.0	1										
		electron homolepti onyl stretching freq	ic complexes of Mn, Ti, C quency $v_{co}$	r and V with CO as li	gand and arra	ange them in the	e increasing order 2 Marks				
•		Story		CX < M	n < Ti	∠\					
() 29.	Arrange the complexes $Mo(CO)_3(PR_3)$ with $R = OMe$ , $Cl$ , $F$ and $Ph$ in the increasing order of their $M$ - $C$ bond strength 1 Mar										
1	CLLFLOMELPh.										
7 3	Draw the product obtained when Vaska's complex [IrCl(CO)(PPh <sub>3</sub> ) <sub>2</sub> ] is reacted with (i) CH <sub>4</sub> and (i) CH <sub>3</sub> Br  1 + 1 Man										
	(i)	PPhs	Ex CH3 A	(ii) CO Is pph3  Ryp Is Bo.							
31.	Indicate the number of valence electron on each metal complex. (0.5 X										
		H CO CO	Sir N	//mm. Ni CI	Ni ******CI	OC Fe Ph	Ph CO				
~	Electron Count					1					
32.	Indicate if the following exhibit Strong (S), Weak (W) or No (N) Jahn-Teller distortion (0.5 X 4) Marks $ [Fe(ox)_3]^{3-} \qquad [Fe(en)_3]^{3+} \qquad [Ti(H_2O)_6]^{3+} \qquad [Cr(H_2O)_6]^{2+} $										
	Strength of Jahn-Teller distortion [Fe(ox) <sub>3</sub> ] <sup>3</sup>			[Fe(en) <sub>3</sub> ] <sup>3+</sup>							
33.	In the MO approach, the frontier orbitals for an $O_h$ complex with $\sigma$ -donor ligands are $t_{2g}$ (non-bonding) and $e_g(\sigma^*)$										
	respectively. Indicate the corresponding frontier orbitals in the case of $\pi$ -donating and $\pi$ -accepting ligands $\pi$ -accepting Ligands										
34.	Assign the transitions for the following bands observed in the electronic absorption spectrum of [CrFe] <sup>3</sup> . 2 Mark										
	670 nm Transition:		440 nm Transition:	440 nm 2		90 nm ransition:					
35.	. The respective ground state term for $[CuCl_4]^2$ and $[Cu(H_2O)_6]^{2+}$ are										
	(U) <sup>2</sup> E an	d <sup>2</sup> T <sub>2g</sub>	(V) ${}^2E_g$ and ${}^5T_2$	$(X)^{2}T_{2}$ a	nd <sup>2</sup> E <sub>g</sub>	(Y) <sup>5</sup> T	$_2$ and $^5E_g$				
36.											
	Zeff = 4.3   $Z$ eff = 3.30										
37.			e in the CFSE (ignoring pa								
	2.0 Δ	0	(V) 1.0 Δ <sub>0</sub>	(X) 0.0 A			3 Δ <sub>0</sub>				
11/				T 03 12. FO (ONE) 12-1							
38.		complex ions, ([Cr	(NH <sub>3</sub> ) <sub>6</sub> ] <sup>3+</sup> , [CrCl <sub>6</sub> ] <sup>3–</sup> , [Cr(l	H <sub>2</sub> O) <sub>6</sub> ] <sup>3+</sup> , [Cr(CN) <sub>6</sub> ] <sup>3-</sup> ]	in the decrea	asing order of th	1 Mark				
38.	absorption	complex ions, ([Cr	(NH3)6]3+, [CrCl6]3-, [Cr(1				1 Mark				
38.	absorption  C  Draw and no	val <sub>3</sub> ->	VIII	> C&MH	3)673+>	[((cn)	1 Mark				
38.	absorption	val <sub>3</sub> ->	[Ca(H20)6]3+	> C&MH		[((cn)	1 Mark				
	Draw and no	ame the molecular	[Ca(H20)6]3+	> TCV(NH)	clahed	[(x(cn)	1 Mark				



## Indian Institute of Technology, Guwahati Guwahati. INDIA 781 039

Department of Chemistry

Date: 27 November 2017; 2:00-5.00 p.m.

CH-101

**End-Semester Exam** 

Maximum Marks = 60

Name: IBRAR ALI

 $\overline{5kT}$ 

Division:

Signature of Invigilator: (2).

Roll No .: 170121020.

