

TEST SERIES | GATE 2019

BOOKLET SERIES **A**

INORGANIC CHEMISTRY

Paper Code: **CY**

Test Type: **TEST SERIES**

Duration: **2:30 Hours**

CHEMISTRY-CY

Date: **08-01-2019**

Maximum Marks: **100**

Read the following instructions carefully:

1. Attempt all questions.
2. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory. The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each. The subject specific GATE paper section consists of **55** questions, out of which question numbers 11 to 35 are of 1-mark each, while question numbers 36 to 65 are of 2-mark each.
3. The question paper may consist of questions of **multiple choice type (MCQ)** and **numerical answer type**.
4. Multiple choice type questions will have four choices against (a), (b), (c), (d), out of which only **ONE** is the correct answer.
5. For numerical answer type questions, each question will have a numerical answer and there will not be any choices.
6. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of $\frac{1}{3}$ marks for a **1-mark** question and $\frac{2}{3}$ marks for a **2-mark** question.
7. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.
8. Non-programmable type Calculator is allowed

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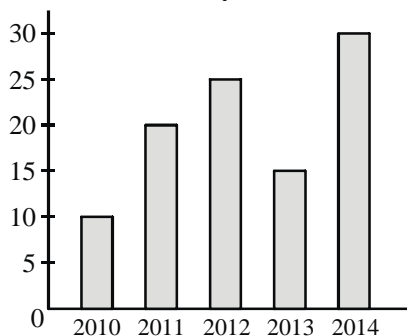


Q.1-Q. 5 carry ONE mark each.

- Which one of the following options is the closest in meaning to the word given below?
Cantankerous
(a) Freedom (b) meticulous (c) bad tempered (d) coercion
- Which one of the following options is the closest in meaning to the word given below?
Fecund
(a) Fruitful (b) Fruitless (c) Juicy (d) Smooth
- Pointing to a photograph of a girl a man says, "She is the daughter of the wife of the only son of my father". How is the girl related to the man ?
(a) Aunt (b) Daughter (c) Mother (d) Niece
- Manish does a work in 20 days. Harish is twice as efficient as Manish. They together works for 5 days and quits the work. If the remaining work is completed by Ravish in 5 days, then in how many days Ravish alone can complete the work ?
(a) 15 (b) 10 (c) 20 (d) 12
- In a cricket match Rahul got 5 wickets for 26 runs and average runs per wicket decreases by 0.5 runs and new average runs per wicket become 12. Find total wicket taken by Rahul till date ?
(a) 65 (b) 70 (c) 73 (d) 68

Q.6-Q. 10 carry TWO marks each.

- Choose the most appropriate word from the options given below to complete the following sentence.
Privacy is _____ by laws relating to defamation, under the Indian Penal Code.
(a) secluded (b) derived (c) protected (d) confined
- The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair:
Gravity : Pull ::
(a) Iron: Metal (b) North Pole: Direction
(c) Magnetism: Attraction (d) Dust : Desert
- If a, b, c, d are four consecutive odd numbers numbers, and x average of the four numbers, then which one of the statements is *true* ?
(a) x is even (b) x is odd
(c) x is equal to one of the numbers (d) x is equal to a mixed number
- 20 % of total marks of a student comes from physics. What should be the central angle for physics in a proper pie-chart ?
(a) 200° (b) 180° (c) 72° (d) 90°
- The graph represents the production of steel of a steel plant in metric ton from year 2010 to year 2014. What is the percentage increase in production of steel in year 2014 as compared to previous year ?



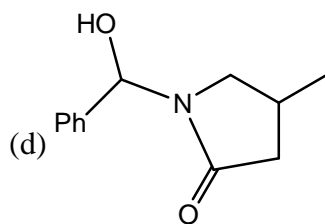
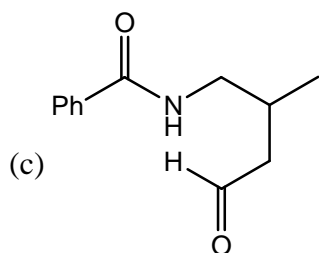
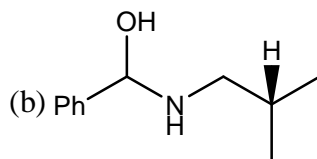
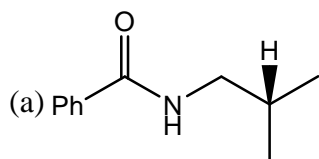
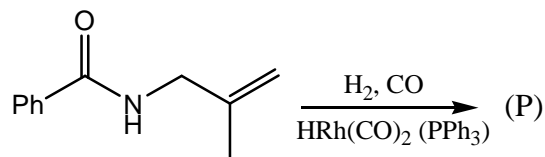
- (a) 100 (b) 80 (c) 70 (d) 75

Q.11-Q.35 carry one mark each.

