

JAM – 2015 – Chemistry



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7. The ene-yne that produces a chiral compound upon treatment with Lindlar's catalyst is



An organic compound $P(C_4H_8O)$ is positive to Bayer's test, but inert to sodium 8. metal. On treatment with conc. HCl, "P" gives CH₃CH₂Cl and CH₃CHO. The structure of **P** is



1.

2.

3.

4.

5.

6.

(a)

(a)



16. The Volhard method is used for the estimation of

(a) chloride ion (b) silver ion directly (c) oxygen in water (d) glucose in blood

17. The set of products formed in the following reaction is



JAM - 2015 - CY



(a) $CHBr_3$ and a racemic acid

(b) CHBr₃ and a chiral acid

3

(c) CHBr₃ and a racemic ester

- (d) CH_2Br_2 and a chiral ester
- 18. The correct set of reagents required for the following transformation is



(a) I > II > III > IV (c) III > II > I > IV

(b) II > I > III > IV (d) II > III > IV > I

(iv) Involves two transition states

(c) (i), (iii) and (iv)

- 21. Which of the following statements are correct for SNAr reaction?
 - (i) Follows second order kinetics (ii) $K_H/K_D > 1$
 - (iii) Involves carbanion-type intermediate
 - (a) (i) and (ii) (b) (ii) and (iii)

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(d) (i) and (iii)





22. According to the equipartition principle, the predicted high temperature limiting value of the molar heat capacity at constant volume for C_2H_2 is

23. The major product formed in the following reaction is



24. At 25 °C, the solubility product (K_{sp}) of CaF₂ in water is 3.2×10^{-11} . The solubility (in mole per kg of water) of the salt at the same temperature (ignore ion pairing) is

(a)
$$4.0 \times 10^{-6}$$
 (b) 3.2×10^{-4} (c) 2.5×10^{-4} (d) 2.0×10^{-4}

- 25. For an isothermal free expansion of an ideal gas into vacuum, which one of the following set of values is correct?
 - (a) $\Delta U = 0$, q > 0 , w < 0 (b) $\Delta U > 0$, q > 0 , w = 0

(c)
$$\Delta U = 0$$
 , $q = 0$, $w = 0$ (d) $\Delta U < 0$, $q = 0$, $w < 0$

26. The kinetics of the reaction 2N₂O₅ → 4NO₂ + O₂ in liquid bromine medium was measured independently for three different initial concentrations of N₂O₅:
0.11, 0.07 and 0.05 mol L⁻¹. The half-life of the reaction was found to be 4.5 hours for all these concentrations. The order of the reaction is

(a) 0
(b) 1
(c) 2
(d) 0.5

27. The concentration of K⁺ ion inside a biological cell is 20 times higher than outside. The magnitude of potential difference between the two sides is

		[Given: 2.303 RT/F = 59 mV]					
(a) 0 mV	(b) 26 mV	(c) 77 mv	(d) 177 mV				

28. The correct order of the fundamental vibrational frequencies of the following diatomic molecules is:

(a)	¹ H ³⁵ Cl	>	$^{1}\text{H}^{37}\text{Cl}$	>	$^{2}D^{35}Cl$	(b)	$^{2}D^{35}Cl$	>	$^{1}\text{H}^{37}\text{Cl}$	>	$^{1}\text{H}^{35}\text{Cl}$
(c)	$^{1}\text{H}^{37}\text{Cl}$	>	$^{1}\mathrm{H}^{35}\mathrm{Cl}$	>	$^{2}D^{35}Cl$	(d)	$^{1}\text{H}^{37}\text{Cl}$	>	$^{2}D^{35}Cl$	>	$^{1}\text{H}^{35}\text{Cl}$

29. Identify the correct reagents required for the following transformation



JAM - 2015 - CY



- (c) (i) $HOCH_2CH_2OH, H^+$; (ii) $LiAlH_4$; (iii) H_3O^+
- (d) (i) $\text{HSCH}_2\text{CH}_2\text{SH}, \text{H}^+$; (ii) LiAlH_4 ; (iii) H_3O^+
- The complex that is expected to show orbital contribution to the overall magnetic 30. moment is

(a) $[Cr(CN)_6]^{3-}$ (b) $[Co(H_2O)_6]^{2+}$ (c) $[Ni(en)_3]^{2+}$ (d) $[Cu(NH_3)_6]^{2+}$ Attempt ALL the questions. Q.31 – Q.40 Multiple Select Question (MSQ), carry TWO mark each (no negative marks).

