IIT JAM 2018 Chemistry (CY) Question Paper

Time Allowed :3 Hours	**Maximum Marks :**100	**Total questions :**60

General Instructions

General Instructions:

 i) All questions are compulsory. Marks allotted to each question are indicated in the margin.

 ii) Answers must be precise and to the point.

iii) In numerical questions, all steps of calculation should be shown clearly.

iv) Use of non-programmable scientific calculators is permitted.

 v) Wherever necessary, write balanced chemical equations with proper symbols and units.

vi) Rough work should be done only in the space provided in the question paper.

1. On hydrolysis, aluminium carbide produces

(A) CH4

(B) C2H6

(C) C2H4

(D) C2H2

---

2. Carbonic anhydrase is an example of

(A) Hydrolase enzyme

(B) Redox enzyme

(C) O2 transport protein

(D) Heme protein


**3. The CORRECT order of melting points of group 15 trifluorides is**

(A) PF3 ¡ AsF3 ¡ SbF3 ¡ BiF3

(B) BiF3 ¡ SbF3 ¡ PF3 ¡ AsF3

(C) PF3 ¡ SbF3 ¡ AsF3 ¡ BiF3

(D) BiF3 ¡ AsF3 ¡ SbF3 ¡ PF3

---

4. NaF, KF, MgO and CaO are crystalline solids. They have NaCl structure. Their lattice energies vary in the order

(A) NaF ¡ KF ¡ MgO ¡ CaO

(B) KF ¡ NaF ¡ CaO ¡ MgO

(C) MgO ¡ CaO ¡ NaF ¡ KF

(D) CaO ¡ MgO ¡ NaF ¡ KF

---

5. The major product formed in the following reaction is

$$\underset{\text{Liq. NH}_3}{\xrightarrow{\text{NaNH}_2}}$$

(A)

(B)

(C)

(D)

---
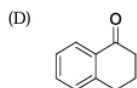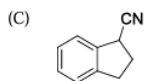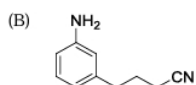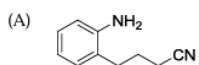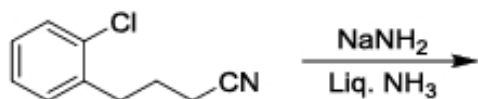
6. The compound that contains the most acidic hydrogen is

(A) H2C=CH2

(B) HC≡CH

(C) H2C=C=CH2

(D) H3C-CH3

---

7. The C-2 epimer of D-glucose is

(A) D-Mannose

(B) D-Fructose

(C) D-Galactose

(D) D-Gulose

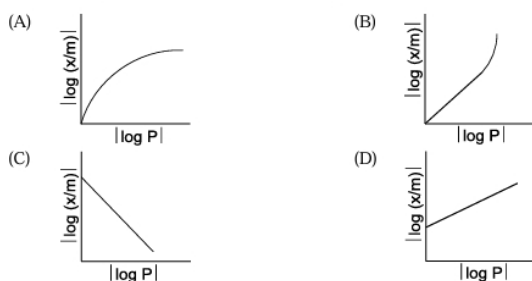## 8. The value of integral $\int_{-2}^{2} xe^{-2x^2}\,dx$ is

(A) 0

(B) $\frac{1}{2}$

(C) 1

(D) 2

9. The number of crystal systems and the number of Bravais lattices are, respectively,

(A) 14 and 7

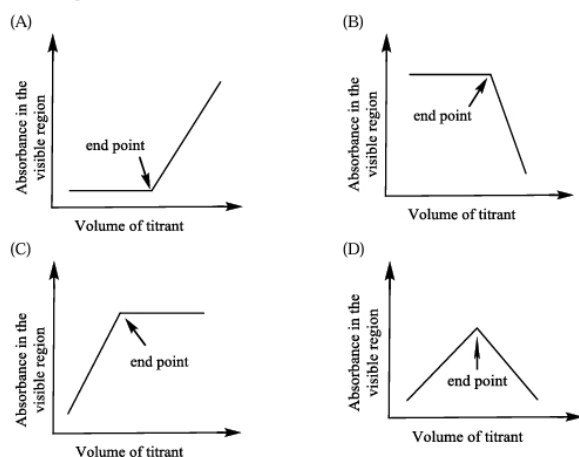(B) 7 and 32

(C) 32 and 14

(D) 7 and 14

10. For adsorption of a gas on a solid surface, the plot that represents Freundlich isotherm is

11. With respect to periodic properties, the CORRECT statement is

(A) Electron affinity order is F ¿ O ¿ Cl

(B) First ionisation energy order is Al ¿ Mg ¿ K

(C) Atomic radius order is N ¿ P ¿ As

(D) Ionic radius order is K+ ¿ Ca2+ ¿ Mg2+

12. Which plot represents a spectrophotometric titration, where the titrant alone absorbs light in the visible region?

(A)

