3.091 Fall Term 2002
Homework Quiz #3B

(a) Explain why the atomic radius of potassium (r_K = 2.03 Å) is larger than that of bromine (r_{Br} = 1.14 Å) while the ionic radius of the potassium ion (r_{K^+} = 1.33 Å) is smaller than that of the bromide ion (r_{Br^-} = 1.96 Å).

Potassium and bromine are in the same shell, $n = 4$, but bromine has many more electrons which occupy both *s* and *p* orbitals while in potassium only the *s* orbital is occupied. But K^+ is substantially smaller than Br^- because with the loss of its 4*s* electron K^+ is effectively a member of the third period, i.e., K^+ and Br^- are not in the same shell. K^+ is isoelectronic with Ar which is $n = 3$ while Br^- is isoelectronic with Kr which is $n = 4$.

(b) Identify all atoms that would act the same way Ag did in the Stern-Gerlach experiment: Cu, Zn, Sn. Explain your reasoning.

The key to the answer is identification of paramagnetic atoms which means those possessing unpaired electrons.

Cu is $[Ar]3d^{10}4s^1$ which is paramagnetic. YES. Same behavior as that observed with Ag.

Zn is $[Ar]3d^{10}4s^2$ which is diamagnetic owing to the pairing of the 3*d* and 4*s* electrons. NO.

Sn is $[Kr]4d^{10}5s^2p^2$ which is paramagnetic because the two *p* electrons are unpaired according to Hund's Rule. YES. Same behavior as that observed with Ag.