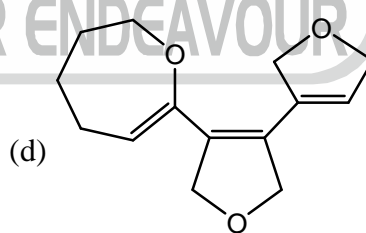
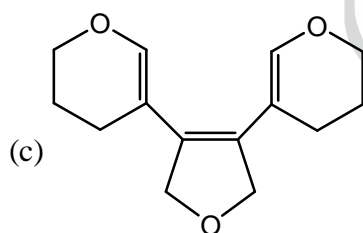
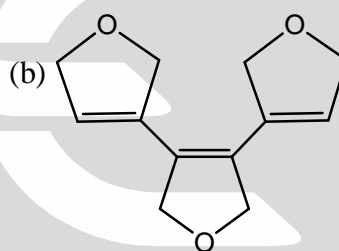
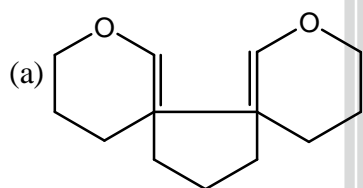
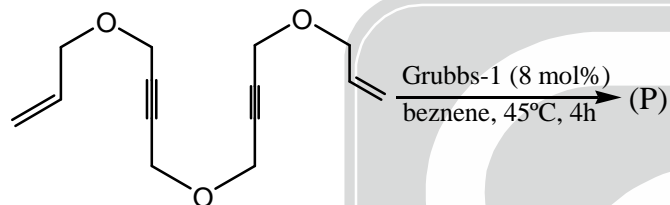
11. Mössbauer effect is related to
 (a) Resonance fluorescence of γ -rays (b) Intranuclear rather than electronic energy levels
 (c) Both (a) and (b) (d) Stark effect
12. The correct statement for ferredoxin in the favour of Mössbauer spectrum is/are
 (1) Two Fe(III) ion in oxidised form having isomer shift 0.22 mms^{-1} .
 (2) Two Fe(II) ion in oxidised form having isomer shift 0.56 mms^{-1}
 (3) Two Fe(III) ion having doublet and two Fe(II) ion having singlet M.B. spectrum in oxidised form
 (4) One Fe(III) ion having singlet and three Fe(II) ion having doublet M.B. spectrum in reduced form
 (a) 1, 3 (b) 1, 2, 4 (c) 2, 3, 4 (d) Only 3
13. Following the 18 electron rule as guide, the value of x in $[\eta^5\text{-Cp}(\text{CO})_2\text{Fe}(\text{PhC}\equiv\text{CH})]^x$ is _____
14. The metal in coenzyme B_{12} is Co and its oxidation state is _____
15. The true statement among following is
 (a) The Cr–C bond in $(\text{CO})_5\text{Cr}=\text{C}(\text{OMe})\text{Ph}$ is longer than in $(\text{CO})_5\text{Cr}=\text{C}(\text{OMe})\text{NMe}_2$
 (b) Oxidative addition is quite facile in complexes with a d^0 metal
 (c) Ferrocene with $n\text{-BuLi}$ and $t\text{-BuLi}$ form only the monolithiated product
 (d) $\text{Fe}(\text{CO})_4$ and $\text{CpRh}(\text{CO})$ are isolobal fragments
16. Among the given boron based compound the oxidising agent is
 (a) B_2O_3 (b) NaBO_2 (c) $\text{Na}_2\text{B}_4\text{O}_7$ (d) $\text{Na}_2\text{B}_2\text{O}_4(\text{OH})_4$
17. The major types of complexes formed by C_{60} are of the type having
 (a) η^2 and η^1 heptacities (b) η^6 and η^1 heptacities
 (c) η^2 and η^5 heptacities (d) η^2 and η^6 heptacities
18. The number of S–O bonds in $\text{H}_2\text{S}_2\text{O}_8$ is _____ (answer should be an integer)
