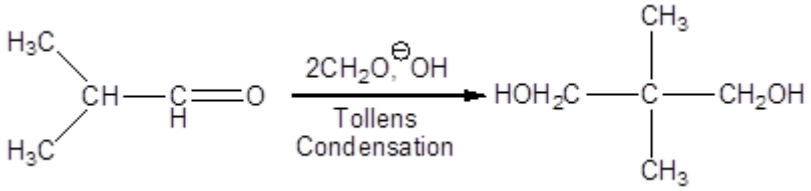
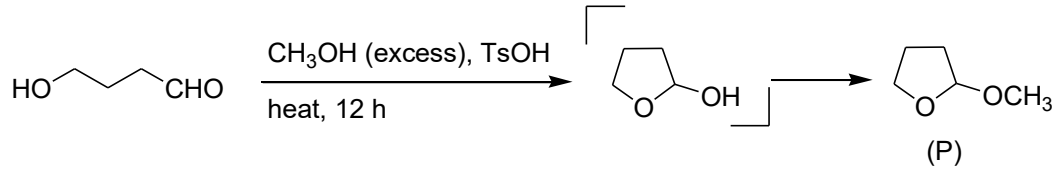
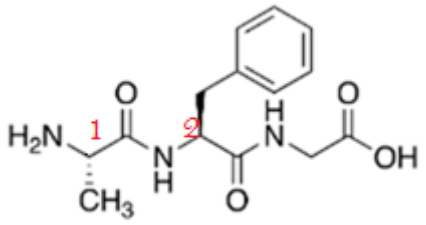
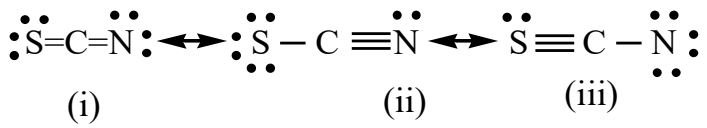
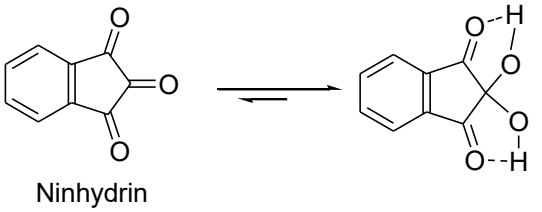
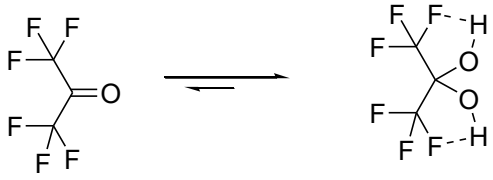
	IOQC 2021-22 Part-I (NSEC 2021-22)
	SOLUTION PAPER CODE - 31
	SECTION A-1
1	The magnitude of CFSE depends upon- (1) Geometry of the complex (Octahedral complexes have higher CFSE than Tetrahedral complexes), (2) Oxidation state of metal (higher the oxidation state, larger the CFSE), (3) Size of metal (5d metal have higher CFSE than 4d which have larger CFSE than 3d metals) and (4) Nature of ligand (stronger the ligand, larger is the CFSE). On the basis of 1, 2 and 3 factors. **Correct Option (a)**
2.	The set of which contains all polar solvents is (p)1,2-dibromobenzene (s) 1,2-dichloroethane (t) N-ethyl-N-methylpropan-1-amine **Correct Option: (a)**
3.	First order reaction need not be unimolecular. Order is experimentally determined and it is not related with molecularity. **Correct option: (c)**
4.	Colour is due to charge transfer transitions in both the cases. In both compounds, the oxidation state of Cr is +6 i.e., d^0 configuration. Hence d-d transition is not possible. **Correct option: (c)**
5.	K.E. $= \frac{3}{2} kT,$ hence K.E (Ne) $= \frac{3}{2} kT$ *and* for K.E. (Ar) $= \frac{3}{2} k(2T) = 3kT$ Thus K.E. will be twice in II (Ar) than in I (Ne). $\nu_{av.} = \sqrt{\frac{8RT}{\pi M}}$, for ν_{av} (Ne) $= \sqrt{\frac{8RT}{\pi 20}}$ for ν_{av} (Ar) $= \sqrt{\frac{8R(2T)}{\pi 40}} = \sqrt{\frac{8RT}{\pi 20}}$ $V_{av\ (Ne)} = V_{av\ (Ar)}$ Average velocity for both I and II will be same. **Correct option: (c)**
6.	The anion obtained from 2-methylcyclohexane-1,3-dione will undergo Michael type addition reaction with 3-buten-2-one. The Michael addition product will undergo intramolecular aldol condensation reaction to yield the Wieland-Miescher ketone. **Correct option: (b)**
7.	2-methylpropanal will undergo cross-aldol condensation followed by cross- cannizaro reaction. **Correct Option (a)** 
8.	1 mole of K salt of dibasic acid = 2 moles of K 0.805 g of salt = 0.323 g of K

	X g of salt = 39 x 2=78g of K hence X = 194 Mol wt of salt of acid =194 hence Mol wt acid = 194-78+2 =**118 g/mol** **Correct Option (c)**
9.	Disproportionation reactions are those redox reactions in which an element undergoes both oxidation and reduction. Any element in its highest or lowest oxidation state cannot show disproportionation reactions. In HCl and $HOClO_3$ the Cl atoms are in lowest oxidation state (-1) and highest oxidation state (+7) respectively. Hence (i) and (iv) cannot show disproportionation reactions. While Cl atom in HOClO (ii) and $HOClO_3$ (iii) have intermediate oxidation states of +3 and +5 respectively, hence can show disproportionation reactions. **Correct option (c)**
