2

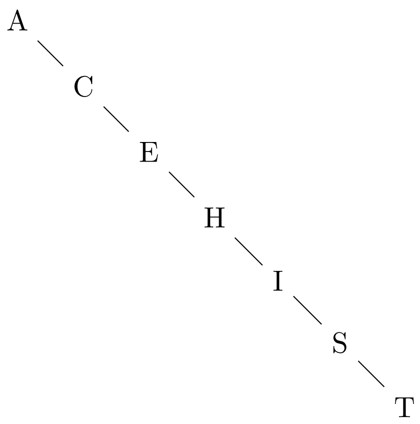
a) A binary tree with 4 childless vertices means it has 4 leaves ($l = 4$).

The number of leaves (l) in a full m-ary tree with i internal vertices and n vertices is $(m-1) \cdot i + 1$.

Here,

$$\begin{aligned}(m-1) \cdot i + 1 &= 4\\ (2-1)(n-4) + 1 &= 4\\ n - 4 + 1 &= 4\\ n &= 4 + 3\\ n &= 7\end{aligned}$$

b) BST:



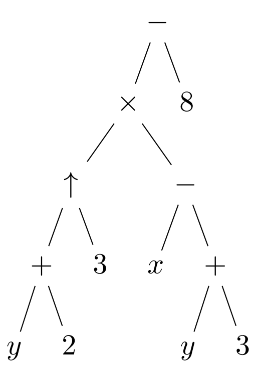
3

b) Postorder traversal of
Tree 1: c, d, b, f, g, h, e, a
Tree 2: c, d, b, f, g, h, e, a

c) Prefix notation:

$$(- \quad (\times \quad (\uparrow \quad (+ \quad y \quad 2) \quad 3) \quad (- \quad x \quad (+ \quad y \quad 3))) \quad 8)$$

Binary tree of the expression:



d) Rewriting the expression in infix format: $\left(\frac{9}{3}+5\right) \times (7-2)$
Which evaluates to 40.

4

a) It will be a weakly connected directed graph.

The direction is implied by one-way/two-way roads and it's weakly connected because vertices must have edges because vertices represent road intersections.

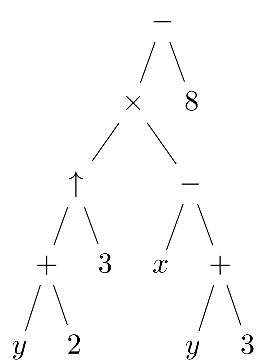
b) Suppose there are o number of vertices with odd degree and e number of vertices with even degree and the number of edges is E. According to the handshaking theorem $3o + 4e = 2E$.

Now, the possible values of o are 2 and 4 because there should be an even number of vertices with odd degree. So the possible values of e are 3 and 1.

When $o = 2$ and $e = 3$, $E = \frac{6+12}{2} = 9$.
When $o = 4$ and $e = 1$, $E = \frac{12+4}{2} = 8$.

Therefore the possible number of edges are 8 and 9.

c) Binary expression tree:



Prefix notation: $(- \quad (\times \quad (\uparrow \quad (+ \quad y \quad 2) \quad 3) \quad (- \quad x \quad (+ \quad y \quad 3))) \quad 8)$

d) 40

5

a) Adjacency matrix:

	v_1	v_2	v_3	v_4	v_5	v_6
v_1	0	1	1	0	0	0
v_2	1	0	0	0	0	0
v_3	0	0	0	1	0	1
v_4	0	0	0	0	1	0
v_5	0	0	1	1	0	1
v_6	0	0	0	0	0	0

b) Doing the following tests,

i. number of vertices is the same (7)

ii. number of edges is the same (9)
iii. sequence of degrees is not the same (3,3,3,3,3,3,2) and (3,3,3,4,3,3,2)

As the third test fails, the graphs are not isomorphic.

6

a) $C(7, 5) \times C(6, 4) \times 5 \times 7 \times 6 \times 5 \times 4 \times 4 \times 3 \times 2 \times 1$