19. The bond formation between ligand (X) and Cu^{2+} follow the order ($\text{X} = \text{F}^-, \text{Br}^-, \text{I}^-, \text{NH}_3$)
 (a) $\text{F}^- > \text{Br}^- > \text{I}^- > \text{NH}_3$ (b) $\text{I}^- > \text{Br}^- > \text{F}^- > \text{NH}_3$
 (c) $\text{NH}_3 > \text{F}^- > \text{Br}^- > \text{I}^-$ (d) $\text{F}^- > \text{NH}_3 > \text{Br}^- > \text{I}^-$
20. The following ions exhibit intense ligand to metal charge transfer transition, the species having lowest wavelength for the transition is
 (a) CrO_4^{2-} (b) MnO_4^- (c) MoO_4^{2-} (d) TcO_4^-
21. The correct order of the rate of exchange of water molecules between the coordination sphere and the bulk is
 (a) $\text{Co}^{3+} > \text{V}^{2+} > \text{Mg}^{2+} > \text{Cr}^{2+}$ (b) $\text{Cr}^{2+} > \text{Mg}^{2+} > \text{V}^{2+} > \text{Co}^{3+}$
 (c) $\text{Mg}^{2+} > \text{Cr}^{2+} > \text{V}^{2+} > \text{Co}^{3+}$ (d) $\text{Cr}^{2+} > \text{V}^{2+} > \text{Mg}^{2+} > \text{Co}^{3+}$
22. The ground state term symbols corresponding to d^7 and p^4 are
 (a) ${}^4\text{F}_{3/2}$ and ${}^3\text{P}_0$ (b) ${}^4\text{F}_2$ and ${}^3\text{P}_1$ (c) ${}^4\text{F}_{9/2}$ and ${}^3\text{P}_2$ (d) ${}^4\text{F}_1$ and ${}^3\text{P}_{1/2}$
23. According to Polyhedral electron count rule, the structure of $\text{Fe}_4\text{C}(\text{CO})_{13}$ and $[\text{Co}_6(\text{CO})_{15}]^{2-}$ are
 (a) closo and closo (b) nido and arachno (c) arachno and closo (d) arachno and nido
24. The option which is correct for the given properties is
 (a) $\text{C} > \text{B} > \text{Al} > \text{Ga}$ (electronegativity order) (b) $\text{Ne} > \text{Be} > \text{N}$ (electron affinity order)
 (c) $\text{Ir} > \text{Co} > \text{Rh}$ (ionisation energy order) (d) $\text{Fe}-\text{C} > \text{Ru}-\text{C} > \text{Os}-\text{C}$ (bond energy order)
25. The bond order of metal-metal bond in the complex $[\text{Re}_2\text{Cl}_4(\text{PMe}_2\text{Ph})_4]^+$ is _____ (Upto one decimal places).