- 31. The common feature(s) of Rb⁺, Kr and Br⁺ is/are
 - (a) have same number of valence electrons
 - (b) have same magnitude of effective nuclear charge
 - (c) have same magnitude of first ionization potential
 - (d) are isoelectronic species
- 32. The characteristics of the blue solution of sodium in liquid ammonia is/are (a) diamagnetic (b) paramagnetic (c) reducing in nature (d) conducts electricity
- 33. Which of the following statement(s) is/are true about the transition metal-alkene :маср complexes?
 - (a) Back-bonding weakens the double bond of the alkene
 - (b) σ -Bonding and back-bonding synergistically strengthen metal-alkene interaction
 - (c) Electron-withdrawing substituents on alkene reduce back-bonding
 - (d) π -Acidic co-ligands on metal strengthen back-bonding
- 34. Which of the following statement(s) is/are true about the reaction given below?



- (a) It involves a carbocation intermediate
- (b) Rearrangement is due to $S_N 1$ reaction mechanism
- (c) It proceeds via a concerted $S_N 2$ pathway
- (d) It involves neighbouring group participation





JAM-2015-CY

35. The reaction(s) which give(s) phenol is/are



36. Which of the following species is/are aromatic in nature?



37. Which of the following compound(s) show(s) only two signals in ¹H-NMR and a strong IR band at ~1690 cm⁻¹?



- 38. If $\hat{\mathbf{x}} = \mathbf{x} \times \text{and } \widehat{\mathbf{p}_{\mathbf{x}}} = \frac{\hbar}{2\pi i} \frac{d}{d\mathbf{x}'}$ then the value(s) of $\widehat{\mathbf{p}_{\mathbf{x}}} \hat{\mathbf{x}} \hat{\mathbf{x}} \widehat{\mathbf{p}_{\mathbf{x}}}$ is/are (a) $\frac{\hbar}{i}$ (b) $-i\hbar$ (c) 0 (d) $\frac{i}{\hbar}$
- 39. At what angle(s) of incidence, X-rays of wavelength 5.0 Å will produce diffracted beam from the (110) planes in a simple cubic lattice with a = 10 Å?

(a)
$$6.8^{\circ}$$
 (b) 10.2° (c) 20.7° (d) 45.0°

40. Which of the following thermodynamic relation(s) is/are correct?

(a)
$$\left(\frac{\partial T}{\partial V}\right)_{S} = \left(\frac{\partial P}{\partial S}\right)_{V}$$
 (b) $\left(\frac{\partial T}{\partial P}\right)_{S} = \left(\frac{\partial V}{\partial S}\right)_{P}$ (c) $\left(\frac{\partial S}{\partial V}\right)_{T} = \left(\frac{\partial P}{\partial T}\right)_{V}$ (d) $\left(\frac{\partial S}{\partial P}\right)_{T} = \left(\frac{\partial V}{\partial T}\right)_{P}$
Attempt ALL the questions. Q.41 – Q.50 Numerical Answer Type

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(NAT), carry ONE mark each (no negative marks).

- 41. Given that the crystal field stabilization energy for $[Co(H_2O)_6]^{2+}$ is 7360 cm⁻¹, the calculated value of Δ_0 in kJ mol⁻¹ is _____
- 42. The amount (in grams) of potassium dichromate (MW = 294) present in 75 mL of 0.16 M aqueous solution is _____
- 43. Given that the expected spin-only magnetic moment for $(Et_4N)_2[NiCl_4]$ is 2.83 μ_B , the total number of unpaired electrons in this complex is _____
- 44. The pK_a values of lysine are 2. 18, 8. 95 and 10. 79. The isoelectric point of lysine is _____
- 45. The amount (in grams) of NaOH (MW = 40) required for complete neutralization of one mole of the following compound is ______



46. In the given list, the total number of compounds that form a clear homogenous solution on treatment with cold dilute H₂SO₄ is _____

1-propyne	cyclohexanone	cyclohexane		
1-propene	propan-1-amine	propoxypropane		
tetrahydropyran	ethylbutanoate	pyridine		

- 47. In the gas phase, the ratio of excluded volume to molecular volume for a spherical molecule is _____
- 48. The pK_a values of H₃PO₄ are 2.12, 7.21 and 12.67. The pH of a phosphate buffer containing 0.2 M NaH₂PO₄ and 0.1 M Na₂HPO₄ is _____
- 49. For the reaction, $2SO_2 + O_2 \rightleftharpoons 2SO_3$, the equilibrium constant $K_P = 5.0$ at 207 °C. If the partial pressures of SO_2 , O_2 and SO_3 are 1.0×10^{-3} , 0.20 and 1.0×10^{-4} , respectively, then the Gibbs free energy of the reaction ($\Delta_r G$) in kJ mol⁻¹ at 207 °C is _____ [Given: $R = 8.314 \text{ JK}^{-1} \text{mol}^{-1}$]
- 50. Two moles of an ideal gas is expanded isothermally and reversibly from 5 to 1 bar at 298K. The change in the entropy (in JK^{-1}) of the system is

Attempt ALL the questions. Q.51 - Q.60 Numerical Answer Type



(NAT), carry TWO mark each (no negative marks).

