

MIT OpenCourseWare
<http://ocw.mit.edu>

5.111 Principles of Chemical Science
Fall 2008

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.

5.111 Principles of Chemical Science
Selected biology-related questions from problem sets for lectures 27-36

Transition Metals

A.

Cisplatin [$\text{Pt}(\text{NH}_3)_2\text{Cl}_2$] is a potent anticancer drug. (a) Draw the structure of this square planar molecule and the structure of its isomer *transplatin*. (b) What are the angles for a square planar molecule? (c) What is the CN? (d) Draw the crystal field energy-level diagram for *cisplatin*, labeling the *d*-orbitals. (e) Predict whether *cisplatin* is diamagnetic or paramagnetic? Explain your answer.

B.

Octahedral platinum(IV) complexes are used in protein crystallography to help determine three-dimensional protein structures. If the octahedral crystal field splitting energy (Δ_o) is large for these complexes, (a) predict whether they are diamagnetic or paramagnetic, and (b) write the expected d^n electron configuration.

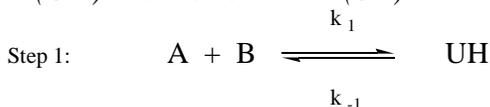
Rate laws and enzyme kinetics

C.

The element *technetium* has never been found in nature. It can be obtained readily as a product of uranium fission in nuclear power plants, however, and is produced in quantities of many kilograms per year. MIT Chemistry Professor Alan Davison pioneered the use of *Technetium* in the diagnosis of heart disease. Calculate the total activity (in disintegrations per second) caused by the decay of 0.5 microgram of ^{99m}Tc (an excited nuclear state of ^{99}Tc), which has a half-life of 6.0 hours.

D.

Consider the formation of a DNA double helix from strands A and B to form an unstable helix (UH) and a stable helix (SH).



(a) What is the molecularity of each step?

Step 1 is bimolecular and step 2 is unimolecular.

(b) Write the rate law for the formation of the stable helix (SH) using the steady-state approximation. Be sure to eliminate intermediates from the rate expression.