

Date: 06/02/2021

Test Booklet Code

31



Aakash

Medical | IIT-JEE | Foundations

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Questions & Answers

Time : 1 hr

for

Max. Marks : 120

International Olympiad Qualifier (Part I) in CHEMISTRY (IOQC) 2020-21

INSTRUCTIONS TO CANDIDATES

- (1) There are 32 objective type questions. Out of 32 questions, 24 questions in **Part A1** and 8 questions in **Part A2**. All questions are compulsory.
- (2) In **Part A1** each question has four options out of which only one is correct.
- (3) For **Part A1**, each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer.
- (4) In **Part A2** each question has four options out of which any number of option(s) (4,3, 2 or 1) may be correct.
- (5) For **Part A2**, each correct answer carries 6 marks if all correct options are marked and no wrong option. No negative marking for this part.

PART-A1

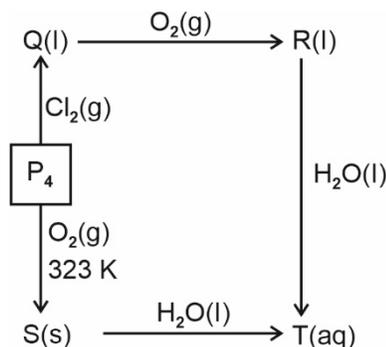
1. Reaction of ammonia with diborane gives an ionic product ($B_2H_6 \cdot 2NH_3$). The hybridization of boron in the cation and anion of this product are respectively

- (a) sp^3 in both
(b) sp^3 and sp^2
(c) sp^2 and sp^3
(d) sp^2 in both

Answer (a)

2. A sequence of reactions of phosphorous (P_4) is given below

The correct set of products (Q, R, S and T) among the following is



- (a) Q = PCl_3 ; R = $POCl_3$; S = P_2O_3 ; T = H_3PO_3
(b) Q = PCl_5 ; R = P_2O_5 ; S = P_4O_6 ; T = H_3PO_3
(c) Q = PCl_3 ; R = $POCl_3$; S = P_4O_{10} ; T = H_3PO_4
(d) Q = PCl_5 ; R = P_4O_{10} ; S = P_4O_{10} ; T = H_3PO_4

Answer (c)

3. In the gaseous state of $Fe(CO)_5$, the 'd' orbital that would participate in hybridization is

- (a) $d_{x^2-y^2}$
(b) d_{z^2}
(c) d_{xz}
(d) any one of the 'd' orbitals

Answer (b)

4. Among the following, the correct statement/s about 'p' block elements is/are

- I. The valence shell electronic configuration of all them is ns^2np^{1-6}
II. Only in p block, metals, nonmetals and metalloids are present
III. Halogens have the lowest negative electron gain enthalpy in the respective periods
IV. Noble gases have no tendency to accept an electron and hence they have large negative values of electron gain enthalpy

- (a) I, IV
(b) II, III
(c) IV only
(d) II only

Answer (d)

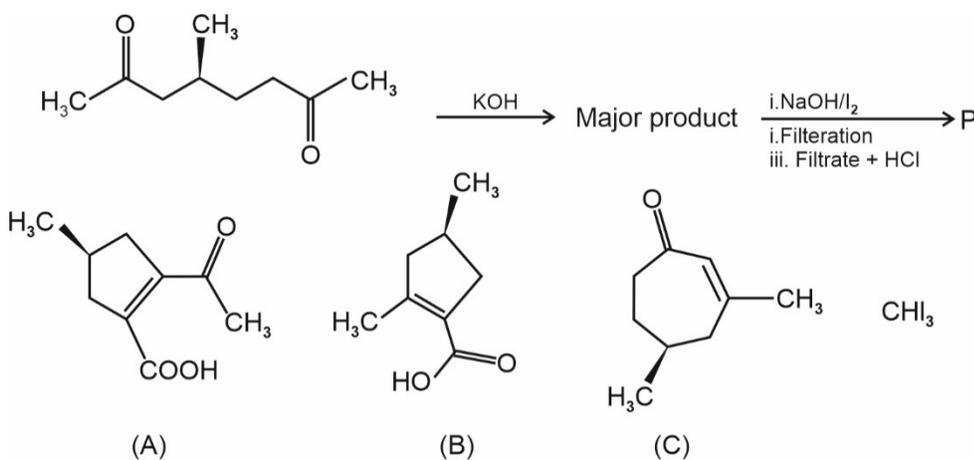
5. A chemical reaction is carried out at two different temperatures T_1 and T_2 ($T_2 > T_1$) and also with and without a catalyst.

