the crystal are taken to be hard spheres touching each other in the unit cell, then the fraction of volume occupied in the body centred cubic structure is?

- (a) $\sqrt{3}\pi$

$$\frac{\sqrt{3}\pi}{6}$$

Q.54 Repeated measurements Pb in a lake water sample gave 3.2, 5.2 & 7.2 ppb of Pb. Standard deviation in the measurement of Pb is?

- 2 ppb (a)

- (d) $2\sqrt{2}$ ppb

Q.55 The stability of lyophobic colloids is a consequence

- Electrical double layer at the surface of the particles.
- van der Waals force between the particles. (b)
- Small particle size. (info@dalalinstitute.com, +91 (c) www.dalalinstitute.com
- Shape of the particles. (d)

Q.56 The equivalent conductance at infinite dilution of a strong electrolyte (Λ_0) can be obtained from the plot of?

- (a) $\Lambda vs C$
- (b)
- $\Lambda vs \sqrt{C}$
- $\Lambda vs C^2$
- (d) $\Lambda vs 1/C$

Q.57 The number-average molar mass (\overline{M}_n) for a monodisperse polymer is related to the weight-average molar mass (\overline{M}_w) by the relation?

- (a)

- $\overline{M}_n = \frac{\overline{M}_w}{3}$ (b) $\overline{M}_n = \frac{\overline{M}_w}{4}$ (c) $\overline{M}_n = 2\overline{M}_w$ (d) $\overline{M}_n = \overline{M}_w$

Q.58 For a sequence of consecutive reactions, the concentration of I would be, by steady state approximation:

$$A \xrightarrow{k_1} I \xrightarrow{k_2} P$$

- (a) $k_I[A]$
- (b) $(k_1 + k_2)[A]$
- (c) $k_1 k_2 [A]$
- (d) $k_1/k_2[A]$



Q.59 Enthalpy is equal to?

(a)
$$TS + PV + \sum u_i n_i$$

$$TS + \sum u_i n_i$$

$$\sum u_i \, n_i$$

(d)

$$TS + \sum u_i n_i$$
$$PV + \sum u_i n_i$$

Q.60 The structure of ribonucleoside uridine is?





Q.61 The peak area of differential thermal analysis curve is proportional to one or more of the following:

A. mass loss B. mass of the sample C. heat of decomposition / phase change

The correct answer is

- (a) A only
- (b) B only
- (c) A & C
- (d) B & C

Q.62 To determine the bond parameters at 25°C, electron diffraction is generally unsuitable for both?

O₃ and NO₂ (a)

Sulphur and dry ice

NO₂ and sulphur (c)

O₃ and dry ice

Q.63 Match lanthanides in Column I with their properties in Column II:

	Column I		Column II
a)	Lu	i)	Reagent in oxidation state IV
b)	Eu	ii)	MI ₂ of metallic lustre
c)	Се	iii)	Diamagnetic M(III)
d)	Tb	iv)	Pink in oxidation state III

(a)	a-((iii)	۰ h-	(ii)·	c-(i))· d-((iv)
(a)	a-((111)	,, v-	(11),	U-(1)	/, u-ı	(11)

Q.64 Among the following, species isolobal to CH₂ are:

A. CpCr(CO)₂

B. CpCu

C. $Ni(CO)_2$ D. $Cr(CO)_4$

(d) A, B and D

(a) A, C and E

(b) B, C and D

(c) B, C and E

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Q.65 Choose the incorrect statement for the phosphomolybdate anion, [PMo₁₂O₄₀]³-.

(a) It has a Keggin structure.

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(b) Phosphorus is in +5 oxidation state.

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- (c) It is extremely basic.
- (d) It forms crystalline precipitates with $[R_4N]^+$ (R = bulky alkyl or aryl group).

Q.66 Consider the following statement(s) for actinides (An) & choose the correct one:

- A. Oxidation states greater than +3 are more frequent in An compared to lanthanides (Ln).
- B. Some An(III) ions show d-d transitions.
- C. UO_2^{2+} and PuO_2^{2+} are stable.
- D. Some of actinides do not have radioactive isotopes.
- (a) A & C
- (b) B & D
- (c) A, B & C
- (d) B, C & D



Q.67 According to Bent's rule, for *p*-block elements, the correct combination of geometry around the central atom and position of more electronegative substituent is?