26. The correct order of the ν_{CO} for the following complexes is
- (a) $\text{Mo}(\text{CO})_3(\text{PCl}_3)_3 > \text{Mo}(\text{CO})_3(\text{PF}_3)_3 > \text{Mo}(\text{CO})_3(\text{PPh}_3)_3 > \text{Mo}(\text{CO})_3(\text{NMe}_3)_3$
 (b) $\text{Mo}(\text{CO})_3(\text{PPh}_3)_3 > \text{Mo}(\text{CO})_3(\text{PF}_3)_3 > \text{Mo}(\text{CO})_3(\text{PCl}_3)_3 > \text{Mo}(\text{CO})_3(\text{NMe}_3)_3$
 (c) $\text{Mo}(\text{CO})_3(\text{PF}_3)_3 > \text{Mo}(\text{CO})_3(\text{PCl}_3)_3 > \text{Mo}(\text{CO})_3(\text{PPh}_3)_3 > \text{Mo}(\text{CO})_3(\text{NMe}_3)_3$
 (d) $\text{Mo}(\text{CO})_3(\text{NMe}_3)_3 > \text{Mo}(\text{CO})_3(\text{PF}_3)_3 > \text{Mo}(\text{CO})_3(\text{PCl}_3)_3 > \text{Mo}(\text{CO})_3(\text{PPh}_3)_3$
27. Correct order of oxidising power is
- (a) $\text{CrO}_4^{2-} > \text{MnO}_4^{2-} > \text{FeO}_4^{2-}$ (b) $\text{VO}_4^{3-} > \text{CrO}_4^{2-} > \text{MnO}_4^-$
 (c) $\text{MnO}_4^- < \text{TcO}_4^- < \text{ReO}_4^-$ (d) $\text{BrO}_4^- > \text{IO}_4^- > \text{ClO}_4^-$
28. Correct order of X–O / O–O bond length is
- (a) $\text{SiO}_4^{4-} < \text{PO}_4^{3-} < \text{SO}_4^{2-} < \text{ClO}_4^-$ (b) $\text{ClO}_4^- > \text{BrO}_4^- > \text{IO}_4^-$
 (c) $\text{NO}_3^- < \text{NO}_2^- < \text{NO}_2^+$ (d) $\text{O}_2 < \text{O}_3 < \text{O}_2^{2-}$
29. Select the more and less soluble pair of hydroxide in hot conc. NaOH
- (a) $\text{Gd}(\text{OH})_3$ and $\text{Tm}(\text{OH})_3$ (b) $\text{Ce}(\text{OH})_3$ and $\text{Gd}(\text{OH})_3$
 (c) $\text{Yb}(\text{OH})_3$ and $\text{Sm}(\text{OH})_3$ (d) $\text{La}(\text{OH})_3$ and $\text{Lu}(\text{OH})_3$
30. The species having central metal ion with lowest soft character (as per HSAB principle) among the following is
- (a) $[\text{Cr}(\text{CO})_5]^{2-}$ (b) $[\text{CrO}_4]^{2-}$ (c) $[\text{CrCl}_4]^-$ (d) $[\text{Cr}(\text{bipy})_3]$
31. The boron hydride having least Bronsted acidity is
- (a) $\text{B}_{10}\text{H}_{14}$ (b) B_4H_{10} (c) $\text{B}_{18}\text{H}_{22}$ (d) B_5H_9
32. The magnetic moment of Yb^{3+} ion is _____ (upto two decimal places).
33. In the following species, the number of species undergoes positron emission is _____ (answer should be an integer).
- ${}_{20}^{38}\text{Co}$, ${}_{18}^{35}\text{Ar}$, ${}_{16}^{35}\text{S}$, ${}_{9}^{17}\text{F}$, ${}_{14}^{10}\text{Be}$
34. Hemerythrin contains
- (a) a dinuclear iron core and binds dioxygen in the ferrous state
 (b) a dinuclear iron core and binds dioxygen in the ferric state
 (c) a mononuclear iron core and binds dioxygen in the ferrous state
 (d) a mononuclear iron core and binds dioxygen in the ferric state
35. Which of the following forms of analytical chemistry seeks to obtain the condition of full polarization
- (a) potentiometry (b) voltammetry (c) coulometry (d) ohmetry
- Q.36-Q.65 carry TWO marks each.**
36. In the following system H , H_2 , Na^+ , N_2 , NO , Cu^+ , Cu^{2+} , CH_3 , CO . The total number of ESR system is/are _____ (answer should be an integer).
37. The total number of hyperfine line and intensity pattern for ESR spectrum of diphenyl picryl hydrazyl radical in benzene solution are
- (a) 1, 1 : 4 : 6 : 4 : 1 (b) 4, 1 : 2 : 1 : 3 (c) 4, 3 : 1 : 1 : 1 (d) 5, 1 : 2 : 3 : 2 : 1

