

1. (10%) Cisplatin, $cis-[PtCl_2(NH_3)_2]$, has been used as an anti-cancer drug in clinical treatment, whereas transplatin, $trans-[PtCl_2(NH_3)_2]$ has no anti-cancer effect. Research work in this area reveals that when NH_3 of cisplatin is replaced by alkyl amine, the anti-cancer effect follows the order:

primary > second > tertiary amine. Explain this order.

2. (10%) Gold recovery from ores is quite important, because it has a high commercial value. One of the recovery methods involves "zinc cementation", using zinc metal to react with $[Au(CN)_2]^-$, and then to give Au and CN^- . Zinc is known as a reducing metal, but it is still strange to find that this metal can even react with the complex with negative charges. Explain this strange feature.

3. (10%) Hydrogenation using platinum as a heterogeneous catalyst is important in industry. In the gas phase the homolysis of H_2 into two H atoms without such a catalyst requires 435 KJmol^{-1} and a temperature above 1300 K, whereas this homolysis only requires a temperature at 20 K in the presence of the Pt catalyst. Explain the difference.

4. (20%) A linear or a branched alkane can be obtained from hydrogenation of alkene, using an organometallic complex as a homogeneous catalyst. It is usually found that addition of phosphine can control the type of products. Why? Give a mechanism to clarify your explanation.

5. (10%) Asymmetric synthesis, such as the Monsanto process for the production of L-Dopa, is known to be very important, using an organometallic complex with chiral ligands. Explain why the asymmetric induction can occur to give 96% e. e.

6. (10%) NO_x is the major part forming the air pollution. It is produced daily by the high-temperature combustion of hydrocarbons such as gasoline in vehicles such as cars, airplanes, and motorcycles. Research has found that the effective catalyst helping to converting NO_x and CO into N_2 and CO_2 is rhodium

(背面仍有題目,請繼續作答)

metal, working as a heterogeneous catalyst. Give a possible mechanism for the conversion pathway.

7. (10%) Some inorganic chemicals are used due to their decorative purposes. Explain why an inorganic pigment that is ideal for a printing ink is unlikely to be ideal for ceramic applications.

8. (10%) There are several methods used in the preparation of ceramic powder. Compare the differences among hydrothermal synthesis, sol-gel method, and chemical vapor deposition (CVD).

9. (10%) Many inorganic compounds can be used for water purification, helping to reduce water pollution. Precipitation and sorption are the two commonly used processes. Give some details about these two processes.