Basic Categorial Grammar:

- forward application: \( A/B + B = A \)
- backward application: \( B + A\backslash B = A \)
- composition: \( A/B + B/C = A/C \)
- conjunctions: \( A \text{ CONJ} A' = A'' \)
- type raising: \( A = X/(X\backslash A) \)

(1) Show syntactic analysis of the following sentences using the above syntax CCG rules and the following lexical entries:

John NP
Mary NP
Jill NP
Bob NP
flowers NP
chocolates NP
walks S\NP
and CONJ
like (S\NP)/NP
likes (S\NP)/NP
dislikes (S\NP)/NP
a NP/N
man N
gave (S\NP)/NP/NP

John walks
John likes Mary
John and Mary like Bob
John likes and Mary dislikes Bob
a man walks John gave Mary flowers and Jill chocolates

(2) Show syntactic and semantic analysis of the following sentences

A/B:S + B:T = A:S.T
B:T + A:B:S = A:S.T
X:A CONJ X':A' = X'':lambda S (A . S & A'. S)
X/Y:A Y/Z:B => X/Z: lambda Q ( A . (B . Q))
NP:a -> T/(T\NP): lambda R (R . a)

John NP:j
Mary NP:m
Bob NP:b
walks S\NP: lambda X walks(X)
and CONJ:
like (S\NP)/NP: lambda Y lambda X like(X,Y)
likes (S\NP)/NP: lambda Y lambda X likes(X,Y)
dislikes (S\NP)/NP: lambda Y lambda X dislikes(X,Y)

John walks
John likes Mary
John and Mary like Bob
John likes and Mary dislikes Bob
(3) Adding appropriate features to the basic S, NP categories show how the following could be treated in a categorial framework. Show your lexical entries and the syntactic analysis, no semantic analysis is required for these examples.

    I walk
    You walk
    He walks
    He walked
    the boy walks
    the boy likes the movie
    the boys like the movie