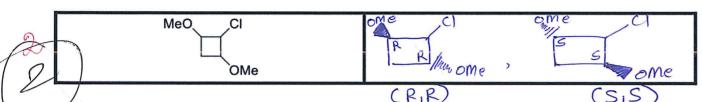
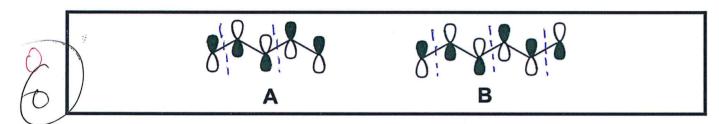
14. Provide the absolute configuration(s) of optically active isomer(s) of the following compound.

2 Marks

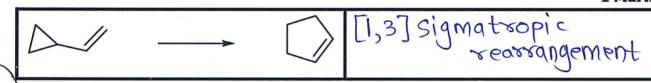


15. Linear combinations of atomic orbitals representing π -molecular orbitals are given below. Place (via dotted line using pen, not with pencil) the appropriate number(s) of nodes at appropriate position (s). 2 Marks



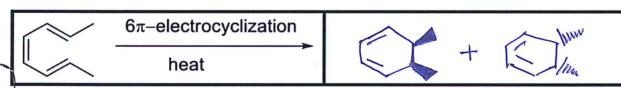
16. Provide the name of the pericyclic reactions involved in the following transformation.

1 Mark

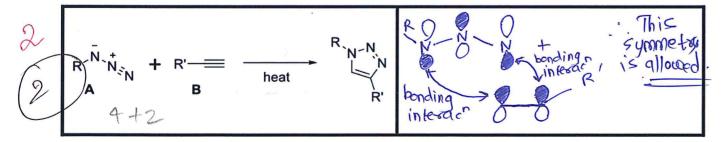


17. Provide the structure of the major product formed in the following pericyclic reactions with proper relative stereochemistry.

1 Mark



18. Present an FMO analysis for following cycloaddition reaction using LUMO of A and HOMO of B to predict the feasibility of the reaction. Is this reaction symmetry allowed?2 Marks







Indian Institute of Technology, Guwahati

Guwahati, INDIA 781 039

Department of Chemistry

Date: 20 September 2019; 2:00-4.00 p.m.

CH-101

Mid Semester Exam

Maximum Marks = 30

Name: Pradnesh p. Kalkars

Division:

Signature of Invigilator

Roll No.: 190 (23046

Tutorial Group: T 18

Char

Answer only in this sheet. Only fully correct answers will be accepted.

All questions are compulsory. Rough work is mandatory.

For a particle-in-a-box of length L, the wavefunction is written as, $\Psi(x) = \sqrt{\frac{2}{L}} \sin \frac{n\pi x}{L}$. If

for the first excited state (n = 2), the value of energy is 5.5×10^{-19} J, then the de Broglie wavelength of the particle (in Å) would be, (*Please Tick*)

2.0 Marks

3.32	4.42	6.63	8.84	Use (h = 6.630×10^{-34} Js, m = 9.11×10^{-31} kg)
		V		

A proton (1.67×10⁻²⁷ kg) is confined in an infinite one-dimensional square well of width 10 fm (1 fm = 10⁻¹⁵ m); h = 6.62 × 10⁻³⁴ Js; c = 3.0 × 10⁸ ms⁻¹. The approximate wavelength of the photon (in fm) emitted when the proton undergoes a transition from the second excited state to the first excited state is: (Please Tick)
 2.0 Marks

/				
/	242	303	151	121 🏏

3. If the wave function for an electron circulating on a ring could be written as $\Psi(\varphi) = Ae^{im\varphi}$, then the value of A would be, (*Please Tick*)

2.0 Marks

$\sqrt{2\pi}$	$1/\sqrt{\pi}$	$1/\sqrt{2\pi}$	$\sqrt{2/\pi}$

4. The force required to stretch the 12 C-H bond (harmonic oscillator) by 0.2 Å is 250 pN (1 pN= 10^{-12} N). The vibrational frequency of the 12 C-H bond in Hz is: (*Please Tick*) **2.0 Marks**

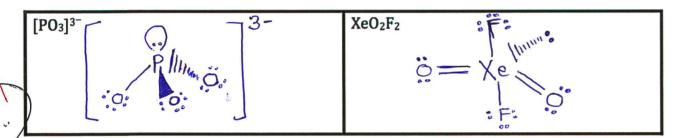
		Alda		
2	1.44 x 10 ¹³	9.03 x 10 ¹³	18.06 x 10 ¹³	4.51 x 10 ¹³



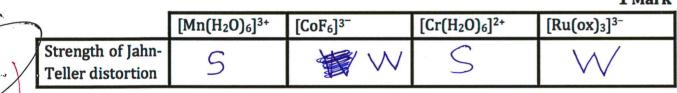
5. The hydrogenic Hamiltonian for the electron with mass me and nucleus with mass mo can be rewritten using reduced mass (μ) and total mass (m) as, (Please Tick) 2.0 Marks

