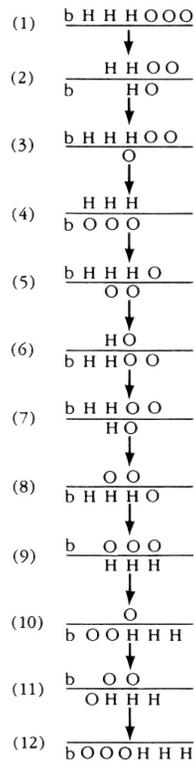


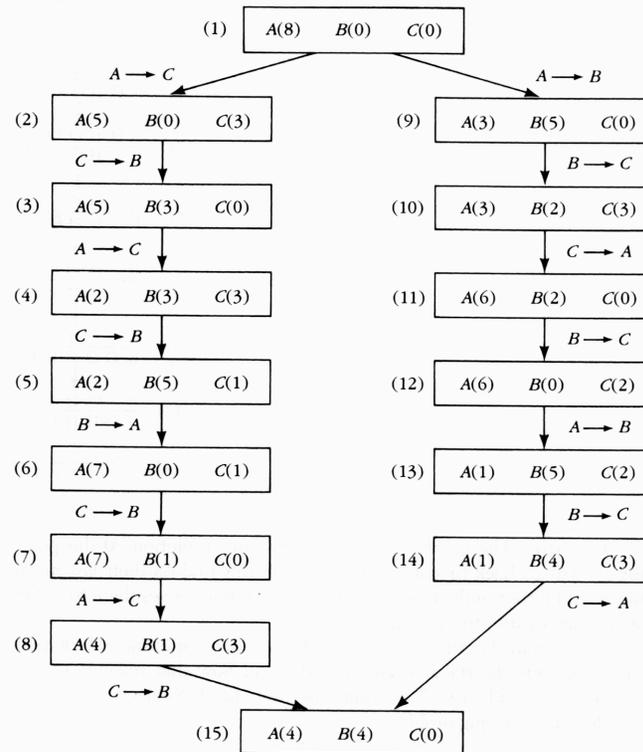
## Problem Solving SOLUTIONS

Why are these problems difficult? All three problems involve multiple steps, so it is hard to keep track of where you are and where you need to go. Also, it is hard to identify intermediate stages (subgoals) that you need to reach in order to solve the problem. In the Hobbits and Orcs problem, the transition from step 6 to 7 is difficult because you seem to be getting further from the goal rather than closer. In the water jug problem, one key subgoal is to get 1 ounce of water (step 5 or 13 in the diagram). In the 4-block tower of hanoi problem, it is important to see that the top 3 blocks need to be moved to peg 2 in order to move the largest block to peg 3.

**Hobbits and Orcs** There are 3 hobbits and 3 orcs on one side of a river. Their only means of transportation is a boat that can only hold, at most, 2 creatures at a time. How can you transport all 6 creatures across the river. The orcs can never outnumber the hobbits (they'll get eaten!).



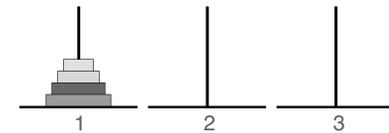
**Water jug problem** You have 3 jugs. Jug A holds exactly 8 ounces of water, B holds exactly 5, and C holds 3. Jug A is filled to capacity with 8 ounces of water. B and C are empty. Find a way to equally divide the water in A so that both B and C contain exactly 4 ounces. Two solutions are shown below.



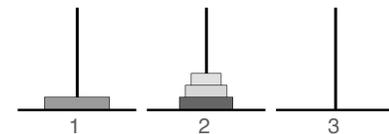
**Now try this problem:** Suppose you had three jugs that held exactly 14, 9, and 5. How could you divide 14 into 7 and 7?

**Tower of Hanoi** The puzzle consists of 3 pegs and 3 to 7 different sized blocks. Move the tower from peg 1 to peg 3. You can only move one block at a time. You can't put a bigger block on top of a smaller one. The blocks can only go on the pegs, not held in your hand or placed on the table.

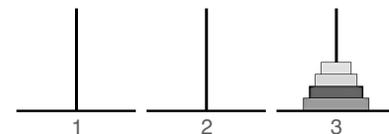
The initial state of the 4-block problem



A key subgoal to reach to solve the problem



The goal state of the problem



Can you solve the puzzle in the minimum number of moves? For 3 blocks, the fewest moves possible is 7. For 4 and 5 blocks, the minimum number of moves is 15 and 31, respectively.