Exercise 1.1: (Search Space 1)

2.) a)

Model:

x ≈ Liters in 3-Liter jug

y ≈ Liters in 4-Liter jug

(x,y) ≈ x Liters in 3-Liter jug and y Liters in 4-Liter jug

Transitions:

p ≈ pump, d ≈ drain, III ≈ 3-liter jug, IIII ≈ 4-liter jug

p → III ≈ source is pump and destination is 3-liter jug

Possible states	P → III, conditions: x < 3 | loss or win of liters		P → IIII, conditions: y < 4 | loss or win of liters		III → IIII, conditions: x > 0, y < 4 | loss or win of liters		IIII → III, conditions: y > 0, x < 3 | loss or win of liters		III → d, conditions: x > 0 | loss or win of liters		IIII → d, conditions: y > 0 | loss or win of liters	
00	30	+3	04	+4	/	/	/	/	/	/	/	/
01	31	+3	04	+3	/	/	10	0	/	/	00	-1
02	32	+3	04	+2	/	/	20	0	/	/	00	-2
03	33	+3	04	+1	/	/	30	0	/	/	00	-3
04	34	+3	/	/	/	/	31	0	/	/	00	-4
10	30	+2	14	+4	01	0	/	/	00	-1	/	/
11	31	+2	14	+3	02	0	20	0	01	-1	10	-1
12	32	+2	14	+2	03	0	30	0	02	-1	10	-2
13	33	+2	14	+1	04	0	31	0	03	-1	10	-3
14	34	+2	/	/	/	/	32	0	04	-1	10	-4
20	30	+1	24	+4	02	0	/	/	00	-2	/	/
21	31	+1	24	+3	03	0	30	0	01	-2	20	-1
22	32	+1	24	+2	04	0	31	0	02	-2	20	-2
23	33	+1	24	+1	14	0	32	0	03	-2	20	-3
24	34	+1	/	/	/	/	33	0	04	-2	20	-4
30	/	/	34	+4	03	0	/	/	00	-3	/	/
31	/	/	34	+3	04	0	/	/	01	-3	30	-1
32	/	/	34	+2	14	0	/	/	02	-3	30	-2
33	/	/	34	+1	24	0	/	/	03	-3	30	-3
34	/	/	/	/	/	/	/	/	04	-3	30	-4

Answer:

There are two ways of solving the riddle:

Method 1:

- Fill the 3 liter jug from the pump.

- Empty the 3 liter jug into the 4 liter jug.

- Fill the 3 liter jug from the pump.

- Fill the 4 liter jug with 1 liter from the 3 liter jug - leaving 2 liters in the 3 liter jug.

- Pour away the contents of the 4 liter jug.

- Empty the 2 liters in the 3 liter jug into the 4 liter jug. Leaving 2 liters in the 4 liter jug.

- (Loss of Water: 4 Liter)

Method 2:

- Fill the 4 liter jug from the pump.

- Empty the 3 of 4 liter of the 4 liter jug into the 3 liter jug, leaving 1 liter in the 4 liter jug.

- Pour away the contents of the 3 liter jug.

- Empty the 4 liter jug into the 3 liter jug.

- Fill the 4 liter jug from the pump.

- Empty 2 of 4 liters in the 4 liter jug into the 3 liter jug. Leaving 2 liters in the 4 liter jug.
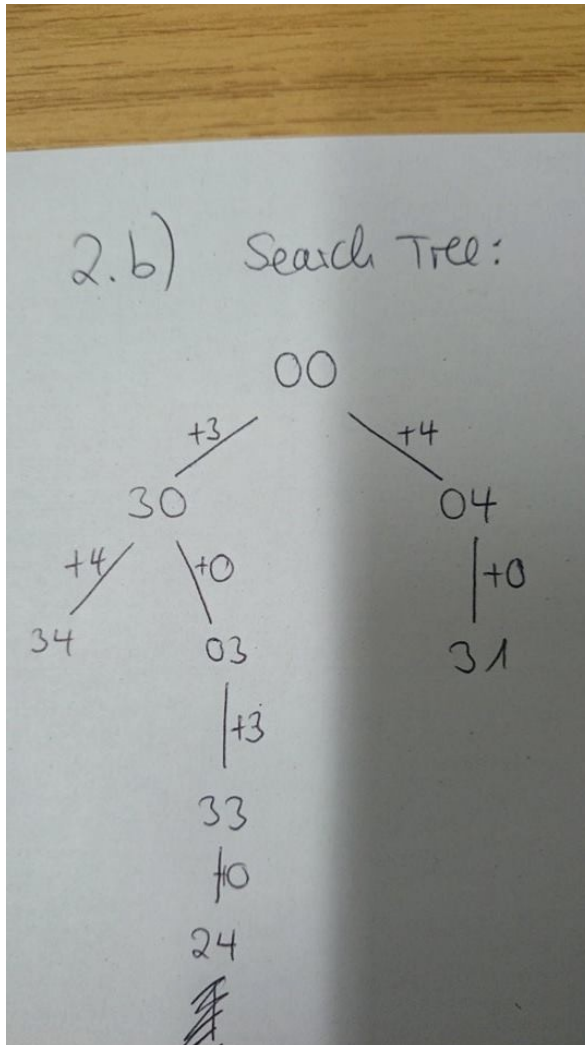
- (Loss of Water: 3 Liter)

Way to do it:
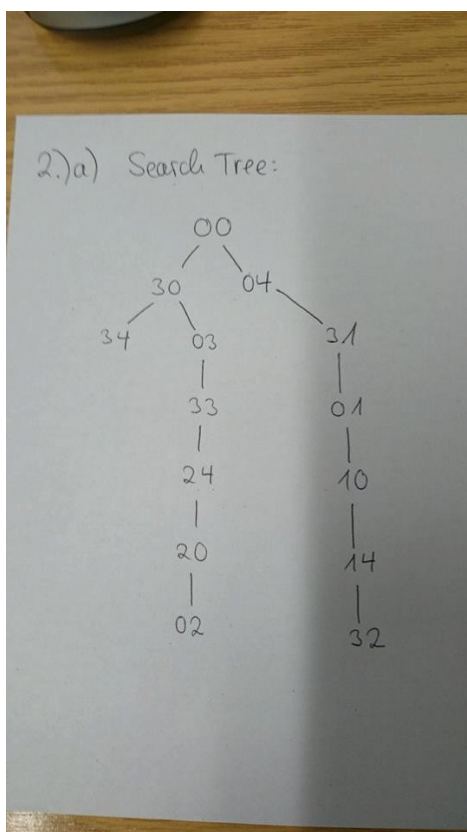
Design a search tree with root (0,0). The table with possible states shows us, what possible children the root has: 30 and 04. Before we enter the new generation, we check the search tree with breadth-first search for duplicates (we don't want duplicates). 30 and 04 have not appeared until now, so they can be children of 00. Next we check 30: possible states after 30 are 34, 03 and 00. 00 did appear in the beginning, is found by breadth-first search and does not appear as child of 30. We do this so long until we reach states of the form (x,2), where y=2, which means our goal "2 liters in the 4 liter jug".

2.) b)

No, the riddle is unsolvable then.

We do what we did in 2.a), but we eliminate transitions from the last 2 columns, because it's not allowed to drain the wine. Breadth-first search then gives us the search tree below, where the goal (x,2) does not appear.