

INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
Department of Chemistry
CH-101 (B.Tech. 1st Semester), Quiz-1

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| Duration: 8.00 - 8.45 AM Full marks: 15 Date: 27/08/2019 (Tuesday) Answer all the questions and write the answers inside the box. Only fully correct answers will be accepted and there will be no partial marks. |
| 1. Given the Planck's radiation law expressed in wavelength, $\rho(\lambda)d\lambda = \frac{8\pi hc}{\lambda^5} \frac{1}{\frac{hc}{(e^{\lambda kT}-1)}} d\lambda$ and considering |
| $\lambda << \frac{hc}{kT}$, the wavelength at which the radiation would be maximum (λ_{max}) is, (Tick inside the appropriate box) |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ |
| 2. For a particle-in-a-box of length L = 6.63 Å, the wave function can be written as $\Psi(x) = \sqrt{\frac{2}{L}} \sin \frac{n\pi x}{L}$. The value of linear momentum in the 3 rd excited state (ground state is the lowest energy state) (in the unit of kg m s ⁻¹) would be, (Use h = 6.63× 10 ⁻³⁴ Js). (Tick inside the appropriate box) (2.5 Marks) (A) 0.2×10^{-24} ; (B) 2.0×10^{-24} ; (C) 2.0×10^{-34} ; (D) 0.2×10^{-34} |
| 3. Draw the Lewis structures of IF ₄ and ClF ₄ with appropriate molecular geometry. (1.0 Mark) |
| IF4 (Answer) CIF4 (Answer) Figure F: |
| 4. Arrange the following complexes in the decreasing order of crystal field splitting energy Δ_0 . |
| (i) $[Cr(NH_3)_6]^{3+}$, $[CrCl_6]^{3-}$, $[Cr(CN)_6]^{3-}$ (ii) $[Co(H_2O)_6]^{2+}$, $[Rh(H_2O)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$ (ii) $[Cr(CN)_6]^{3-} > [Cr(NH_3)_6]^{3+} > [Cr(NH_3)_6]^$ |

5. Using Slater's rules, calculate the effective nuclear charge for 3d electron in copper.

(1.0 Mark)

Answer

6. State whether the following statements are True (T) or False (F)

(1.0 Mark)

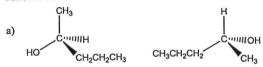
| Statements | T/F |
|---|-----|
| (i) N ₂ has a very high electron affinity | F |
| (ii) For the isoelectronic pair Br and Rb ⁺ , the one with the larger radius is Br | T |
| (iii) For the Compounds EH ₃ (E = As, N and P), the increasing order of their H-E-H bond | T |
| angles is AsH ₃ < PH ₃ < NH ₃ | |

7. Using CFT indicate the correct d-orbital splitting pattern for a square planar complex. (Tick inside the appropriate box)

(1.0 Mark)

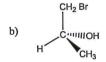
| (i) $d_z 2 < d_x 2 - y 2 < d_{xy} < d_{xz} < d_{yz}$ | (ii) $d_{xy} < d_z 2 < d_x 2 - y 2 < d_{xz} < d_{yz}$ | |
|--|---|--|
| (iii) $d_{xz} = d_{yz} < d_z 2 < d_x 2 - y 2 < d_{xy}$ | (iv) $d_{xz} = d_{yz} < d_z 2 < d_{xy} < d_x 2 - y 2$ | |

8. Do the following structure pairs represent identical molecules, a pair of enantiomers or a pair of diastereoisomers? (3.0 Marks)





enantiomers



identical



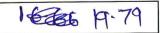
c) C:1181Br



enantiomers

9. Enantiomerically pure 2-Butanol (25.00 g) is dissolved in 20.0 mL of ethanol. 5.00 mL of this solution is placed in a 200 mm polarimeter tube at 25 °C. The observed rotation is 60° counter-clockwise. The optical rotation of a sample of 2-Butanol (10 g in 20 mL of ethanol) was measured in the same polarimeter under identical conditions. The observed rotation was found to be + 19°. What is the enantiomeric excess of the sample?

Answer



(2.0 Marks)