

Homework 10 – Molecular Symmetry

Name: _____

Exercise 10A.4(a) (10 points)

List the symmetry elements of the following molecules and name the point groups to which they belong:

(i) NO_2 (ii) PF_5 (iii) CHCl_3

(iv) 1,4-difluorobenzene

Exercise 10B.5(a) (10 points)By inspection of the character table for D_{3h} , state the symmetry species of the $3p$ and $3d$ orbitals located on the central Al atom in AlF_3 **Exercise 10B.7(a)** (5 points)

What is the maximum possible degree of degeneracy of the orbitals in benzene?

Exercise 10C.1(a) (5 points)Use symmetry properties to determine whether or not the integral $\int p_x z p_z d\tau$ is necessarily zero in a molecule with symmetry C_{2v} **Exercise 10C.2(a)** (5 points)Is the transition $A_1 \rightarrow A_2$ forbidden for electric dipole transitions in a C_{3v} molecule?

Exercise 10C.4(a) (10 points)

Consider the C_{2v} molecule OF_2 ; take the molecule to lie in the yz -plane, with z directed along the C_2 axis; the mirror plane σ'_v is the yz -plane, and σ_v is the xz -plane. The combination $p_z(A) + p_z(B)$ of the two F atoms spans A_1 , and the combination $p_z(A) - p_z(B)$ of the two F atoms spans B_2 . Are there any valence orbitals of the central O atom that can have a non-zero overlap with these combinations of F orbitals? How would the situation be different in SF_2 , where $3d$ orbitals might be available?

Exercise 10C.6(a) (5 points)

The ground state of NO_2 is A_1 in the group C_{2v} . To what excited states may it be excited by electric dipole transitions, and what polarization of light is it necessary to use?

Wild Geese

By Mary Oliver

You do not have to be good.
You do not have to walk on your knees
for a hundred miles through the desert repenting.
You only have to let the soft animal of your body
love what it loves.
Tell me about despair, yours, and I will tell you mine.
Meanwhile the world goes on.
Meanwhile the sun and the clear pebbles of the rain
are moving across the landscapes,
over the prairies and the deep trees,
the mountains and the rivers.
Meanwhile the wild geese, high in the clean blue air,
are heading home again.
Whoever you are, no matter how lonely,
the world offers itself to your imagination,
calls to you like the wild geese, harsh and exciting -
over and over announcing your place
in the family of things.

The Summer Day

By Mary Oliver

Who made the world?
Who made the swan, and the black bear?
Who made the grasshopper?
This grasshopper, I mean-
the one who has flung herself out of the grass,
the one who is eating sugar out of my hand,
who is moving her jaws back and forth instead of up and down-
who is gazing around with her enormous and complicated eyes.
Now she lifts her pale forearms and thoroughly washes her face.
Now she snaps her wings open, and floats away.
I don't know exactly what a prayer is.
I do know how to pay attention, how to fall down
into the grass, how to kneel down in the grass,
how to be idle and blessed, how to stroll through the fields,
which is what I have been doing all day.
Tell me, what else should I have done?
Doesn't everything die at last, and too soon?
Tell me, what is it you plan to do
with your one wild and precious life?