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一、問答題

(一) At most, how many electrons in an atom can have both the principle quantum number n = 5 and angular quantum number l = 3 ? (5 points)

(二) X-ray crystal structures of ClF_3O and BrF_3O have been determined.

1. Would you expect the lone pair on the central halogen to be axial or equatorial in these molecules? (2 points) Why? (3 points) (Draw the Lewis structure will be helpful)
2. Which molecule would you predict to have the smaller $F_{equatorial}$-central atom-oxygen angle? (2 points) Why? (3 points)

(三) Using the Character table shown below, constructing the molecular orbital of PH_3 (please write the construction process as detail as possible). (15 points)

C_{3v}	E	$2C_3$	$3\sigma_{v)}$		
A_1	1	1	1	z	x^2+y^2, z^2
A_2	1	1	-1	R_z	xy
E	2	-1	0	(x, y) (Rx, R_y)	(x^2-y^2, xy) (xz, yz)
I	II			III	IV

(四) What are the differences (name 2 differences) between the structure of diamond, fullerene and graphite. (20 points)

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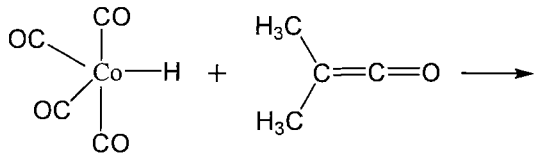
(五) Draw the structure of $[Re_2Cl_8]^{2-}$(4 points) and estimate the bond order of Re-Re metal-metal bond (explain how do you use to estimate the bond order). (6 points)

(六) Predict the metal-containing product(s) of the following reactions (write the structure(s) of the product(s)). (20 points, 4 points each)

1. $2HF + 2SbF_5 \rightleftharpoons$

2. 

3. $[Fe(H_2O)_5(OH)]^{2+} + H^+ \rightarrow$

4. *cyclo*-$C_5H_5MgBr + FeCl_3 \rightarrow$

5. $[Co(CO)_4]_2 + F_2C{=}CF_2 \rightarrow$

(七) Name 5 inorganic compounds containing only carbon elements (5 points) and briefly describe their electric property (such as insulator, semi-conductor or conductor). (5 points)

(八) Beryllium is distinctly different from the other alkali earths in its chemical properties. Therefore the structure of beryllium halide (such as $BeCl_2$) will depend on the temperature. Write down the three chemical structures of $BeCl_2$ at different temperatures (6 points) and explain why the structure of $BeCl_2$ is dependent of the temperature. (4 points)