The statement that is correct among the following is

- (a) Lowering in the activation energy of the reaction due to catalyst would be higher at T_2 than at T_1
 (b) Lowering in the activation energy of the reaction due to catalyst would be higher at T_1 than at T_2
 (c) The factor by which the rate of the reaction is increased by the catalyst would be lower at T_2 than at T_1
 (d) The factor by which the rate of the reaction is increased by the catalyst would be higher at T_2 than at T_1

Answer (c)

6. The product 'P' in the following sequence of reactions is



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

Answer (b)

7. Among the following maximum number of resonance structures is possible for

- (a) PO_4^{-3} (b) SO_4^{-2}
 (c) CO_3^{-2} (d) MnO_4^-

Answer (b)

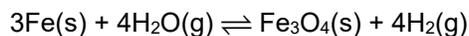
8. A mixture of sodium (Na) and potassium (K) metals weighing 32 g was reacted with water and the solution obtained could be neutralized with 517.3 mL of 1.0 M H_2SO_4 (aq).

The mass of sodium that was present in the mixture is

- (a) 20 g (b) 16 g
 (c) 10 g (d) 12 g

Answer (d)

9. The mass ratio of steam and hydrogen is found to be 1:1.5 at equilibrium in the following reaction



The value of the equilibrium constant (K_c) of the above reaction is

- (a) 3.0×10^{-5}
- (b) 3.3×10^4
- (c) 3.3×10^6
- (d) 1.3×10^3

Answer (b)

10. Two students did a set of experiments on ketones 'X' and 'Y' independently and obtained the following result.

Reaction/Experiment	X	Y
Optical rotation	Yes	Yes
Optical rotation after treatment with a base	Zero	Yes
NH_2NH_2 , KOH, Heat	Formation of an optically inactive hydrocarbon C_6H_{12}	Formation of an optically inactive hydrocarbon C_6H_{12}

The ketones 'X' and 'Y' are respectively

- (a) 2-ethylcyclobutanone and 3-ethylcyclobutanone
- (b) 2-methylcyclopentanone and 3-methylcyclopentanone
- (c) 3-methylcyclopentanone and 2-methylcyclopentanone
- (d) 3-methyl-4-penten-2-one and 4-methyl-1-penten-3-one

Answer (b)

11. Glycine ($\text{C}_2\text{H}_5\text{O}_2\text{N}$) is the simplest of amino acids. Molecular formula of the linear oligomer synthesized by linking ten glycine molecules together via a condensation reaction would be

- (a) $\text{C}_{20}\text{H}_{32}\text{O}_{11}\text{N}_{10}$
- (b) $\text{C}_{20}\text{H}_{68}\text{O}_{29}\text{N}_{10}$
- (c) $\text{C}_{20}\text{H}_{40}\text{O}_{10}\text{N}_{10}$
- (d) $\text{C}_{20}\text{H}_{50}\text{O}_{20}\text{N}_{10}$

Answer (a)

12. If Ni^{2+} is replaced by Pt^{2+} in the complex ion $[\text{NiCl}_2\text{Br}_2]^{2-}$, which of the following would change?

- I. Magnetic moment
 - II. Geometry
 - III. Geometrical isomerism
 - IV. Optical isomerism
- (a) I, II, III
 - (b) II, III
 - (c) I, II
 - (d) II, III, IV

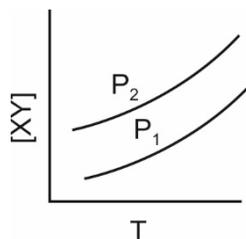
Answer (a)

13. An inorganic compound 'X' of an alkali metal on heating gives a reddish-brown gas 'Y' and a binary solid 'Z'. This solid is less soluble in water and its solution is basic. 'X' does not give a positive silver nitrate test. 'X' can be identified as

- (a) KIO_3 (b) LiNO_3
 (c) NaNO_3 (d) KNO_2

Answer (b)

