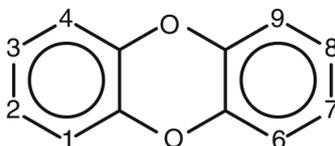


**Exercise 1**

## Dibenzodioxin

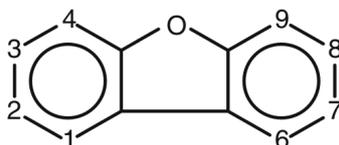
We consider “congeners” of the chlorinated dibenzodioxins (see for example [http://en.wikipedia.org/wiki/Congener\\_%28chemistry%29](http://en.wikipedia.org/wiki/Congener_%28chemistry%29)).



Dibenzodioxin can be chlorinated with 0, 1, ..., 9 chlorine atoms. How many different chlorinated dibenzodioxin do exist?

**Exercise 2**

## Dibenzofuran

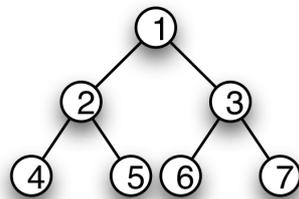


Dibenzofuran can also be chlorinated with 0, 1, ..., 9 chlorine atoms. How many different chlorinated dibenzofuran do exist?

**Exercise 3**

Polya Counting

Consider the following unlabeled tree (the numbers in the nodes are just the node-ids).

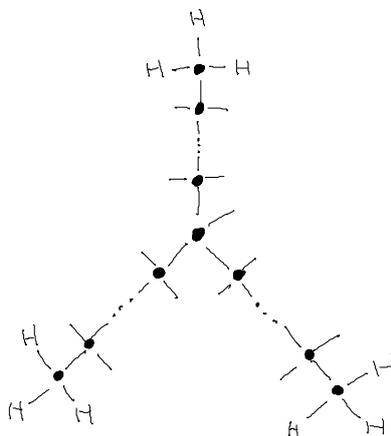


The tree is unordered: there is no order on the branches, i.e. the children of a node are a multiset of trees, and not a sequence of trees. How many different ways are there to color the nodes of this tree with colors black, white, and green? How many ways are there to color 3 of the nodes black, 2 nodes white, and 2 nodes green?

**Exercise 4**

Acyclic Saturated Hydrocarbons

Consider the following class of molecules (the three branches can be of different length (i.e. having a different number of carbon atoms), including length 0)



The sum formula obviously is  $\text{CH}(\text{CH}_2)_k(\text{CH}_3)_3$ . Determine the generating function for this combinatorial class of compounds. How many structural isomers are there with  $k$  carbon atoms? Determine also the generative function for the class of molecules where none of the three branches is empty.