

**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 C(O)Cl₂ and XeO₂F₂ 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 IA 1 H 1.0079	2 IIA 3 Li 6.941	4 Be 9.012												13 IIIA 10.81	14 IVA 12.011	15 VA 14.007	16 VIA 15.999	17 VIIA 1.0079	18 VIIIA 4.0026
11 Na 22.990	12 Mg 24.305	3 IIIB 44.956	4 IVB 47.90	5 VB 50.941	6 VIB 51.996	7 VIIIB 54.938	8 VIIIB 55.847	← VIIIB 58.933	→ VIIIB 58.70	10 IB 63.546	11 IIB 65.38	12 IIB 69.72	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948	
19 K 39.098	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.941	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.70	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80		
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc [97.91]	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.868	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30		
55 Cs 132.905	56 Ba 137.33	57-71 La 178.49	72 Hf 180.948	73 Ta 183.85	74 W 186.21	75 Re 190.2	76 Os 192.22	77 Ir 195.05	78 Pt 196.966	79 Au 200.59	80 Hg 204.37	81 Tl 207.2	82 Pb 208.98	83 Bi [208.98]	84 Po [209.99]	85 At [222.02]	86 Rn [294]		
87 Fr [223.02]	88 Ra [226.03]	89-103 Ac [265.12]	104 Rf [268.13]	105 Db [271.13]	106 Sg [270]	107 Bh [277.15]	108 Hs [276.15]	109 Mt [281.16]	110 Ds [280.16]	111 Rg [285.17]	112 Cn [284.18]	113 Nh [284.18]	114 Fl [289.19]	115 Mc [288.19]	116 Lv [293]	117 Ts [294]	118 Og [294]		

Lanthanides	57 La 138.905	58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm [145]	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967
Actinides	89 Ac [277.03]	90 Th 232.038	91 Pa 231.035	92 U 238.029	93 Np [237.05]	94 Pu [244.06]	95 Am [243.06]	96 Cm [247.07]	97 Bk [247.07]	98 Cf [251.08]	99 Es [252.08]	100 Fm [257.10]	101 Md [258.10]	102 No [259.10]	103 Lr [262.11]