10.	$\frac{1}{\lambda} = R_H Z^2 [\frac{1}{n1^2} - \frac{1}{n2^2}]$ substituting Z =2 for He^+ and n = 4 and n = 2 we get: $\lambda = \frac{4}{3\,RH}$ $\frac{1}{\lambda} = R_H Z^2 [\frac{1}{n1^2} - \frac{1}{n2^2}]$ substituting Z =1 for H and n = 2 and n = 1 we get: $\lambda = \frac{4}{3\,RH}$ λ is same for Hydrogen n = 2 to n = 1and for He^+ n = 4 to n = 2. **Correct option: (d)**
11.	Intramolecular cyclisation will lead to the formation of a hemi acetal. This product will be converted to acetal, C on treatment with excess Methanol in presence of TsOH. **Correct option : (c)**  (P)
12.	The option (a) has 2 optical stereoisomers- d and l. Option (b) has 2 geometrical isomers- cis and trans. The cis isomer exists in d and l forms while trans is optically inactive, hence a total of 3 stereoisomers. Option (c) has 3 geometrical isomers-one cis and two trans. The cis isomer exists in d and l forms while both the trans isomers are optically inactive, hence a total of 4 *stereoisomers.* Option (d) has 2 geometrical isomers- facial and meridional, hence a total of 2 stereoisomers **Correct option : (c)**
13.	\When total nodes are 3, then the subshells will be 4s (Radial node = 3 + Angular node = 0), 4p (RN = 2 + AN = 1), 4d (RN = 1 + AN = 2) and 4f (RN = 0 + AN = 3). There will be 2 for 4s, 6 for 4p, 10 for 4d and 14 for 4f electrons i.e. 32 electrons. Half of it, that is 16 electrons will have m_s = ½. RN = n-l-1, AN = l. (n = principal quantum no, l = azimuthal quantum no.) **Correct option : (b)**
14	Since the compound 'X' responds to Hinsberg test to produce a solid compound, Y. 'Y' is insoluble in 10% aq. NaOH. However, the compound gets dissolved in 10% aq. sulfuric acid. Considering all such conditions, b is the best option. **Correct option : (b)**
15	M^{3+} has same no. of electrons to that of $CuCl_2$= (29+34) = 63 So, atomic no. (Z) of M^{3+} = (63+3) = 66 = (no. of protons (P) in M^{3+})

	No. of neutrons(N) in M^{3+} = (Z+2) = (66+2) = 68 Therefore, ionic mass of M^{3+}= (P+N) = (66+68) = 134 **Correct option : (d)**
16.	 There are two chiral centers marked red in the structure and two peptide linkages represented by two -CO-NH- hence **Correct option: (c)**
17	Reaction (a) is simply a redox reaction. Since no transaction of lone pair is involved, it is not Lewis acid-Lewis base type reaction. **Correct option: (a)**
18.	19.1025 mg KCl is required to be dissolved in 1000 ml of water to get10 ppm K^+ solution. Now when 19.1025 mg happens to be KNO_3 salt instead of KCl then the concentration K^+ ions in the solution will be =19.1025x39/101= 7.37 mg/1000 ml =7.37 ppm. **Correct Option (a)**
19	The set of oxide in which A is soluble in NaOH , B in HCl and C in both are b or c. **Correct Option (b) or (c)**
20	H of -OH marked '3' is more acidic because its conjugate base formed will be more resonance stabilized. Since it is more acidic hence it will have lower Pka. **Correct Option: (c)**
21	The molecule must have –CHO as well as CH_3–CO both present in its structure to give Silver mirror test and yellow precipitate with I_2/NaOH. Hence (d) 2,2-dimethyl-4-oxopentanal is the best option. **Correct option: (d)**