	$H = -\frac{\hbar^2}{2\mu} \nabla_{c.m.}^2 - \frac{\hbar^2}{2m} \nabla^2 - \frac{Ze^2}{4\pi\varepsilon_0 r}$	$H = -\frac{\hbar^2}{2m} \nabla_{c.m.}^2 - \frac{\hbar^2}{2\mu} \nabla^2 + \frac{Ze^2}{4\pi\varepsilon_0 r}$
_	$\mathcal{H} = -\frac{\hbar^2}{2\mu} \nabla_{c.m.}^2 - \frac{\hbar^2}{2m} \nabla^2 + \frac{Ze^2}{4\pi\varepsilon_0 r}$	$H = -\frac{\hbar^2}{2m} \nabla_{c.m.}^2 - \frac{\hbar^2}{2\mu} \nabla^2 - \frac{Ze^2}{4\pi\varepsilon_0 r}$

6. Draw the Lewis structure with appropriate molecular geometry for the following. 1 Mark



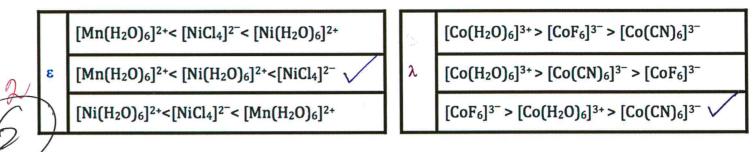
7. Indicate if the following exhibit Strong (S), Weak (W) or No (N) Jahn-Teller distortion 1 Mark



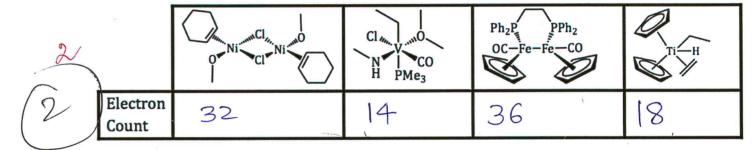
- 8. Which of the following statements are true (T) and which are false (F). $0.5 \times 8 = 2 \text{ Marks}$
 - a) Asymmetry in e_g orbital occupancy results in strong Jahn-Teller distortion (F)/ (F)
 - b) Using VBT, one can infer that $[CoF_6]^{3-}$ involves d^2sp^3 hybrid orbitals
 - c) In a square-pyramidal complex, the d_z^2 orbitals are destabilized

 - d) In d^4 octahedral complexes with π -donor ligands, the LUMO is e_g^* molecular orbital (\digamma)
 - e) In octahedral complex with CO ligands, the first d electron is filled in t_{2a} (π) bonding (T) molecular orbital
 - f) The C-H bond energies for the given molecules follows the trend:
 - Acetylene > Ethylene >> Methane
 - g) There is an large increase in atomic radii as one moves from Al to Ga
 - h) Cl has a larger ionic radius than P3-

9. Which of the following are true when, one compares Molar Extinction Co-efficient (ε) and Wavelength of Absorption (λ) that are highlighted (*Please Tick*) 2 Marks



- 10. Indicate the number of valence electron on each metal complex.
- $(0.5 \times 4) = 2$ Marks



- 11. Using CFT, indicate the correct d-orbital splitting pattern for octahedral and square-pyramidal complex (Please Tick) 1 Mark
 - a) Octahedral: $d_{z^2} = d_{x^2-v^2} < d_{xy} = d_{xz} = d_{yz}$; Square pyramidal: $d_{xz} = d_{yz} < d_{z^2} < d_{xy} < d_{x^2-v^2}$ b) Octahedral: $d_{xy} < d_{z^2} = d_{x^2-y^2} < d_{xz} < d_{yz}$; Square pyramidal: $d_{xz} = d_{yz} < d_{z^2} < d_{x^2-y^2} < d_{xy}$ (e) Octahedral: $d_{xz} = d_{yz} = d_{xy} < d_{z^2} = d_{x^2-y^2}$; Square pyramidal: $d_{xz} = d_{yz} < d_{xy} < d_{z^2} < d_{x^2-y^2}$ d) Octahedral: $d_{xz} = d_{yz} < d_{z^2} < d_{xy} < d_{x^2-y^2}$; Square pyramidal: $d_{xz} < d_{yz} < d_{xy} < d_{z^2} = d_{x^2-y^2}$
- 12. The magnitude of the difference in the CFSE (ignoring pairing energy), of $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2+}$ is (Please Tick) 1 Mark
- 2.0 Ao 1 1.0 **Δ**o 0.0 Δο 3.3 ∆o
- 13. Determine the configurations (R/S) of the chiral centers of the following molecules. **2 Marks**