- 51. The ionic radii of Cs⁺ and Cl⁻ ions are 181 and 167 pm, respectively. The Born exponents for the He, Ne, Ar, Kr and Xe configurations are 5, 7, 9, 10 and 12, respectively. If the value of $\frac{ANe^2}{4\pi\epsilon_0}$ is 2.45 × 10⁻⁴ J m, the lattice energy (in kJ mol⁻¹) of CsCl according to Born-Landé equation is ______
- 52. A 2.5×10^{-4} M solution of a complex exhibits an absorption maximum at 625 nm with an absorbance of 0.90 when measured in a cuvette with a path length of 1.5 cm. The absorbance of 1.5×10^{-3} M solution of the same complex recorded in a cuvette with a path length of 0.2 cm is _____
- 53. A wood specimen containing ¹⁴C taken from an ancient palace showed 24 counts in 3 minutes per gram of carbon in a detector. However, a fresh wood showed 52 counts in 2 minutes per gram of carbon. Assuming no background signal in the detector and half-life of ¹⁴C as 5730 years, the age (in years) of the wood specimen is ______
- 54. The magnetic field (in Tesla) required for flipping a ¹H nucleus in an NMR spectrometer operating at 400 MHz is______
- [Given: γ = 2.67 × 10⁸ T⁻¹ s⁻¹, π = 3.14]
 55. The total number of compounds (shown below) that form phenylhydrazone derivatives under acidic conditions is ______



- 56. The number of possible monoalkylated products formed in the Friedel-Crafts reaction of anisole with 2-chloro-3-methylbutane in the presence of anhydrous AlCl₃ at 50 ℃ is _____
- 57. For a reaction, the rate constant at 25 °C is doubled when the temperature is raised to 45 °C. The activation energy (in kJ mol⁻¹) of the reaction is _____

[Given: ln2 = 0.693]

8

58. The standard reduction potentials of the Fe^{3+}/Fe^{2+} and Fe^{2+}/Fe couples are 0.77



JAM-2015-CY

and -0.44 V, respectively. The standard reduction potential (in V) for the Fe³⁺/Fe couple is _____

- 59. When a perfect monolayer of stearic acid is formed at the air-water interface, each molecule of stearic acid (MW = 284, density = 0.94 gcm^{-3}) occupies an area of 20 Å². The length (in Å) of the molecule is _____
- 60. In an ideal monoatomic gas, the speed of sound is given by $\sqrt{\frac{5RT}{3M}}$. If the speed of sound in argon at 25 °C is 1245 km h⁻¹, the root mean square velocity in m s⁻¹ is

Q.No	Ans	1	Q.No	Ans		Q.No	Ans	
1.	b	YI	21.	С	Ľ.F	41.	109.0 to 111.0	
2.	d	CS	22.	d		42.	3.52 to 3.54	
3.	с		23.	а	15	43.	2 to 2	
4.	b		24.	d		44.	9.0 to 10.0	
5.	а		25.	С		45.	160 to 160	
6.	с		26.	b		46.	4 to 4	
7.	b		27.	С		47.	8 to 8	
8.	b		28.	а		48.	6.9 to 7.0	
9.	b	X	29.	С		49.	-18.5 to -18.3	
10.	с	1	30.	b	5	50.	26.5 to 27.0	
11.	d		31.	a & d		51.	-638.0 to -636.0	
12.	b		32.	b & c & d		52.	0.70 to 0.74	
13.	b		33.	a & b		53.	9600 to 9900	
14.	d		34.	c & d		54.	9.0 to 10.0	
15.	b		35.	a & b & c & d		55.	5 to 5	
16.	a		36.	a & b & c		56.	4 to 4	
17.	b		37.	a & d		57.	27.0 to 27.6	
18.	С		38.	a & b		58.	-0.04 to -0.03	
19.	С		39.	c & d		59.	24 to 26	
20.	b		40.	b & c		60.	462 to 465	

An	swer Key	
S. ME	Ser.	Ľ

Q. 1 – 10	1 Mark			Q. 41 – 50	1 Mark
	(MCQ)				(NAT)
Q. 11 – 30	2 Mark	Q. 31 – 40	2 Mark	Q. 51 – 60	2 Mark
	(MCQ)		(MSQ)		(NAT)





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