CS 310-0
Homework Assignment No. 8
Not Due

1. Assume that the 26 (capital) letters of the English alphabet

   {A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z}

   are represented as (loop-free) graphs. Classify them by homeomorphism. How many classes of graph-homeomorphic letters are there?

2. For each of the following graphs find an Euler circuit and a Hamiltonian cycle, or prove that there is none.

3. The five Platonic solids are the following:

name	faces	edges	vertices	edges per vertex	edges per face
tetrahedron	4	6	4	3	3
hexahedron	6	12	8	3	4
octahedron	8	12	6	4	3
dodecahedron	12	30	20	3	5
icosahedron	20	30	12	5	3

   All Platonic solids have connected loop-free regular[1] planar graphs. Their dual graphs are also loop-free and regular. Prove that the table above describes all possible connected loop-free regular graphs whose dual graphs are also loop-free and regular. Hint: Call d = the degree of the vertices of the given graph (= number of edges that meet at each vertex), d' = the degree of the vertices of the dual graph (= number of edges surrounding each region of the given graph). If the graph is loop-free then $d' \geq 3$. Since the dual graph must also be loop-free then $d \geq 3$. Next, pose three equations: (1) Euler's formula for planar graphs, (2) a relation among d, v, e, (3) a relation among d', r, e. Find all positive integer solutions to those equations such that $d, d' \geq 3$.

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[1] A regular graph is a graph whose vertices have all the same degree.

4. Consider the following arithmetic expression:

$$a * (b + c \uparrow d \uparrow 2)/(e + f * h \uparrow i - j * (k + 5)) .$$

The hierarchy for evaluation of arithmetic expressions (from do first to do last) is: (1) "$\uparrow$", (2) "$*$" and "$/$", (3) "$+$" and "$-$". The inner parenthesis must be evaluated first, and operations with the same priority level are evaluated from left to right, except $\uparrow$, which is evaluated from right to left—for instance, $2/3*5$ means $(2/3)*5$, but $2 \uparrow 3 \uparrow 5$ means $2 \uparrow (3 \uparrow 5)$.

(a) Represent the given expression with a binary rooted tree.
(b) Write it in Polish notation.
(c) Write it in reverse Polish notation.