22	$E_{cell} = E^0_{cell} - \frac{0.0592}{n} \log \frac{[Oxi]}{[Red]}$ $E_{cell} = E^0_{cell} - \frac{0.0592}{n} \log 1 \times 10^{-3}$ $E_{cell} - E^0_{cell} = - \frac{0.0592}{n} (-3)$ $E_{cell} - E^0_{cell} = 3. \frac{0.0592}{n}$ **Correct Option (b)**

23	Among the following numbers, the one in which all the zeros are significant is (a) 0.0004 (b) 0.0400 (c) 40.000 (d) 0.0040 **Correct Option (c)**
24	butanal and phenylmagnesium bromide followed by hydrolysis gives 1-phenyl-2-butanol. **Correct Option (b)**
	SECTION A-2
25	(a)To compare molarities in (I) and (II),we need to know the masses of both the solutions --- this statement is incorrect, because information given at the beginning of the question is good enough to know the molarities (b)Molalities cannot be compared without measuring the mass of water added in each case -----it is incorrect statement as volume of water added was same in both the cases. (c)If (I) and (II) are completely poured into another container (III), [Cl^-] in (III) will be sum of that in (I) and (II) -----this is an incorrect statement, because volume of [Cl -] solution formed by mixing (I) and (II) will be different. (d)Information given is sufficient to compare the vapour pressure in (I) and (II)---------- **is correct**, as lowering of vapour pressure is directly proportional to mole fraction of the solute. **Correct option (d)**
26.	The pairs which give above set of reactions are (b) cyclopentene and 1-methylcyclobutene (c) 1-methylcyclobutene and 3-methylcyclobutene **Correct options: b, c**
27.	 (i) (ii) (iii) Statement (b) In structure (iii), the charge on S is +1 and statement (c) -- The degree of contribution of these structures is in the order: i > ii > iii are wrong statements. **Correct options: b or b, c**
28	Ninhydrin (a) and 1,1,1,3,3,3-hexafluoropropan-2-one (c) will form stable hydrates due

	to their capability to take part in intramolecular Hydrogen bonding. **Correct option: Answer: a, c**  Ninhydrin 
29	The molecule 'X' is of *R*- configuration. This matches with both a and c. **Correct options: a, c**
30	(a) In II and IV ΔS is zero ----- incorrect, because temperature of the system increases and hence the entropy. (b) For I and III, ΔS is zero ---- correct, as they are isentropic processes (c) I and III are isothermal and reversible ------- incorrect, as the process is adiabatic and reversible (d) In II and IV, change in internal energy of the gas (ΔU) is zero – incorrect, as II and IV are isobaric, change in internal energy of the gas (ΔU) will not be zero. **Correct option: b**
31	The difference in % 's' character of various phosphorous bonds could be due to- The larger size of bromine atom and increased overlap of σ-orbitals of terminal P-O bond. **Correct options: a, c**
32	The correct statement(s) are (b) It reacts with singlet oxygen, an excited form of O_2, to produce an epoxide and (d) It comes in the oil phase when carrots are cooked in oil and water in a curry **Correct options: b, d**