14. The qualitative plots given represent the yield of the product, [XY], at equilibrium in the reaction $\text{X(g)} + \text{Y(g)} \rightleftharpoons \text{XY(g)}$, as a function of temperature, at total pressures P_1 and P_2 . The reaction is



- (a) endothermic and $P_1 < P_2$ (b) endothermic and $P_2 < P_1$
 (c) exothermic and $P_1 > P_2$ (d) exothermic and $P_2 > P_1$

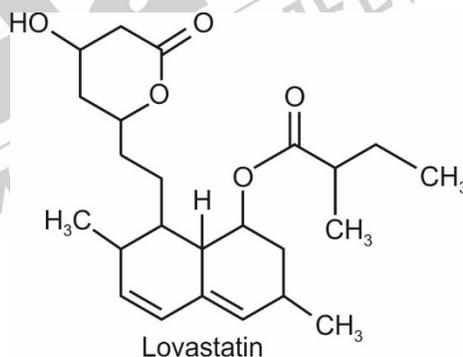
Answer (a)

15. When 6.8 g of AgNO_3 completely reacts with H_3PO_2 , metallic silver produced (g) and H_3PO_2 consumed (mole) are respectively.

- (a) 4.32 and 0.1 (b) 1.08 and 0.01
 (c) 4.32 and 0.01 (d) 2.16 and 0.01

Answer (c)

16. Lovastatin, a drug used to reduce the risk of cardio vascular diseases has the following structure



The number of stereogenic centers present in lovastatin is

- (a) 8 (b) 3
 (c) 4 (d) 6

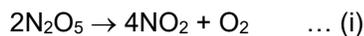
Answer (a)

17. Among the following sets, the one in which all the molecules are non polar is

- (a) XeF_4 , XeO_3 , XeO_4 (b) XeF_2 , XeO_4 , XeOF_4
(c) XeF_2 , XeF_4 , XeO_4 (d) XeF_2 , XeO_3 , XeOF_4

Answer (c)

18. Gas phase reactions (i) and (ii) are of first and second order respectively



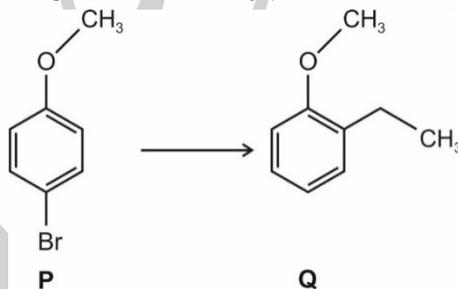
Under certain conditions, the rate constants (k_1 , k_2) of (i) and (ii) respectively, have the same numerical value, when the concentrations of the reactants are expressed in mol/dm³.

If the concentrations are expressed in mol/mL, the correct relationship between k_1 and k_2 is

- (a) $k_2 \times 10^{-3} = k_1$ (b) $k_2 \times 10^3 = k_1$
(c) $k_1 = k_2$ (d) $k_1 \times 10^6 = k_2$

Answer (a)

19. The correct sequence of reactions to get 'Q' as the only product from 'P' is



- (a) (i) H_2 and Pt catalyst (ii) $\text{C}_2\text{H}_5\text{Cl}$ and AlCl_3
(b) (i) Mg in ether (ii) aqueous alcohol (iii) $\text{C}_2\text{H}_5\text{Cl}$ and AlCl_3
(c) (i) Mg in ether (ii) $\text{C}_2\text{H}_5\text{Cl}$ and AlCl_3
(d) (i) $\text{C}_2\text{H}_5\text{Cl}$ and AlCl_3 (ii) Mg in ether (iii) aqueous alcohol

Answer (d)