- (a) Trigonal bipyramidal and axial
- (b) Trigonal bipyramidal and equatorial

(c) Square pyramidal and axial

(d) Square pyramidal and basal

Q.68 Allred-Rochow electronegativity of an element is:

- A. directly proportional to the effective nuclear charge.
- B. directly proportional to the covalent radius
- C. inversely proportional to the square of the covalent radius.
- D. directly proportional to the square of the effective nuclear charge.

The correct answer is

- (a) A & B
- (b) A & C
- (c) B & C
- (d) A & D

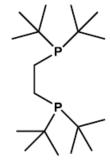
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Q.69 Br₂ with propanone forms a charge transfer complex and I₂ forms triiodide anion with I⁻. This implies that?

- (a) Both Br_2 and I_2 act as bases.
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- (b) Both Br₂ and I2 act as acids.
- (c) Br_2 acts as an acid and I_2 acts as a base.
- (d) Br₂ acts as a base and I₂ acts as an acid.

Q.70 In the complex [Pd(L-L)(Me)(Ph)], the bisphosphine (L-L) that does not allow reductive elimination of PhMe, is?

(a)



(b)

MeO P....

Q.71 In the reaction given below, the bisphosphine (P-P) that is ineffective for transfer-hydrogenation reaction is:

$$CpRu(P-P)H + Ph CD_{2}Cl_{2} CpRu(P-P)(CH_{3}CN)]^{+}BF_{4} + Ph CD_{2}Cl_{2} CpRu(P-P)(CH_{3}CN)]^{+}BF_{4} + Ph CD_{2}Cl_{2} CpRu(P-P)(CH_{3}CN)$$

- (a) Diphenylphosphinomethane.
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 (b) 1,2-Diphenylphosphinoethane. www.dalalinstitute.com
- (c) 1,3-Diphenylphosphinopropane.
- (d) 1,4-Diphenylphosphinobutane.

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Q.72 For high spin and low spin d^6 octahedral complexes (ML₆), the generally observed spin allowed transitions, respectively, are?

- (a) Two & one
- (b) One & two
- (c) Zero & one
- (d) Two & two

Q.73 The reactions given below:

A.
$$Cl_2 + 2H_2O \rightarrow HOCl + H_3O^+ + Cl^-$$

$$B.~Cl_2 + 2NH_3 \rightarrow NH_2Cl + NH_4{}^+ + Cl^-$$

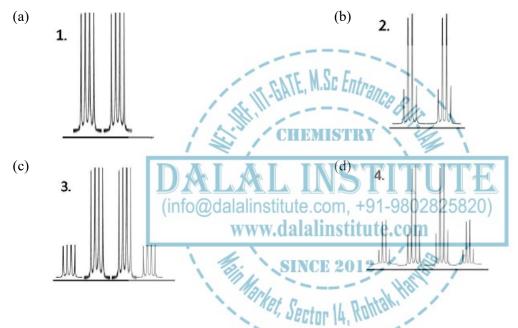
are examples of

(a) Disproportionation only

(b) Disproportionation (A) and solvation (B)



- (c) Solvation (A) and disproportionation (B)
- (d) Solvolysis as well as disproportionation
- Q.74 According to Wade's rules, the cluster type and geometry of [Sn₉]⁴, respectively, are?
- (a) Closo and tricapped trigonal prismatic.
- (b) Nido and monocapped square-antiprismatic.
- (c) Archno and heptagonal bipyramidal.
- (d) Closo and monocapped square antiprismatic
- Q.75 Assuming ${}^{1}J_{PH} > {}^{1}J_{PB}$, the expected ${}^{31}P$ NMR spectrum of $H_{3}P: {}^{11}BCl_{3}$ [for ${}^{11}B$, I = 3/2] is?



