RDCH 702 Name:_____
Quiz 3
Assigned 14 November 12, Due 21 November 12

Quiz Topics: Electronic Orbitals and Energetics, Decay Kinetics, Nuclear Models, Radiation Interactions
Use the lecture notes, chart of the nuclides, table of the isotopes, and web links to answer the following questions.

1. **(10 Points) What are the possible structures for a 5 coordinate compound? How are the structures related?**

2. **(10 Points) What is the relationship between molecular orbital theory, crystal field theory, and ligand field theory?**

3. **(10 Points) The earth is 4.5E9 years old.**
   3.1. **Provide the ^{235}U to ^{238}U ratio at the origin of the earth.**
   3.2. **Provide the ^{235}U to ^{238}U ratio 1 billion years from today.**

4. **(15 Points) You have a sample of ^{95}Zr that is counted for 1 minute and has an activity of 702 Bq. Consider this the activity at time zero. Please provide the activity in Bq and the % error in the counts for the following times after time zero for 1 minute counting. Assume you have 100 % detection for each decay, so the total counts is equal to the total decay that occurs in 1 minute.**

Time (days)	Activity (Bq)	% error
0	702	
10		
65.0		
100		
135.8		
365		
505		

5. (20 Points) Using the Shell model find the spin and parity of the following isotopes. Compare with the actual values. Explain any differences.

