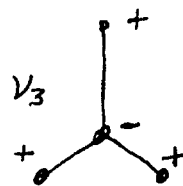
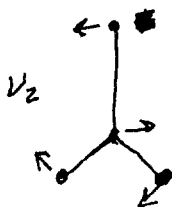
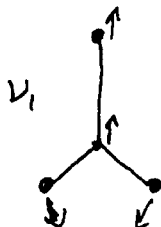


① H_2BF is trigonal planar and has C_{2v} symmetry

② how many normal modes does it have?

$$3(4) - 6 = 6$$

③ Three of the normal modes are



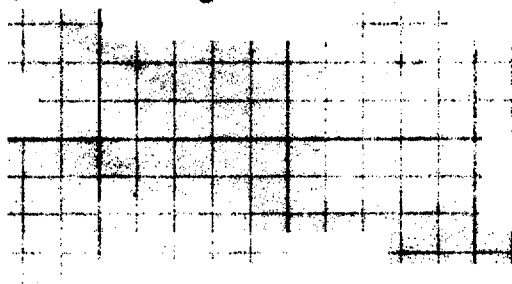
Give the representation (A_1, A_2, B_1, B_2) of each of these three vibrations (character table below)

$\nu_1: A_1$ $\nu_2: B_2$ $\nu_3: B_1$

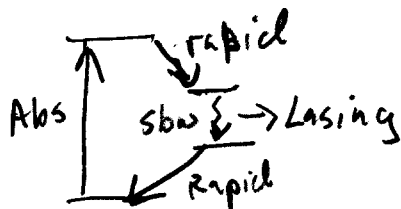
④ Which modes are IR active? Which modes are Raman active?

All are both IR and Raman active

C_{2v}	E	C_2	σ_v	σ_v'		
A_1	1	1	1	1	Z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	X, R_y	xz
B_2	1	-1	-1	1	Y, R_x	yz
Γ_{vib}	3	-1	1	1		



② Use a four level system to show how one can achieve the necessary population inversion to get lasing.



③ sketch a general schematic for a laser operating in narrowband mode.