- Q.76 The geometry around Cu and its spin state for K_3CuF_6 and $KCuL_2$, $[H_2L = H_2NCONHCONH_2]$, respectively are:
 - (a) (octahedral, high-spin) and (square planar, low-spin).
 - (b) (octahedral, low-spin) and (square planar, low-spin).
 - (c) (trigonal prismatic, high-spin) and (tetrahedral, high-spin).
 - (d) (trigonal prismatic, low-spin) and (tetrahedral, high-spin).
- Q.77 The active site structure for oxy-hemerythrin is:



Q.78 Consider the following statements with respect to the base hydrolysis of $[CoCl(NH_3)_5]^{2+}$ to $[Co(NH_3)_5(OH)]^{2+}$:

- A. One of the ammonia ligands acts as a Bronsted acid.
- B. The entering group is water @dalalinstitute.com, +91-9802825820)
- C. A hepta-coordinated Co³⁺ species is an intermediate. Stitute CO

The correct statement(s) is/are

- (a) A & B
- (b) A & C
- (c) B & C
- (d) C only

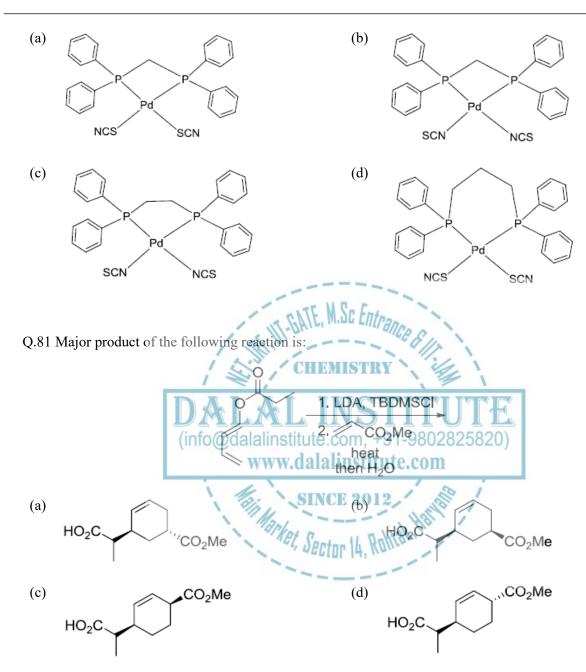
Q.79 The number of inorganic sulphides in cubane like ferredoxin and their removal method, respectively, are?

- (a) Eight and washing with an acid
- (b) Four and washing with a base

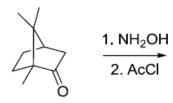
- (c) Eight and washing with a base
- (d) Four and washing with an acid

Q.80 Considering the ambidentate behaviour of thiocyanate ion, the most stable structure among the following is?



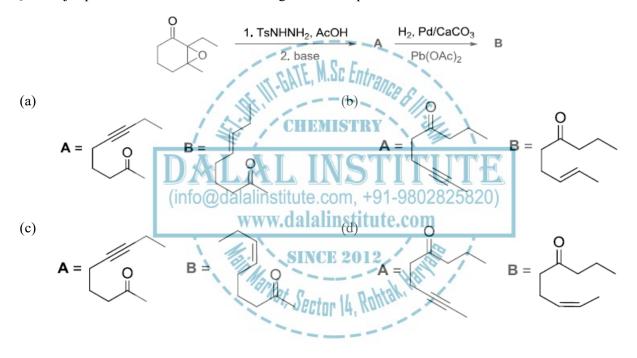


Q.82 Major product in the following reaction is:





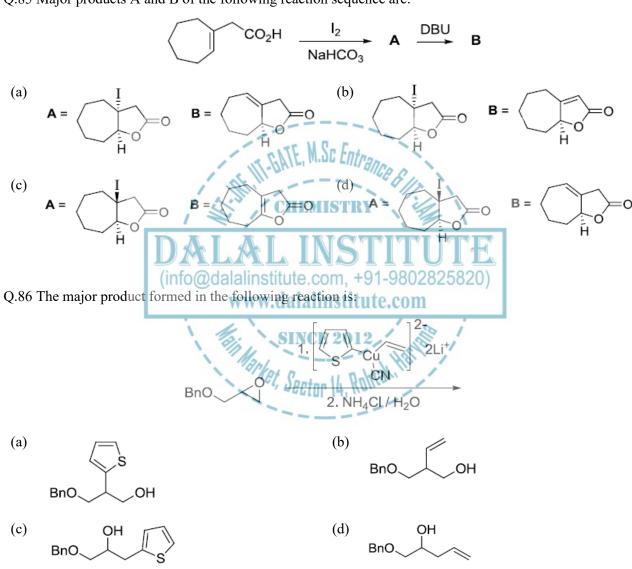
Q.83 Major products A and B of the following reaction sequence are:



Q.84 The major product formed in the following reaction is:

$$(c) \qquad \qquad (d) \qquad \qquad CI$$

Q.85 Major products A and B of the following reaction sequence are:



Q.87 Correct sequence of reagents (i)-(iii) required for the conversion of A to B is:

- (i) Thionyl chloride, (ii) 4-Chloropyridine, (iii) Piperidine
- (a) (i), (ii) and (iii)
- (b) (i), (iii) and (ii)
- (c) (ii), (i) and (iii)
- (d) (iii), (i) and (ii)

Q.88 The following reaction involves:

- (a) [1,2] sigmatropic rearrangement
- (b) [2,3] sigmatropic rearrangement
- (c) [3,3] sigmatropic rearrangement
- (d) C-H insertion reaction
- Q.89 Correct sequence of steps involved in the following transformation is:

- (a) Michael addition, aldol condensation, syn-elimination, keto-enol tautomerism.
- (b) Aldol condensation, electrocyclic ring closing, syn-elimination, dehydrogenation.
- (c) Michael addition, Claisen condensation, anti-elimination, keto-enol tautomerism.
- (d) Robinson annulation, dehydrogenation, anti-elimination.
- Q.90 The major products A and B in the following reaction sequence are:



(a)
$$\mathbf{A} = \bigcup_{\mathbf{COOH}} \mathbf{NEt}_2$$
 $\mathbf{B} = \bigcup_{\mathbf{COOH}} \mathbf{COOH}$

(b)
$$A = \bigcup_{i=1}^{N} NEt_2$$
 $B = \bigcup_{i=1}^{N} NEt_2$

(c)
$$A = \bigcup_{N \in \mathcal{L}_2} A = \bigcup_{$$

(d)
$$A = \bigcup_{N \in \mathcal{L}} B = \bigcup_{N \in \mathcal{L}} M.Sc. Entrance$$

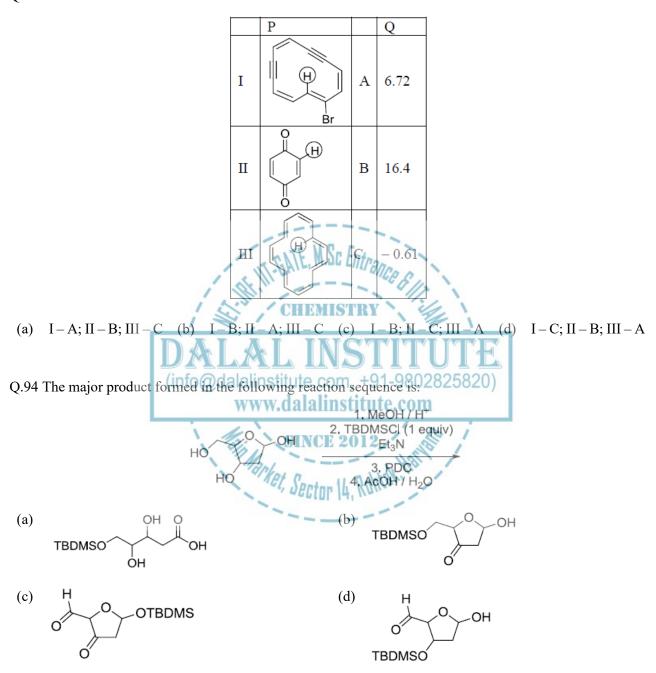
Q.91 The major product formed in the following reaction sequence is: 2825820)

www.daiaH₂O₂(AcOH.CO) 2. HNO₃, H₂SO₄ SI₃. PCI₃²012

- Q.92 The number of optically active stereoisomers possible for CH₃-CH(OH)-CH(OH)-CH(OH)-CH₃ is?
- (a) Two
- (b) Four
- (c) Six