Absorbance in the visible region

end point

Volume of titrant

(B)

Absorbance in the visible region

end point

Volume of titrant

(C)

Absorbance in the visible region

end point

Volume of titrant

(D)

Absorbance in the visible region

end point

Volume of titrant

---

13. Among the following metal carbonyl species, the one with the highest metal-carbon back bonding is

(A) $[Ti(CO)_6]^{2-}$

(B) $[V(CO)_6]^{-}$

(C) $[Cr(CO)_6]$

(D) $[Mn(CO)_6]^{+}$

---

14. The CORRECT order of $\triangle_0$ (the octahedral crystal field splitting of d orbitals) values for the following anionic metal complexes is

(A) $[Ir(CN)_6]^{3-} < [Rh(CN)_6]^{3-} < [Rh(CN)_6]^{3-} < [Co(CN)_6]^{3-}$

(B) $[Co(CN)_6]^{3-} < [Rh(CN)_6]^{3-} < [Ir(CN)_6]^{3-} < [Rh(CN)_6]^{3-}$

(C) $[Co(CN)_6]^{3-} < [Rh(CN)_6]^{3-} < [Rh(CN)_6]^{3-} < [Ir(CN)_6]^{3-}$

(D) $[Ir(CN)_6]^{3-} < [Co(CN)_6]^{3-} < [Rh(CN)_6]^{3-} < [Rh(CN)_6]^{3-}$

---

15. The decay modes of ^{14}C and ^{14}O are

(A) β decay

(B) positron emission

(C) β decay and positron emission, respectively

(D) positron emission and β decay, respectively

---

16. Consider the following four xenon compounds: XeF2, XeF4, XeF6 and XeO3. The pair of xenon compounds expected to have non-zero dipole moment is

(A) XeF4 and XeF6

(B) XeF2 and XeF4

(C) XeF2 and XeO3

(D) XeF6 and XeO3

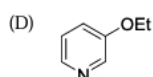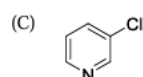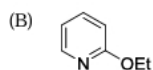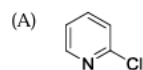**17. The CORRECT order of stability for the following carbocations is**

I   II   III   IV

(A) I ¡ III ¡ IV ¡ II

(B) III ¡ II ¡ IV ¡ I

(C) II ¡ IV ¡ III ¡ I

(D) IV ¡ I ¡ III ¡ II
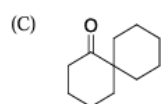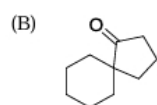
---

18. Among the dimethylcyclohexanes, which one can be obtained in enantiopure form?

---

19. The major product formed in the following reaction is

(A)

(B)

(C)

(D)

---

20. The product X in the following reaction sequence is

1) TiCl$_3$, Zn-Cu
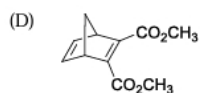2) Cold alkaline KMnO$_4$
3) H$_2$SO$_4$

X

(A)

(B)

(C)

(D)

---
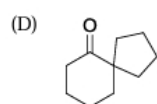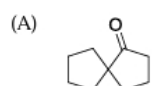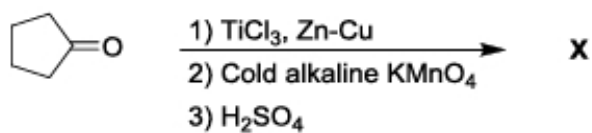
21. The major product formed in the following reaction is

Δ

(A)

(B)

(C)

