

Homework 8 – Atomic Structure and Spectra

Name: _____

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

State the orbital degeneracy of the levels in a hydrogen atom that have energy

$$(i) -hc\tilde{R}_H \quad (ii) -\frac{1}{9}hc\tilde{R}_H \quad (iii) -\frac{1}{25}hc\tilde{R}_H$$

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 proportional 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 spectrum 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) $^3F_4 \rightarrow ^3D_3$?

Pioneers

By Carol Lynn Pearson

My people were Mormon pioneers.
Is the blood still good?
They stood in awe as truth
Flew by like a dove
And dropped a feather in the West.
Where truth flies you follow
If you are a pioneer.
I have searched the skies
And now and then
Another feather has fallen.
I have packed the handcart again
Packed it with the precious things
And thrown away the rest.
I will sing by the fires at night
Out there on uncharted ground
Where I am my own captain of tens
Where I blow the bugle
Bring myself to morning prayer
Map out the miles
And never know when or where
Or if at all I will finally say,
"This is the place,"
I face the plains
On a good day for walking.
The sun rises
And the mist clears.
I will be all right:
My people were Mormon Pioneers.