(d) Eight

Q.93 The correct match of the circled protons in Column P with the ^{1}H NMR chemical shift (δ ppm) in Column Q is:



Q.95 For the successful synthesis of peptide linkage leading to the product A, the side chain of the amino acid B should have:

(a) XH = -OH

(b) $XH = -(CH_2)_4NH$

(c) $XH = -p-(C_6H_4)OH$

(d) XH = -SH

Q.96 The major products A and B in the following reaction sequence are:

Q.97 The intermediate A and the major product B in the following reaction are:

OMe
Br
$$\xrightarrow{1. \text{LDA (1 equiv.)}}$$
 [A] $\xrightarrow{2. \text{MeO}_2\text{C}}$ CO₂Me

(a) OMe
$$CO_2Me$$
 $B = CO_2Me$ CO_2Me CO_2Me (b) OMe CO_2Me CO_2Me

Q.99 In the following transformation, the mode of electrocyclization A and the major product B are:

(a)
$$\mathbf{A} = (4n) e^{-}, dis$$
 $\mathbf{B} = \begin{bmatrix} \mathbf{H} & \mathbf{O} \\ \mathbf{H} & \mathbf{O} \end{bmatrix}$

(b)
$$\mathbf{A} = (4n+2) e^{-}, dis$$
 $\mathbf{B} = \begin{bmatrix} \mathbf{H} & OH \\ H & OH \end{bmatrix}$

(c)
$$A = (4n) e^{-}, con$$
 $B = \begin{bmatrix} H & OH \\ OH & OH \end{bmatrix}$ CHEMISTRY

Q.100 The major products A and B in the following reaction sequence are:

(a)
$$\mathbf{A} = \text{n-Bu} \longrightarrow_{B(OH)_2} \mathbf{B} = \text{n-Bu}$$

(b)
$$\mathbf{A} = \text{n-Bu} \longrightarrow_{B(OH)_2} \mathbf{B} = \text{n-Bu}$$

(c)
$$\mathbf{A} = \text{n-Bu} B(\text{OH})_2$$
 $\mathbf{B} = \text{n-Bu}$

(d)
$$\mathbf{A} = \text{n-Bu}$$
 $\mathbf{B}(\text{OH})_2$ $\mathbf{B} = \text{n-Bu}$

Q.101 The correct statement about the symmetry of the eigenfunctions of a quantum of 1-D harmonic oscillator is?

- (a) All the eigenfunctions are only even functions, because the potential is an even function.
- (b) All the eigenfunctions are only odd functions, although the potential is an even function.
- (c) The eigenfunctions have no odd-even symmetry.
- (d) All the eigenfunctions are either odd or even functions, because the potential is an even function.

Q.102 The correct statement about the difference of second and first excited state energies (ΔE) of a particle in 1-D, 2-D square and 3-D cubic boxes with same length for each, is?

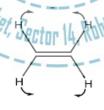
- (a) ΔE (1-D box) = ΔE (2-D box) = ΔE (3-D box) \Box (b) ΔE (1-D box) > ΔE (2-D box) > ΔE (3-D box)
- (c) $\Delta E \text{ (1-D box)} > \Delta E \text{ (2-D box)} = \Delta E \text{ (3-D box)}$ (d) $\Delta E \text{ (1-D box)} < \Delta E \text{ (2-D box)} < \Delta E \text{ (3-D box)}$

CHEMISTRY

Q.103 A one-dimensional quantum harmonic oscillator is perturbed by a potential λx^3 . The first order correction to the energy for the ground state ($\Delta E^{(1)}$) is?