(D)
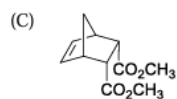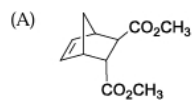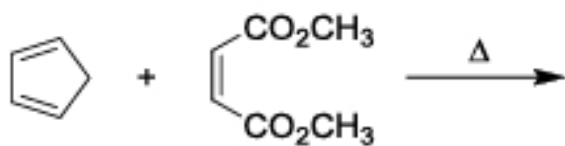
22. The major products Y and Z in the following reaction sequence are
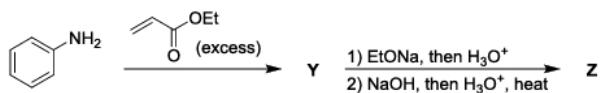
(A)

Y =   Z =

(B)

Y =   Z =

(C)

Y =   Z =

(D)

Y =   Z =

---

23. The CORRECT order of carbonyl stretching frequencies for the following compounds is
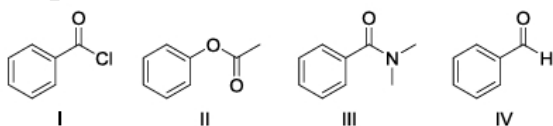
(A) II ¡ I ¡ III ¡ IV

(B) I ¡ III ¡ II ¡ IV

(C) IV ¡ II ¡ III ¡ I

(D) III ¡ IV ¡ II ¡ I

---

24. The sequence of three steps involved in the following conversion is
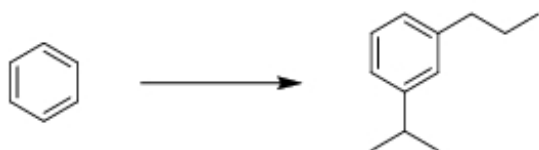
(A) (i) Friedel-Crafts alkylation; (ii) Reduction; (iii) Friedel-Crafts acylation

(B) (i) Friedel-Crafts acylation; (ii) Friedel-Crafts alkylation; (iii) Reduction

(C) (i) Friedel-Crafts acylation; (ii) Reduction; (iii) Friedel-Crafts alkylation

(D) (i) Friedel-Crafts alkylation; (ii) Friedel-Crafts acylation; (iii) Reduction

---

25. The CORRECT expression that corresponds to reversible and adiabatic expansion of an ideal gas is

(A) $\Delta U = 0$

(B) $\Delta H = 0$

(C) $\Delta S = 0$

(D) $\Delta G = 0$

---

26. The electrolyte AB2 ionises in water as
AB2 $\rightleftharpoons A^{2+} + 2B^-$
The mean ionic activity coefficient ($\gamma_\pm$) is
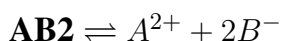
(A) $\gamma_{A^{2+}} \gamma_{B^-}$

(B) $\gamma^2_{A^{2+}} \gamma_{B^-}$

(C) $\gamma^3_{A^{2+}} \gamma^2_{B^-}$

(D) $\left(\gamma^2_{A^{2+}} + 2\gamma_{B^-} \right)^{-1/2}$

---

27. The reaction, $A \rightarrow$ **Products, follows first-order kinetics. If** $[A]$ **represents the concentration of reactant at time** t, **the INCORRECT variation is shown in**

---

28. The behavior of Cl$_2$ is closest to ideal gas behavior at

(A) 100 °C and 10.0 atm

(B) 0 °C and 0.50 atm

(C) 200 °C and 0.50 atm

(D) -100 °C and 10.0 atm

---

29. A vector $\vec{A} = i + xj + 3k$ is rotated through an angle and is also doubled in magnitude resulting in $\vec{B} = 4i + (4x - 2)j + 2k$. An acceptable value of x is

(A) 1

(B) 2

(C) 3

(D) $\frac{4}{3}$

---

30. With reference to the variation of molar conductivity (Λ_m) with concentration for a strong electrolyte in an aqueous solution, the CORRECT statement is

(A) The asymmetry effect contributes to decrease Λ_m whereas the electrophoretic effect contributes to increase Λ_m

(B) The asymmetry effect contributes to increase Λ_m whereas the electrophoretic effect contributes to decrease Λ_m

(C) Both asymmetry effect and electrophoretic effect contribute to decrease Λ_m

(D) Both asymmetry effect and electrophoretic effect contribute to increase Λ_m

---

31. Which of the following metal(s) is(are) extracted from its(their) sulfide ore(s) by self-reduction/air reduction method?