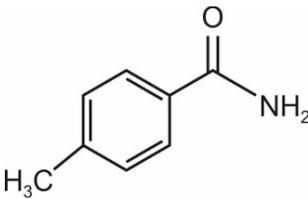
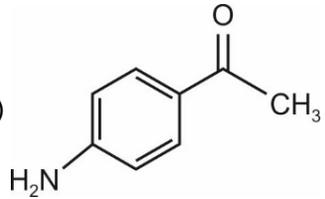
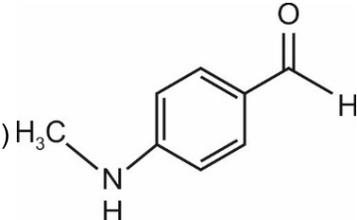
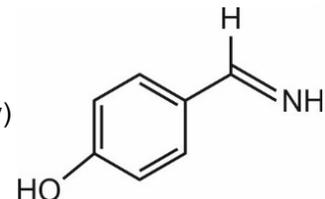
20. The Galvanic cell can be represented as $\text{Zn}/\text{Zn}^{2+} (0.1 \text{ M}) // \text{Cu}^{2+} (0.1 \text{ M})/\text{Cu}$. Among the following, the cell that can produce an EMF more than that of the Galvanic cell is

(E° of Zn^{2+}/Zn and Cu^{2+}/Cu are -0.763 V and 0.337 V respectively)

- (a) $\text{Zn}/\text{Zn}^{2+} (0.1 \text{ M}) // \text{Cu}^{2+} (0.01 \text{ M})/\text{Cu}$ (b) $\text{Zn}/\text{Zn}^{2+} (1 \text{ M}) // \text{Cu}^{2+} (0.01 \text{ M})/\text{Cu}$
(c) $\text{Zn}/\text{Zn}^{2+} (0.01 \text{ M}) // \text{Cu}^{2+} (1 \text{ M})/\text{Cu}$ (d) $\text{Zn}/\text{Zn}^{2+} (0.01 \text{ M}) // \text{Cu}^{2+} (0.01 \text{ M})/\text{Cu}$

Answer (c)

21. The correct match of the molecules in column I and reactions in column II is

Column I	Column II
(i) 	(L) Coloration with FeCl_3
(ii) 	(M) Effervescence with NaHCO_3
(iii) 	(N) Yellow precipitate with NaOH and I_2
(iv) 	(O) Yellow oil with NaNO_2 , HCl at 0°C (P) Heating with NaOH gives out a gas that turns moist turmeric paper brown

- (a) (i)-N (ii)-L (iii)-O (iv)-M
 (b) (i)-O (ii)-N (iii)-L (iv)-P
 (c) (i)-P (ii)-O (iii)-L (iv)-M
 (d) (i)-P (ii)-N (iii)-O (iv)-L

Answer (d)

22. While doing titration, a student recorded a burette reading of 10.0 mL for the neutralization of 10.0 mL NaHC_2O_4 (aq) with 0.1 M NaOH (aq). In a separate experiment, 10.0 mL of this NaHC_2O_4 (aq) solution could be completely oxidized by 10.0 mL of KMnO_4 in an acidic medium.

What would be the molarity of KMnO_4 used by this student?

- (a) 0.02 M
 (b) 0.04 M
 (c) 0.1 M
 (d) 0.2 M

Answer (b)

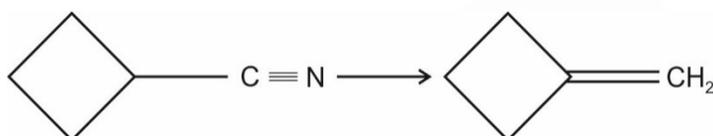
23. Pheromones are chemicals that animals produce for social response. The structure of brevicomin, a pheromone, is shown below. The open chain ketodiols that would form brevicomin is



- (a) 7, 8-dihydroxynonan-3-one
 (b) 6, 7-dihydroxynonan-3-one
 (c) 7, 8-dihydroxynonan-2-one
 (d) 6, 7-dihydroxynonan-2-one

Answer (d)

24. The best reagents and conditions to accomplish the following conversion is



- (a) (i) LiAlH₄ in ether, (ii) 3 moles of CH₃I followed by heating with AgOH
 (b) (i) LiAlH₄ in ether, (ii) P₂O₅ and heat
 (c) (i) 20% H₂SO₄ and heat, (ii) P₂O₅ and heat
 (d) H₂ and Lindlar catalyst

Answer (a)

PART-A2

25. The correct statement/s among the following is/are

- (a) Intermolecular forces in n-heptane are stronger than those in 2-methylheptane
 (b) Boiling point of 2, 2-dimethylpentane is higher than that of 2, 2-dimethylbutane
 (c) Both hydrogen bonding and van der Waals forces exist between molecules of 2-methylbutan-2-ol
 (d) In 2, 2-dimethylbutane, 1°, 2° and 3° types of carbon atoms are present