(a) $(\Delta E^{(1)}) > 0$ but < 1 (b) $(\Delta E^{(1)}) < 0$ titute $CO(c) + (\Delta E^{(1)}) = 0$ 825820) (d) $(\Delta E^{(1)}) > 2$

Q.104 The normal mode of ethylene represented, by the figure below, is



(a) Only IR active

(b) Only Raman active

(c) Both IR & Raman active

(d) None

Q.105 The pair that contains a spherical top and a symmetric top, among the following, is?

- (a) CH₄, CH₂Cl₂
- (b) CH₂Cl₂, CH₃Cl
- (c) CH₃Cl, CH₄
- (d) CH_4 , $C(CH_3)_4$

Q.106 A part of the character table of a point group (of order 4) is given below:

	Е	X_{1}	X_2	X_3
Γ_{1}	1	1	1	1
Γ_2	1	- 1	1	- 1
Γ_3	1	- 1	- 1	1
Γ_{4}	?	?	?	?

The four characters of Γ_4 are, respectively?

- (a) 1, 1, -1, -1
- (b) 2, 0, 0, 1
- (c) 1, i, i, 1
- (d) 1, -i, i, -1

Q.107 The electronic transition energy from $\pi_1 \to \pi_2$ in propenyl radical is 4.8 eV. Within the frame work of Huckle theory, the transitions energy from $\pi_1 \to \pi_3$ would be?

- (a) 2.4 *eV*
- (b) 4.8 *eV*
- (c) 9.6 *eV*
- (d) 14.4 *eV*

Q.108 The g-factors of ¹H and ¹³C are 5.6 and 1.4 respectively. For the same value of the magnetic field strength, if the ¹H resonates at 600 MHz, the ¹³C would resonate at?

- (a) 2400 MHz
- (b) 600 MHz (c) 150 N

38 MHz

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Q.109 The term symbol for the ground state of a metal ion is ³P₂. The residual entropy of a crystal of a salt of this metal ion at 0 K is?

- (a) $k_B \ln 1$
- (b) $k_B \ln 3$
- $\begin{array}{ccc} \textbf{CE 2012} \\ \textbf{(c)} & k_B \ln 5 \end{array}$
- (d) $k_B \ln 7$

Q.110 In stretching of a rubber band, dG = VdP - SdT + fdL. Which of the following relations is true?

- (a) $\left(\frac{\partial S}{\partial L}\right)_{R,T} = -\left(\frac{\partial f}{\partial T}\right)_{R,T}$
- (b)
- $\left(\frac{\partial S}{\partial L}\right)_{P,T} = -\left(\frac{\partial f}{\partial V}\right)_{P,L}$

- (c) $\left(\frac{\partial S}{\partial L}\right)_{P,T} = -\left(\frac{\partial V}{\partial T}\right)_{P,L}$
- (d) $\left(\frac{\partial S}{\partial L}\right)_{PT} = -\left(\frac{\partial f}{\partial P}\right)_{PT}$

Q.111 Four distinguishable molecules are distributed in energy levels E_1 and E_2 with degeneracy of 2 and 3, respectively. Number of microstates, with 3 molecules in energy level E_1 and one in energy level E_2 , is

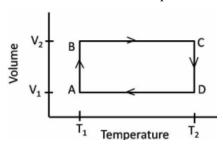
(a) 4

(b) 12

(c) 96

(d) 192

Q.112 One mole of an ideal gas undergoes a cyclic process (ABCDA) starting from point A through 4 reversible steps as shown in the figure. Total work done in the process is:



(a)
$$R(T_1 - T_2)V_2/V_1$$

(b)
$$R(T_1 + T_2)V_2/V_1$$

(c)
$$R(T_1 + T_2) \ln V_2/V_1$$

(d)
$$R(T_1 - T_2) \ln V_2/V_1$$

Q.113 If the specific conductance of an electrolyte solution is $0.2~\Omega^{-1}~\rm cm^{-1}$ and cell constant is $0.25~\rm cm^{-1}$, the conductance of the solution is