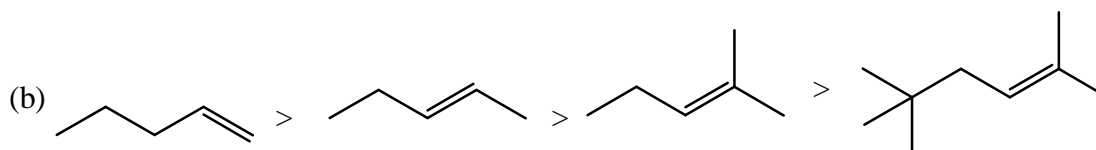
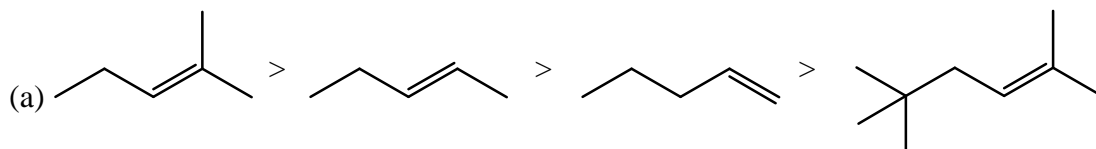
38. The major product (P) is,

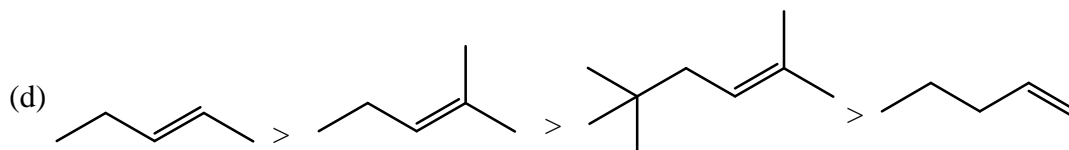
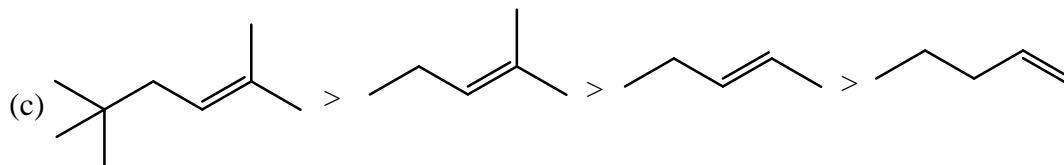


39. The major product (P) is



40. The general reactivity of alkenes for hydroformylation follows the order

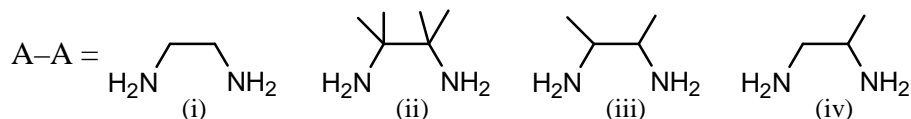




41. Which of the following statement about H_3BO_3 is not correct.
 (a) It has a layer structure in which planar BO_3 units are joined by hydrogen bonds
 (b) It does not act as a proton acid but act as a Lewis acid by accepting a hydroxyl ion
 (c) It has a strong tribasic acid
 (d) It is prepared by acidifying an aqueous solution of borax.
42. Which one among the following statements is wrong?
 (a) Beryl is an example of a cyclic silicate
 (b) Mg_2SiO_4 is an orthosilicate
 (c) The basic structural unit in silicate is the SiO_4 tetrahedron
 (d) Feldspar are not alumino-silicate
43. Which among the following statement about phosphorous oxide is not correct
 (a) P_4O_{10} is anhydride of H_3PO_4
 (b) P_4O_6 is anhydride of H_3PO_3
 (c) P_4O_6 can act as ligand and form complexes with metal carbonyl
 (d) P-P bond present in P_4O_{10}
44. $(B) \xleftarrow[(2)\Delta]{(1)MeONa} N_3P_3Cl_6 \xrightarrow{Aq. NH_3} (A)$
 The product (A) and (B) is
 (a) $A = N_3P_3(NH_3)_6$, $B = N_3P_3(OMe)_6$
 (b) $A = N_3P_3Cl_4(NH_2)_2$, $B = N_3P_3(OMe)_3(Me)_3$
 (c) $A = N_3P_3(NH_2)_6$, $B = N_3P_3O_3(OMe)_6$
 (d) $A = N_3P_3(O)_3(OMe)_3(Me)_3$, $B = N_3P_3(NH_2)_6$
45. Identify the correct statement for the stability constant in aqueous solution at $25^\circ C$ for the formation of complex ions
 (i) $[M(en)_2(H_2O)_2]^{2+}$ (ii) $[M(en)_3]^{2+}$
 (a) Stability constant of complex ion (i) is more for Ni than Cu.
 (b) Stability constant of complex ion (ii) is more for Cu than Ni
 (c) Stability constant of complex ion (ii) is more for Ni than Cu
 (d) Stability constant of complex ion (i) is less for Cu than Ni.
46. The splitting of F terms in octahedral symmetry is
 (a) $A_{2g} + T_{1g} + T_{2g}$ (b) $E_g + T_{2g}$ (c) $E_g + 2T_{1g} + T_{2g}$ (d) $A_{1g} + E_g + T_{1g} + T_{2g}$
47. Consider the incorrect statement for $[M(H_2O)_6]^{2+}$
 (a) If $M = Zn$, then the complex is colorless
 (b) If $M = Mn$ then there is no orbital contribution in magnetic moment
 (c) If $M = Ni$ then ground state term is 3F_4
 (d) If $M = Cu$ then ground state terms is ${}^3D_{3/2}$.