5.1. ^{67}Ni

5.2. ^{64}Cu

5.3. ^{30}Si

5.4. ^{46}Sc

5.5. ^{145}Sm

5.6. ^{201}Hg

5.7. ^{204}Tl

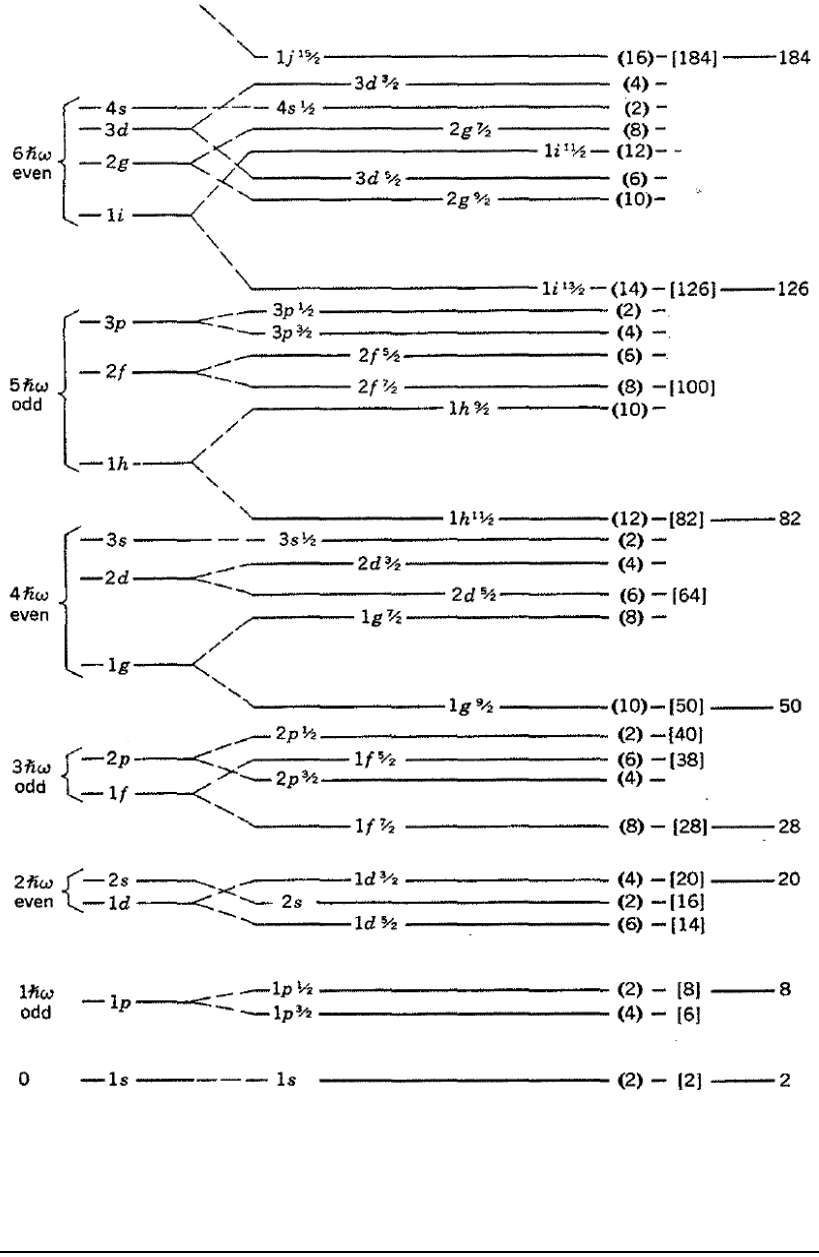
5.8. ^{242}Am

5.9. ^{239}Pu

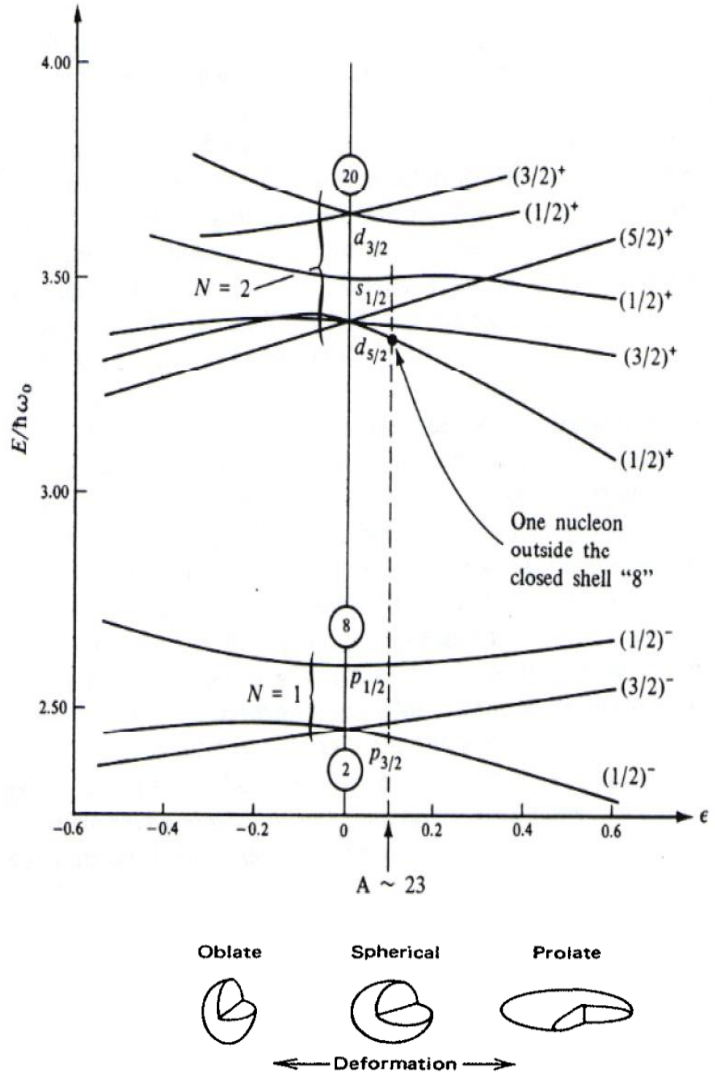
5.10. ^{211}Fr

5.11. ^{206}At

5.12. ^{179}Hf



6. (**10 Points**) **Consider the isotope ^{19}Ne. What is the shape of the nucleus based on the observed spin and parity using the Nilsson diagram?**



7. (20 Points) Please provide the maximum mass of the radionuclide permissible for research based on the conditions below.

Radionuclide	Rad Safety Level	Condition	Mass (mg)
^{99}Tc	2	In solution of UV-Visible spectroscopy	
^{99}Tc	3	Airborne in Fume hood	
^{99}Tc	3	Airborne in glove box	
^{232}Th	3	Non-airborne, benchtop	
^{235}U	3	Airborne in Fume hood	
^{238}U	3	Airborne in Fume hood	
^{238}U	3	Airborne in glove box	
^{237}Np	3	Non-airborne, benchtop	
^{237}Np	3	Non-airborne, fume hood	
^{237}Np	3	Airborne in Fume hood	
^{237}Np	3	Airborne in glove box	
^{243}Am	2	Non-airborne	
^{243}Am	3	Non-airborne, benchtop	
^{239}Pu	3	Non-airborne, benchtop	
^{239}Pu	3	Airborne in Fume hood	
^{239}Pu	3	Airborne in glove box	

8. (5 Points) When is breathing zone monitoring needed for Rad Safety Level 3 work?