Signature of Student

Answer only in this sheet. Only fully correct answers will be accepted. All questions are compulsory. Rough work is mandatory

Given the Planck's radiation law  $\rho(\upsilon) = \frac{8\pi h \upsilon^3}{c^3} \frac{1}{\frac{h\upsilon}{ekT} - 1}$  and  $\frac{N_2}{N_1} = e^{-\Delta E/kT} = e^{-h\upsilon/kT}$ , the relationship between Einstein A and B

coefficients i.e., A/B would be:

(Z)  $\frac{8\pi\hbar v^4}{c^3}$ (Y)  $\frac{8\pi\hbar}{\lambda^3}$ (X)  $\frac{8\pi\hbar v^4}{\lambda^3}$ (W)  $\frac{8\pi\hbar c^3}{v^3}$ 

The C-H bond (harmonic oscillator) vibrational frequency is 9.0 x 10<sup>13</sup> Hz. The force required to stretch the C-H bond (harmonic oscillator) by 0.2 Å is 250 pN. The vibrational frequency of the C-H bond in Hz is:

2.0 Marks

(C)  $9.0 \times 10^{13}$  (B)  $9.0 \times 10^{12}$  (A)  $4.5 \times 10^{12}$  (D)  $4.5 \times 10^{13}$ 

A proton  $(1.67 \times 10^{-27} \text{ kg})$  is confined in an infinite one-dimensional square well of width 10 fm  $(1 \text{ fm} = 10^{-15} \text{ m})$ .  $h = 6.62 \times 10^{-34} \text{ Js}$ ;  $c = 3.0 \times 10^8 \text{ ms}^{-1}$ . The approximate wavelength of the photon (in fm) emitted when the proton undergoes a transition from the second excited state (n = 3) to the first excited state (n = 2) is:

2.0 Marks

242

(I) 303

(L) 121

(J) 202

Butadiene molecule is a conjugated molecule and can be considered (for particle-in-a-box model) to be linear with length of 578 pm. With the mass of electron,  $9.109 \times 10^{-31}$  kg and Planck's constant being  $6.626 \times 10^{-34}$  Js, the absorbance band due to energy difference of  $9.02 \times 10^{-19}$  J would be due to transitions between quantum states,

2.0 Marks

energy difference of  $9.02 \times 10^{-19}$  ] would be due to transitions between quantum states,

(O) 1 and 2 (N) 4 and 5

For a two-electron system when the spatial part of the wavefunction is  $\Psi_+ = \left[\frac{1}{\sqrt{2}} \{\Psi_a(r_1)\Psi_b(r_2) + \Psi_b(r_1)\Psi_a(r_2)\}\right]$ , the spin-part of the wavefunction can then be written as

part of the wavefunction can then be written as  $\frac{2.0 \text{ Marks}}{\sqrt{2}}$   $\frac{1}{\sqrt{2}} \{\alpha(1)\beta(2) - \beta(1)\alpha(2)\}$   $\frac{1}{\sqrt{2}} \alpha(1)\beta(2)$   $\frac{1}{\sqrt{2}} \{\alpha(1)\beta(2) + \beta(1)\alpha(2)\}$   $\frac{1}{\sqrt{2}} \beta(1)\alpha(2)$ 

For a solution of 10% transmission at 600 nm, the absorbance (A) is

2.0 Marks

(U) 0.1 (A) 1.0 (B) 100.0

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,

(X)  $\sqrt{2\pi}$  (B)  $1/\sqrt{\pi}$  (A)  $1/\sqrt{2\pi}$  (Z)  $\sqrt{2/\pi}$  2.0 Marks

Given the Planck's radiation law expressed in wavelength,  $\rho(\lambda)d(\lambda) = \frac{8\pi hc}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda kT}}-1} d(\lambda)$  and considering  $\lambda \ll \frac{hc}{kT}$ , the

wavelength at which the radiation would be maximum  $(\lambda_{max})$  is,

(C) 8hc (D) hc (X) 5hc

5kT

 $\delta$ . For nitrogen molecule at room temperature (T = 300 K), the typical rotational transition frequency is 30 GHz and  $\delta v/_{
m V}=$ 

 $2.3 \times 10^{-6}$ ; where  $\delta v = \frac{2v}{c} \left(\frac{2kT \ln 2}{m}\right)^{1/2}$ . The linewidth would be about

(U) 70 GHz (E) 70 Hz (T) 70 kHz

1

kT