Answer (b, c)

26. Which of the following aqueous solution/s will have a pH value between 4.0 and 5.0 at 25°C?

- (a) 0.01 M solution of benzoic acid ($K_a = 6.6 \times 10^{-5}$ at 25°C)
 (b) 0.02 mol benzoic acid and 0.05 mol sodium benzoate dissolved in appropriate amount of water to make a solution of 1 L
 (c) A mixture of 999 mL water and 1 mL 0.2 M HCl
 (d) 499 mL of 0.01 M NaOH and 501 mL of 0.01 M HCl mixed together

Answer (b, d)

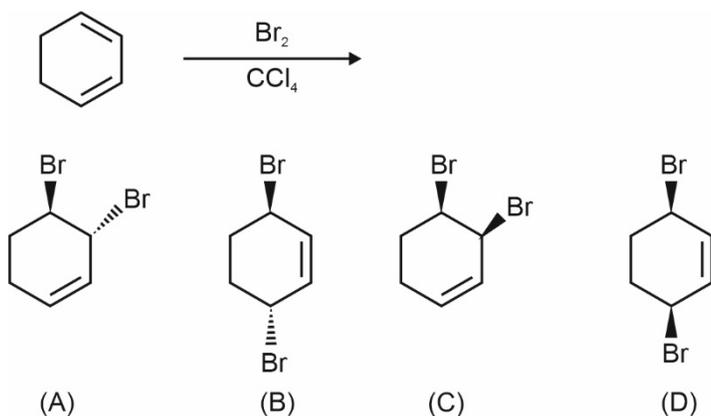
27. The energy required to remove an electron from a gaseous species 'X' to form 'X⁺' is known as first ionization energy (IE) of X. The energy required to remove an electron from a gaseous species 'X⁺' to form 'X²⁺' is called the second IE of X. Similarly, the energy required to remove an electron from a gaseous species X⁻ to form X is called the IE of X⁻.

Identify the correct statement/s from the following

- (a) The second IE of the He atom is four times that of the (first) IE of the H atom.
- (b) The first IEs of F, Ne and Na atoms follow the order IE(Na) < IE(Ne) < IE(F)
- (c) The second IE of the H⁻ ion is much less than the (first) IE of the H atom.
- (d) The IEs of Li, Na and K atoms follow the order IE(K) < IE(Na) < IE (Li)

Answer (a, d)

28. The product/s formed in the following reaction is/are



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

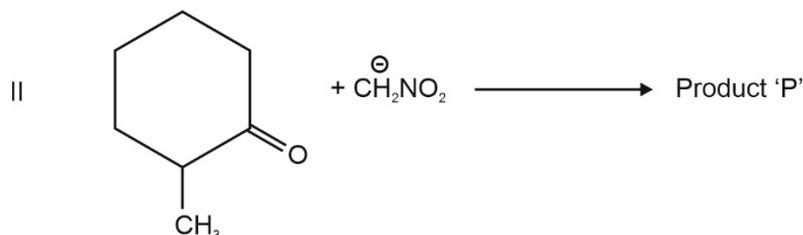
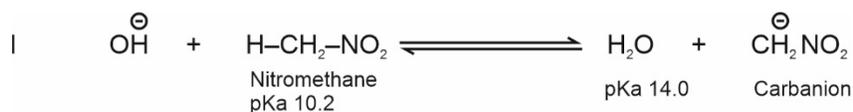
Answer (a, b, d)

29. Which of the following option/s is/are correct?

- (a) C₂ is paramagnetic
- (b) He₂⁺ has the same energy as that of two isolated He atoms
- (c) S₂ is paramagnetic and S₂²⁻ is diamagnetic
- (d) N₂⁺ and N₂⁻ have the same bond order

Answer (c, d)