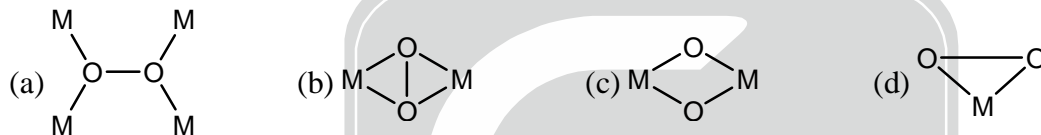
48. The statement which is incorrect regarding the different scales of electronegativity is
- According to Mulliken, electronegativity of an atom is the mean of the values of the first ionization energy and the first electron affinity.
 - Pauling observed that due to the presence of some ionic character in covalent bond, single bond energy of AB molecule is lesser than the geometric mean of A_2 and B_2 molecule.
 - Mulliken's electronegativity is 2.8 times greater than that of Pauling's electronegativity.
 - Alfred-Rochow's electronegativity is inversely proportional to the square of the covalent radius of the atom
49. The ionisation potential of hydrogen atom is 13.6 eV. The first ionisation potential of an aluminium atom, assuming that the energy of its outer electron can be represented by a H-atom like model with an effective nuclear charge of 3.15, is _____ eV. (Upto two decimal places).

50. The rate of acid hydrolysis for $\text{trans} [\text{Co}(\text{A}-\text{A})_2 \text{Cl}_2]^+$ follow the order if



- (i) > (iii) > (iv) > (ii)
- (ii) > (iii) > (iv) > (i)
- (iv) > (iii) > (ii) > (i)
- (ii) > (iv) > (iii) > (i)

51. The incorrect structure types of dioxygen ligands is



52. The statement which is correct regarding metal alkene complexes is
- The back donation leads to the change the formal oxidation state of the metal
 - The stretching frequency of C=C bond in Zeise's salt is observed at 1516 cm^{-1} in comparison with 1623 cm^{-1} in free ethylene.
 - The C-C bond axis is the same plane as that of the other ligands present in complex.
 - Due to the presence of π -acceptor ligand other than ethylene, M-C length decreases.

53. The statement which is incorrect regarding the reaction of $[\text{Co}(\text{NH}_3)_5 \text{Cl}]^{2+}$ with OH^- is

- The rate of determining step involves the abstraction of a proton from $[\text{Co}(\text{NH}_3)_5 \text{Cl}]^{2+}$
- The charge effect enhances the removal of labile ligand.
- The following reaction proceeds by S_N1 mechanism but it is consistent with second order
- The reaction involves the formation of a TBP intermediate.

54. The pair of complexes among the following having maximum rate for the electron transfer is

- $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
- $[\text{Co}(\text{phen})_3]^{2+}$ and $[\text{Co}(\text{phen})_3]^{3+}$
- $[\text{Ru}(\text{NH}_3)_6]^{2+}$ and $[\text{Ru}(\text{NH}_3)_6]^{3+}$
- $[\text{CoF}(\text{NH}_3)_5]^{2+}$ and $[\text{Cr}(\text{OH}_2)_6]^{2+}$

55. $[(\text{MeS})_2 \text{Si}(\text{SiMe}_3)_2] \xrightarrow[254 \text{ nm}]{h\nu} (\text{P})$

Correct statement regarding product (P) is

- It has planar structure like alkene
- It contains $\text{Si} \equiv \text{Si}$
- Unlike ethylene it has less $\pi-\pi^*$ gap hence it is coloured
- It has high $\pi-\pi^*$ gap like ethylene and also it is colourless.

