Problem (1) [20 points] Make a payoff matrix for the game rock-paper-scissors. Then answer which sets of actions are pure Nash equilibrium? Which are pure Pareto optimal?
Problem (2) [10 points] Perform alpha-beta pruning on the tree shown below. Always search the branches from left to right. Show the alpha/beta values (best/worst values) along with what can be pruned after searching or pruning each diamond terminal state (i.e. you should have 2 partial trees and one full tree as your answer).

Figure 1: Tree to be pruned.
Problem (3) [20 points] You are going grocery shopping and have a $20 budget. You are trying to buy at least 1700 calories, 38g of protein and 120% iron. Assume the grocery store comes stocked with the items listed below (can buy multiple of each).

(1) Set this up as a constraint satisfaction problem. Then (2) describe whether you think using consistency constraints and inference or a more basic search is applicable to this problem.

- Potatoes. 110 calories, 3g protein and 6% iron for $1.
- Cereal (healthy-ish). 250 calories, 6g protein, 90% iron for $3
- Beef. 290 calories, 22g protein and 15% iron for $4
Problem (4) [20 points] Use resolution to answer the following questions. Assume the KB is:

\[(A \lor B \lor \neg C) \land (\neg B \lor \neg C \lor D) \land (\neg A \lor D) \land (B \lor C \lor \neg D) \land (A \lor \neg B \lor D)\]

(1) Does \(KB \models (A \lor B)\)?
(2) Does \(KB \models (\neg C \land B)\)?
Problem (5) [30 points] Answer and justify the following questions:

- Can you potentially prune more or less of the overall percent of leaf/terminal nodes if your tree has a larger branching factor?

- Suppose you are making a propositional knowledge base (KB) that you will query often. You use resolution to ask if $KB \models \alpha$ for some sentence $\alpha$. If it is entailed you add $\alpha$ to your KB. If it is not entailed, you add $\neg \alpha$ to your KB. You add these sentences to your KB to speed up future computations. Is this approach a good idea? Why or why not?