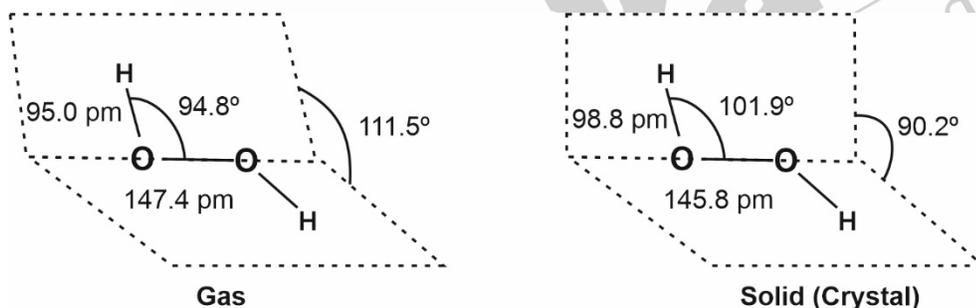
30. Nitromethane undergoes an aldol type reaction with a racemic mixture of 2-methylcyclohexanone in presence of aqueous NaOH in two steps (I, II) to give the product 'P'. The statement/s NOT correct among the following is/are



- (a) The equilibrium in step I will be more towards the right as water is a stronger acid than nitromethane
- (b) The carbanion formed in reaction I can be stabilized due to resonance
- (c) The product formed will be a mixture of four stereoisomers in the form of two pairs of enantiomers
- (d) The mixture of products formed can be readily dehydrated to give a single product

Answer (a, d)

31. The structures of hydrogen peroxide (H_2O_2) in the solid and gaseous states are given below. $\text{H}_2\text{O}_2(\text{l})$ is slightly more viscous than $\text{H}_2\text{O}(\text{l})$. The correct option/s among the following is/are

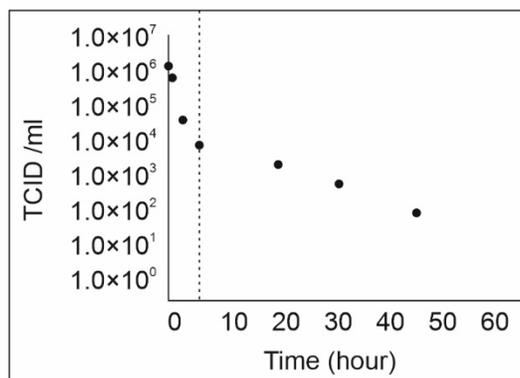


- (a) Both O atoms are near enough to cause repulsion between the electron lone pairs thus making the O-O bond susceptible for cleavage
- (b) The strong intermolecular H-bonding along with restricted rotation present in the liquid state of H_2O_2 make it more viscous than $\text{H}_2\text{O}(\text{l})$
- (c) The molecule gets twisted to minimize the repulsion between the lone pair and bond pair of electrons
- (d) The difference in the dihedral angles in the solid and gaseous states is a consequence of hydrogen bonding between the molecules

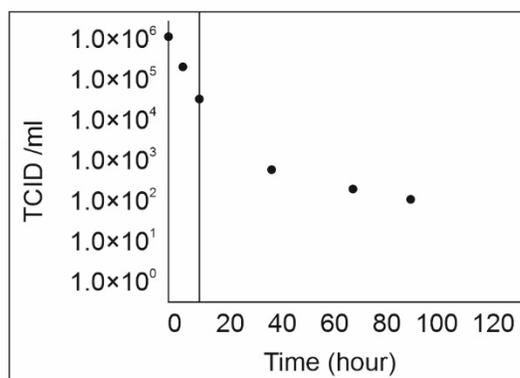
Answer (a, b, c, d)

32. Viruses are non-living complex chemical entities. They undergo inactivation and hence lose the ability to infect a host, with time. Concentration (expressed as 'median tissue culture infectious' TCID/ml, a unit used in expressing virus concentrations) vs. time plots of a corona virus on the surfaces of a paper currency note and a plastic currency note are shown below. Both these plots have two separate regions (shown by vertical lines in the plots), indicating two time zones.

I. Paper currency note



II. Plastic currency note



The correct option/s among the following is/are

- (a) Inactivation of the virus follows zero order kinetics in 1st zone and first order kinetics in 2nd zone
- (b) The rate of inactivation is independent of the surface material
- (c) The virus reacts with different chemical entities/substances in 1st zone and 2nd zone
- (d) On both the surfaces, at least 95% of the virus is inactivated within 10 h

Answer (c, d)

