

CHM 151Y CHEMISTRY: THE MOLECULAR SCIENCE INORGANIC CHEMISTRY SECTION

TERM TEST #3: February 13, 2023

PROF. D. W. STEPHAN

INSTRUCTIONS: The exam time is fifty minutes. Please fill in your name, student number, **and two-digit lab demonstrator group** (where your marked exam will be returned) below. Molecular model kits are allowed. When instructed to begin, you should write your initials at top of each page of the exam. Read the instructions for each problem carefully. Write your answers on the test sheet in the space provided. Only answers written in pen will be considered for re-grading.

DO NOT LOOK AT THE OTHER TEST PAGES UNTIL INSTRUCTED TO BEGIN

(LAST NAME, First Name)	
Student Number	Demonstrator Group # (two digits)

Question	Total Marks Possible	Marks Awarded
1	14	
2	8	
3	8	
Total	30	

Question 1 (a). [8 marks]

Draw the Lewis dot structures for phosgene $\text{C}(\text{O})\text{Cl}_2$ and XeO_2F_2 and label the geometry of the central atom. Using VSEPR theory, describe the perturbation from the ideal geometries in each case.

Question 1 (b). [6 marks]

List, describe and distinguish three allotropes of phosphorus.

Question 2 (a). [4 marks]

Use hybrid orbital diagrams, describe the mixing of the atomic orbitals of the central atom leads to hybrid orbitals in phosphorus trifluoride, PF_3 .

Question 2 (b). [4 marks]

Draw two isomers of six coordinate metal complexes, $(\text{Ph}_2\text{PCH}_2\text{CH}_2\text{PPh}_2)_2\text{CoBr}_2$. Label which is chiral and which is not.

Question 3. [8 marks]

The two octahedral complexes $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Co}(\text{CN})_6]^{3-}$ exhibit dramatically different magnetic properties. One is diamagnetic and the other is paramagnetic. Draw a d-orbital splitting diagram, predict the number of unpaired electrons and account for difference in the magnetic properties.

END OF TEST

Periodic Table of the Elements

1																	17	18	
IA																	VIIA	VIIIA	
1	2													13	14	15	16	1	2
H 1.0079	IIA													IIIA	IVA	VA	VIA	H 1.0079	He 4.0026
3	4													5	6	7	8	9	10
Li 6.941	Be 9.012													B 10.81	C 12.011	N 14.007	O 15.999	F 18.998	Ne 20.179
11	12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Na 22.990	Mg 24.305	IIIB	IVB	VB	VIB	VII B	←	VIII B	→	IB	IIB	Al 26.982	Si 28.086	P 30.974	S 32.06	Cl 35.453	Ar 39.948		
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
K 39.098	Ca 40.08	Sc 44.956	Ti 47.90	V 50.941	Cr 51.996	Mn 54.938	Fe 55.847	Co 58.933	Ni 58.70	Cu 63.546	Zn 65.38	Ga 69.72	Ge 72.59	As 74.922	Se 78.96	Br 79.904	Kr 83.80		
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54		
Rb 85.468	Sr 87.62	Y 88.906	Zr 91.22	Nb 92.906	Mo 95.94	Tc [97.91]	Ru 101.07	Rh 102.905	Pd 106.4	Ag 107.868	Cd 112.41	In 114.82	Sn 118.69	Sb 121.75	Te 127.60	I 126.904	Xe 131.30		
55	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86		
Cs 132.905	Ba 137.33	La	Hf 178.49	Ta 180.948	W 183.85	Re 186.21	Os 190.2	Ir 192.22	Pt 195.05	Au 196.966	Hg 200.59	Tl 204.37	Pb 207.2	Bi 208.98	Po [208.98]	At [209.99]	Rn [222.02]		
87	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118		
Fr [223.02]	Ra [226.03]	Ac	Rf [265.12]	Db [268.13]	Sg [271.13]	Bh [270]	Hs [277.15]	Mt [276.15]	Ds [281.16]	Rg [280.16]	Cn [285.17]	Nh [284.18]	Fl [289.19]	Mc [288.19]	Lv [293]	Ts [294]	Og [294]		
		57	58	59	60	61	62	63	64	65	66	67	68	69	70	71			
Lanthanides		La 138.905	Ce 140.12	Pr 140.907	Nd 144.24	Pm [145]	Sm 150.4	Eu 151.96	Gd 157.25	Tb 158.925	Dy 162.50	Ho 164.930	Er 167.26	Tm 168.934	Yb 173.04	Lu 174.967			
		89	90	91	92	93	94	95	96	97	98	99	100	101	102	103			
Actinides		Ac [277.03]	Th 232.038	Pa 231.035	U 238.029	Np [237.05]	Pu [244.06]	Am [243.06]	Cm [247.07]	Bk [247.07]	Cf [251.08]	Es [252.08]	Fm [257.10]	Md [258.10]	No [259.10]	Lr [262.11]			