(a)
$$1.25 \Omega^{-1}$$

(b)
$$1.0 \Omega^{-1}$$

(c)
$$0.8 \Omega^{-1}$$

(d)
$$2.0 \ \Omega^{-1}$$

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Q.114 The predicted electromotive force (emf) of the electrochemical cell is: 820) $Fe(s)/Fe^{2+}(aq)(0.01M)/Cd^{2+}(aq)(0.01M)/Cd(s)$ alalinstitute com

$$(E^{0}_{(Fe2+/Fe)} = -0.447 \ V \& E^{0}_{(Cd2+/Cd)} = -0.403 \ V)$$

(a)
$$-0.850 V$$

(b)
$$+ 0.044 J$$

(c)
$$+0.0850 V$$

(d)
$$-0.044 V$$

Q.115 A polymer has the following molar mass distribution

Number of molecules	Molar mass (g.mol ⁻¹)
50	5000
75	6000

The calculated number average molar mass \overline{M}_n of the polymer is?

(a) 5200

(b) 5600

(c) 5800

(d) 6000

Q.116 The separation of the (123) planes of an orthorhombic unit cell is 3.12 nm. The separation of (246) and (369) planes are, respectively?

(a) 1.56 nm and 1.04 nm

(b) 1.04 nm and 1.56 nm

(c) 3.12 nm and 1.50 nm

(d) 1.04 nm and 3.12 nm

Q.117 The slope and intercept obtained from (1/Rate) against (1/substrate concentration) of an enzyme catalysed reaction are 300 and 2×10^5 , respectively. The Michalis-Menten constant of the enzyme in this reaction is

- (a) $5 \times 10^6 \,\mathrm{M}$
- (b) $5 \times 10^{-6} \,\mathrm{M}$
- (c) $1.5 \times 10^3 \,\mathrm{M}$
- (d) $1.5 \times 10^{-3} \,\mathrm{M}$

Q.118 The pressure inside (P_{in}) a spherical cavity with a radius r formed in a liquid with surface tension γ is related to the external pressure (P_{out}) as?

(a)

$$P_{in} = P_{out} - \frac{2\gamma}{r}$$

$$P_{in} = P_{out} + \frac{2\gamma}{r}$$

(c) $P_{in} = P_{out} - \frac{\gamma}{r}$

$$P_{in} = P_{out} + \frac{\gamma}{r}$$

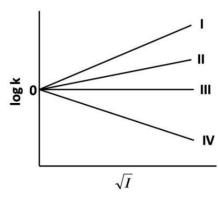
Q.119 Reaction between A and B is carried out for different initial concentrations and the corresponding half-life times are measured. The data are listed in the table:

Entry	$[A]_0(\mu M)$	$[B]_0(\mu M)$	$t_{1/2}(sec)$
119	500	CE 4012	60
2	72500	-20	60
3	10, 50	500/1/1	dh 60
4	20	500	30

The rate can be represented as?

- (a) k[A][B]
- (b) $k[A]^2$
- (c) $k[A]^2[B]$
- (d) $k[A][B]^2$

Q.120 The plot of the rate constant vs. ionic strength of the reaction $A^{2+} + B^{-}$ follows the line (refer to the figure):



(a) I

(b) II

(c) III

(d) IV



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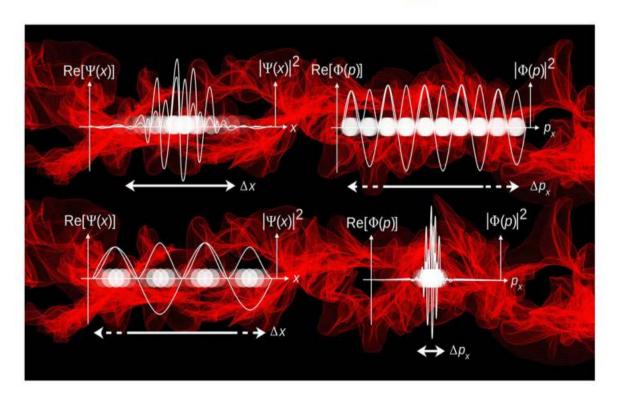
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