(A) Cu

(B) Al

(C) Au

(D) Pb

32. In a saturated calomel electrode, the saturation is with respect to

(A) KCl
(B) Hg2Cl2
(C) HgCl2
(D) AgCl

33. Consider the following six solid binary oxides: CaO, Al2O3, PbO, Cs2O, SiO2, and Sb2O3. The pair(s) of ionic oxides is(are)

(A) CaO and Al2O3
(B) CaO and PbO
(C) Cs2O and Al2O3
(D) SiO2 and Sb2O3

34. Choose the CORRECT answer(s) with respect to the magnesium-EDTA titration carried out in the pH range 7 – 10.5, using Solochrome black as indicator

(A) Magnesium–indicator complex is more stable than the magnesium–EDTA complex
(B) At the end point, the colour changes from red to blue
(C) After the end point, the colour of the solution is due to the indicator
(D) pH range of 7 – 10.5 is necessary for observing the specific colour change

35. On reaction with NaNO2 and HCl, which of the following amino alcohol(s) will yield compound P?

(A)

(B)

(C)

(D)
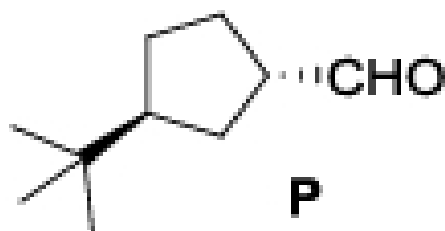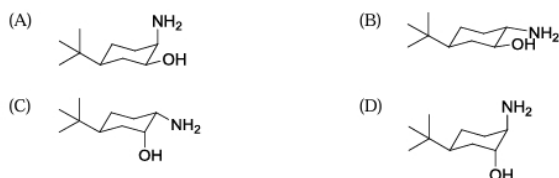
36. The CORRECT statement(s) about carbene is(are)

(A) Carbene is a neutral species

(B) Carbene is an intermediate in the Curtius rearrangement

(C) Carbene can insert into both σ and π-bonds

(D) Carbene is generated from amines on reaction with nitrous acid

37. The compound(s) that shows(show) positive haloform test is(are)

(A)

(B)

(C)

(D)
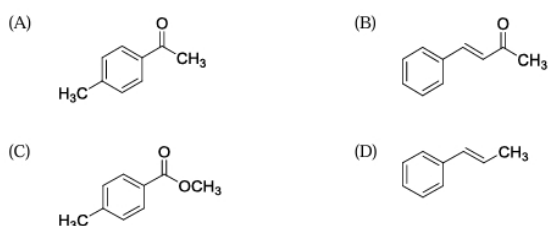
38. Tetrapeptide(s) that gives(give) the following product on reaction with Sanger's reagent followed by hydrolysis is(are)
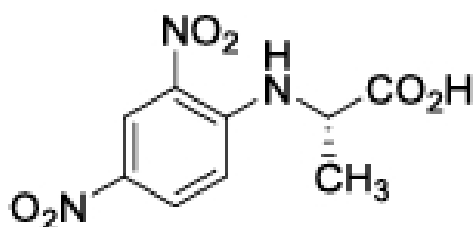
(A) Ala-Gly-Leu-Phe

(B) Asp-Phe-Leu-Pro

(C) Asp-Gly-Tyr-Phe

(D) Ala-Phe-Tyr-Pro

---

39. Which of the following set(s) of quantum numbers is(are) NOT allowed?

(A) $n = 3, l = 2, m_l = -1$

(B) $n = 4, l = 0, m_l = -1$

(C) $n = 3, l = 3, m_l = -3$

(D) $n = 5, l = 3, m_l = +2$

---

40. The CORRECT expression(s) for isothermal expansion of 1 mol of an ideal gas is(are)

(A) $\Delta A = RT \ln \frac{V_{initial}}{V_{final}}$

(B) $\Delta G = RT \ln \frac{V_{initial}}{V_{final}}$

(C) $\Delta H = RT \ln \frac{V_{final}}{V_{initial}}$

(D) $\Delta S = R \ln \frac{V_{final}}{V_{initial}}$

---

41. The number of possible isomers for $[Pt(\mathbf{py})(NH_3)_3BrCl]$ is .... (py is pyridine)

---

42. The volume of 0.3 M ferrous ammonium sulphate solution required for the completion of redox titration with 20 mL of 0.1 M potassium dichromate solution is .... mL.

