Homework 8 – Atomic Structure and Spectra

Name: _____

Excercise 8A.1(a) (5 points)

State the orbital degeneracy of the levels in a hydrogen atom that have energy
(i) $-hc\tilde{R}_H$ (ii) $-\frac{1}{9}hc\tilde{R}_H$ (iii) $-\frac{1}{25}hc\tilde{R}_H$

Exercise 8A.5(a) (5 points)

At what radius does the probability density of an electron in the H atom fall to 50 percent of its maximum value?

Exercise 8A.7(a) (5 points)

The wavefunction of one of the d orbitals is proprotional to $\cos\theta \sin\theta \cos\phi$. At what angles does it have nodal planes?

Exercise 8A.10(a) (5 points)

What subshells and orbitals are available in the M shell?

Exercise 8A.11(a) (5 points)

What is the orbital angular momentum (as multiples of $\hbar$) of an electron in the orbitals (i) $1s$, (ii) $3s$, (iii) $3d$? Give the numbers of angular and radial nodes in each case.

Exercise 8B.1(a) (5 points)

Construct the wavefunction for an excited state of the He atom with configuration $1s^1 2s^1$. Use $Z_{eff} = 2$ for the $1s$ electron and $Z_{eff} = 1$ for the $2s$ electron.

Exercise 8B.2(a) (5 points)

How many electrons can occupy subshells with $l = 3$?

Exercise 8B.4(a) (5 points)

Write the electronic configuration of the Ni^{2+} ion.

Exercise 8C.3(a) (5 points)

Which of the following transitions are allowed in the electronic emission specturm of a hydrogenic atom:
(i) $2s \rightarrow 1s$, (ii) $2p \rightarrow 1s$, (iii) $3d \rightarrow 2p$

Exercise 8C.9(a) (5 points)

What are the possible values of the total spin quantum numbers S and M_S for the Ni^{2+} ion?

Exercise 8C.10(a) (5 points)

skip the first part Which atomic term is likely to lie lowest in energy for the configuration ns^1nd^1?

Exercise 8C.14(a) (5 points)

Which of the following transitions between terms are allowed in the electronic emission spectrum of a many-electron atom: (i) $^3D_2 \rightarrow {}^3P_1$ (ii) $^3P_2 \rightarrow {}^1S_0$, (iii) $^3F_4 \rightarrow {}^3D_3$?