

Set 1 (IQOC2021S1)

Q	Ans	Solution
1	a	$B_2H_6 \cdot 2NH_3$ is formed by the unsymmetrical cleavage of diborane molecule. Both the cation and anion are tetrahedral in shape and hence 'B' will be sp^3 hybridised
2	c	(i) $P_4 + Cl_2(g) \rightarrow PCl_3(\text{liquid})$ and $PCl_5(\text{solid})$. Hence $Q(l)$ is PCl_3 (ii) $Q(l) + O_2(g) \rightarrow R(l) + PCl_3 + O_2 \rightarrow POCl_3(\text{liquid}) + H_2O$ $PCl_5 + O_2 \rightarrow P_2O_5(\text{solid})$. Hence $R(l)$ is $POCl_3$ (iii) $P_4 + O_2(323\text{ K}) \rightarrow S(s)$; $P_4 + 5O_2 \rightarrow P_4O_{10}$. Only this product can be formed at 323 K. Hence $S(s)$ is P_4O_{10} (iv) $S(s) + H_2O(l) \rightarrow T(aq)$; $P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$. Hence $T(aq)$ is H_3PO_4
3	b	$Fe(CO)_5$ has trigonal bipyramidal geometry. For TBP geometry, corresponding hybridisation in this case is dsp^3 . The participating 'd' orbital in this type of hybridisation leading to a TBP geometry is dz^2
4	d	Based on the properties of 'p' block elements
5	c	Arrhenius equation and concept of catalysis
6	b	Intramolecular aldol condensation followed by haloform reaction and filtration
7	b	Based on Lewis dot structures- six structures (maximum) possible for the sulphate ion
8	d	No of mmoles of $H_2SO_4 = 517.3$; No of mmol of $OH^- = 1034.6$; If 'y' is the weight of Na in the mixture, $32000 = 23y + (1034.6 - y) 39$; $y = 521.8$; Hence weight of Na = $(521.8 \times 23) / 1000 = 12\text{g}$
9	b	Let masses of H_2O and H_2 be 1 and 1.5 g $K_c = (1.5/2)^4 / (1/18)^4 = 3.32 \times 10^4$
10	b	Both the molecules contain a chiral center. In presence of a base, 2-methylcyclopentanone will undergo racemization via the formation of an achiral enolate intermediate. Hence optical rotation disappears. With NH_2NH_2 / KOH at high temperature, the carbonyl group gets reduced. The final product does not have a chiral center. Hence no optical rotation is observed.
11	a	The linear oligomer synthesized by linking <i>ten</i> glycine molecules is $10 \times [C_2H_5O_2N] - 9 \times [H_2O] = C_{20}H_{32}O_{11}N_{10}$
12	a	The complex $[NiCl_2Br_2]^{2-}$ is tetrahedral, paramagnetic with two unpaired electrons and cannot show geometrical and optical isomerism. The complex $[PtCl_2Br_2]^{2-}$ is square planar, diamagnetic and can show cis-trans isomerism.
13	b	Colour of the gas evolved is reddish brown and the aqueous solution is

		basic And the solid is less soluble Hence LiNO_3 is the correct choice
14	a	Le Chatelier principle
15	c	$4 \text{AgNO}_3 + 2 \text{H}_2\text{O} + \text{H}_3\text{PO}_2 \rightarrow \text{HNO}_3 + \text{H}_3\text{PO}_4$ Answers obtained from the stoichiometric equation given above $(6.8 \times 108) / 4 \times 170 = 4.32 \text{g Ag}$; $6.8 \times 1 / 4 \times 170 = 0.01$ moles of H_3PO_2
16	a	Can be arrived at from the structure
17	c	XeO_3 – polar; XeOF_4 – polar; XeF_2 – non polar; XeF_4 – non polar; XeO_4 – non polar
18	b	$1 \text{ dm}^3 = 1000 \text{ mL}$. Hence the answer
19	d	Alkylation, followed by formation of RMgBr Replacement of RMgBr by H gives the product
20	c	Based on Nernst equation Positive value of E (electrode potential) is obtained only in option c
21	d	Compound (i), an aromatic amide, when heated with NaOH liberates NH_3 which turns moist turmeric paper brown. Compound (ii) has RCOCH_3 functionality and forms iodoform (yellow precipitate) when treated with NaOH and I_2 . Compound (iii), a secondary amine, forms a yellow oil when treated with NaNO_2 , HCl at 0°C . Compound (iv) with phenolic- OH gives colouration with FeCl_3
22	b	$N_1 V_1 = N_2 V_2$; NaHC_2O_4 solution = 0.1 M $\text{C}_2\text{O}_4^{2-}$ is oxidized to CO_2 by KMnO_4 . $\text{M C}_2\text{O}_4^{2-} = 0.2 \text{ N HC}_2\text{O}_4^-$ $10 \times 0.2 = 10 \times N^1 (\text{MnO}_4^-)$ $N^1 = 0.2$ MnO_4^- is reduced to Mn^{2+} . Hence, $\text{M}(\text{MnO}_4^-) \times 5 = N^1$ Hence Molarity of $\text{MnO}_4^- = 0.04 \text{ M}$
23	d	Brevicommin is a cyclic ketal. This molecule can be synthesized from the open chain ketodiol, 6,7-dihydroxynonan-2-one
24	a	Reduction of $-\text{CN}$, followed by successive methylation and Hoffman elimination
25	b, c	Intermolecular forces and size of the molecule
26	b, d	Concept of molarity, pH and Henderson equation Only in options b and d, pH is 4.0- 5.0
27	a, d	Second IE of He is same as the first IE of He^+ (H like atom) For a H like atom, $E_n = - z^2 \times 13.61/n^2$. Here $z = 2$ and $n = 1$ Dependence of IE on atomic radius and electronic configuration
28	a, b, d	Product 'a' due to anti addition of Br_2 on any one of the two olefinic units

		(formation of a cyclic bromonium ion) Both 'b' and 'd' will be formed due to resonance stabilized allylic carbocation formation. Product 'c' cannot be formed because addition leading to its formation is not possible
29	c,d	Electronic configuration and MO theory. S ₂ has two unpaired electrons In both N ₂ ⁺ and N ₂ ⁻ , there is one unpaired electron on one of the N atoms.
30	a,d	Water is a weaker acid than nitromethane (data given). After the nucleophilic attack of the carbanion obtained from nitromethane to the carbonyl functionality of 2-methyl cyclohexanone, a diastereomeric mixture will be obtained.
31	a,b,c,d	All answers can be derived as correct from the structures given
32	c,d	Since the kinetic curves for both samples are different in zones 1 and 2, the virus must be reacting with different entities in these two zones From the plots it can be seen that almost 95 % inactivation happens within 10h