---

43. Among the following hydrocarbon(s), how many of them would give rise to three groups of proton NMR peaks with 2:2:3 integration ratio?
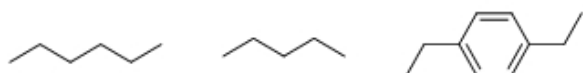
44. The number of stereoisomers possible for the following compound is ....

45. The number of hydrogen bond(s) present in a guanine-cytosine base pair is ....

46. The time for 50% completion of a zero-order reaction is 30 min. Time for 80% completion of this reaction is .... min.

47. Consider the reaction $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$**.**
The value of ΔU for the reaction at 300 K is -281.8 kJ mol^{-1}. The value of ΔH at same temperature is .... kJ mol^{-1}.
**[R = 8.3 J K^{-1} mol^{-1}]**

48. The nuclear spin quantum number (l) of a nucleus is $\frac{3}{2}$. When placed in an external magnetic field, the number of possible spin energy states it can occupy is ....

49. The value of C_v for 1 mol of N$_2$ gas predicted from the principle of equipartition of energy, ignoring vibrational contribution, is .... J K^{-1} mol^{-1} (rounded up to two decimal places).

50. Assuming ideal gas behavior, the density of O$_2$ gas at 300 K and 1.0 atm is .... g L^{-1} (rounded up to two decimal places).

**51. How many of the following interhalogen species have 2 lone pairs of electrons on the central atom?**

ClF_3, ClF_2^-, ClF_5, ICl_2^+

---
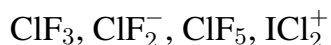
52. ^{24}Na decays to one-fourth of its initial amount in 29.8 hours. Its decay constant is .... hour^{-1} (rounded up to four decimal places).

---

53. The magnitude of crystal field stabilization energy (CFSE) of octahedral $[Ti(H_2O)_6]^{3+}$ complex is 7680 cm^{-1}. The wavelength at the maximum absorption (λ_{max}) of this complex is .... nm (rounded up to the nearest integer).

---

54. Elemental analysis of an organic compound containing C, H, and O gives percentage composition: C: 39.9% and H: 6.7%. If the molecular weight of the compound is 180, the number of carbon atoms present in the molecule is ....

---

55. The number of compounds having S-configuration among the following is ....

---
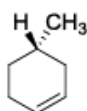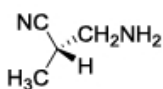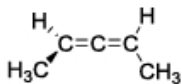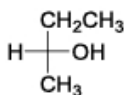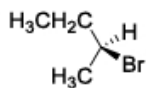
56. The emf of a standard cadmium cell is 1.02 V at 300 K. The temperature coefficient of the cell is -5.0×10^{-5} V K^{-1}. The value of ΔH° for the cell is .... kJ mol^{-1} (rounded up to two decimal places).

---

57. For the reaction $H_2(g) + \frac{1}{2} O_2(g) \longrightarrow H_2O(l)$, the following information is given:

$\Delta H^\circ = -285\,\text{kJ/mol}$, $S^\circ_{H_2O(l)} = 70\,\text{J K}^{-1}\,\text{mol}^{-1}$, $S^\circ_{O_2(g)} = 204\,\text{J K}^{-1}\,\text{mol}^{-1}$, $S^\circ_{H_2(g)} = 130\,\text{J K}^{-1}\,\text{mol}^{-1}$

The value of $\Delta S^\circ_{\text{universe}}$ for the reaction is .... J K^{-1} mol^{-1}.

---

58. For H_2 molecule, the fundamental vibrational frequency ν_e can be taken as 4400 cm^{-1}. The zero-point energy of the molecule is .... kJ/mol (rounded up to two decimal places).

$$[h = 6.6 \times 10^{-34}\,\text{J·s},\ c = 3 \times 10^8\,\text{m/s},\ N_A = 6 \times 10^{23}]$$

---

59. The solubility of PbI$_2$ in 0.10 M KI(aq) is .... $\times 10^{-7}$ M (rounded up to two decimal places).

[The solubility product, $K_{sp} = 7.1 \times 10^{-9}$]

---

60. The electron of a hydrogen atom is in its nth Bohr orbit having de Broglie wavelength of 13.4 Å. The value of n is .... (rounded up to the nearest integer).

$$[\text{Radius of } n\text{th Bohr orbit is } r_n = 0.53n^2\,\text{Å},\ \pi = 3.14]$$