56. The total number of isomer in $[\text{Cr}(\text{o-phen})(\text{NH}_3)_2\text{Cl}_2]^+$ is _____
57. Which of the following statement are true for lanthanoids.
 (I) Bands arising from f-f transition are sharp and their position in the spectrum are little affected by complex formation
 (II) At low temperature magnetic moment of Eu^{3+} approaches zero.
 (III) Intensity of absorption of f-f transition are low
 (IV) Absorption due to f-d transition are broad and are affected by ligand environment.
 The correct answer is
 (a) I and II (b) III and IV (c) I and IV (d) all are correct.
58. In the following reactions,

$$\text{HCl} + \text{H}_2\text{PO}_4^- \rightleftharpoons \text{Cl}^- + \text{H}_3\text{PO}_4$$

$$\text{HCO}_3^-(\text{aq}) + \text{OH}^- \rightleftharpoons \text{CO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(\ell)$$
 The correct pairs for the conjugate acid-base are
 (a) $\text{HCl} - \text{Cl}^-$ and $\text{OH}^- - \text{CO}_3^{2-}$ (b) $\text{HCO}_3^- - \text{CO}_3^{2-}$ and $\text{HCl} - \text{Cl}^-$
 (c) $\text{H}_2\text{PO}_4^- - \text{H}_3\text{PO}_4$ and $\text{HCO}_3^- - \text{H}_2\text{O}$ (d) $\text{H}_2\text{O} - \text{OH}^-$ and $\text{H}_2\text{PO}_4^- - \text{Cl}^-$
59. H_3PO_4 in the solution of H_2SO_4 will act as
 (a) Weak acid (b) Super acid (c) Bronsted base (d) Lewis base
60. Addition of an electron to CN molecule results in
 (I) An increase in the $\bar{\nu}(\text{cm}^{-1})$ CN in IR spectrum
 (II) An EPR inactive species
 (III) Electron in HOMO being more closer to nitrogen than carbon orbitals.
 (IV) Electron in HOMO being more closer to carbon than nitrogen orbital
 The correct answer is
 (a) I and II (b) I, II and III (c) II and IV (d) I, II and IV
61. The pair of having same shape
 (a) SF_4 and PCl_4^+ (b) ClF_3 and IO_3^- (c) XeF_5^- and IF_5^{2-} (d) N_3^- and O_3
62. Consider the correct statement
 (a) deoxy-hemocyanin is heme protein and paramagnetic
 (b) carbonic anhydrase hydrolyse the c-terminal of peptide bond
 (c) the coordination number of iron in cytochrome c is five
 (d) the quaternary structure of human-hemoglobin is best described as a tetramer of two different subunits.
63. The activity of the hair of an egyption mummy is 7 disintegration minute^{-1} of ^{14}C . If $t_{1/2}$ of ^{14}C is 5770 years and disintegration ratio of fresh sample of ^{14}C is 14 disintegration minute^{-1} then the age of the mummy is _____(years). (answer should be an integer)
64. In gas chromatography, the basis for separation of the components of the volatile material is the difference in
 (a) Partition coefficients (b) Conductivity
 (c) Molecular weight (d) Molarity
65. The radioactive element belong to thorium series is
 (a) $^{227}_{89}\text{Ac}$ (b) $^{229}_{91}\text{Th}$ (c) $^{211}_{84}\text{Po}$ (d) $^{228}_{89}\text{Ac}$



Space for rough work





CHEMISTRY - CY

GATE TEST SERIES-A INORGANIC CHEMISTRY

Date: 08-01-2019

ANSWER KEY

PART-A

- | | | | | |
|--------|--------|--------|--------|---------|
| 1. (c) | 2. (a) | 3. (b) | 4. (c) | 5. (c) |
| 6. (c) | 7. (c) | 8. (a) | 9. (c) | 10. (a) |

PART-B

- | | | | | |
|---------|--------------------|--------------------|----------------------|-----------|
| 11. (c) | 12. (b) | 13. (1) | 14. (3) | 15. (d) |
| 16. (d) | 17. (c) | 18. (12) | 19. (c) | 20. (c) |
| 21. (b) | 22. (c) | 23. (c) | 24. (c) | 25. (3.5) |
| 26. (c) | 27. (d) | 28. (d) | 29. (c) | 30. (b) |
| 31. (b) | 32. (4.50 to 4.60) | 33. (3) | 34. (a) | 35. (b) |
| 36. (5) | 37. (d) | 38. (c) | 39. (b) | 40. (b) |
| 41. (c) | 42. (d) | 43. (d) | 44. (b) | 45. (c) |
| 46. (a) | 47. (d) | 48. (b) | 49. (14.90 to 15.00) | 50. (b) |
| 51. (c) | 52. (b) | 53. (a) | 54. (c) | 55. (c) |
| 56. (4) | 57. (d) | 58. (b) | 59. (c) | 60. (b) |
| 61. (c) | 62. (d) | 63. (5770 to 5773) | 64. (a) | 65. (d) |

