1. For each pair of atomic sentences, give the most general unifier if one exists:
   (a) \( P(A, B, B) \) and \( P(x, y, z) \)
   (b) \( Q(y, g(A, B)) \) and \( Q(g(x, x), y) \)
   (c) \( Older(Father(y), y) \) and \( Older(Father(x), John) \)
   (d) \( Knows(Father(y), y) \) and \( Knows(x, y) \)

2. From “Horses are animals,” it follows that “The head of a horse is the head of an animal.” Demonstrate that this inference is valid by doing the following:
   (a) Translate the premise and the conclusion into first-order logic using the predicates \( HeadOf(h, x) \) (“\( h \) is the head of \( x \)”), \( Horse(x) \) (“\( x \) is a horse”), and \( Animal(x) \) (“\( x \) is an animal”).
   (b) Negate the conclusion, and convert the premise and the conclusion into conjunctive normal form.
   (c) Use resolution to show that the conclusion follows from the premise.

3. Suppose a knowledge base contains just the following first-order Horn clauses:

\[
\begin{align*}
Ancestor(Mother(x), x) \\
Ancestor(x, y) \land Ancestor(y, z) \Rightarrow Ancestor(x, z)
\end{align*}
\]

Consider a forward-chaining algorithm that, on the \( j \)th iteration, terminates if the KB contains a sentence that unifies with the query, and otherwise adds to the KB every atomic sentence that can be inferred from the sentences already in the KB after iteration \( j - 1 \).

   (a) For each of the following queries, say whether the algorithm will (1) give an answer (if so, give that answer); or (2) terminate with no answer; or (3) not terminate.
      i. \( Ancestor(Mother(y), John) \)
      ii. \( Ancestor(Mother(Mother(y)), John) \)
      iii. \( Ancestor(Mother(Mother(Mother(y))), y) \)
      iv. \( Ancestor(Mother(John), Mother(Mother(John))) \)
   (b) Can a resolution algorithm prove the sentence \( \neg Ancestor(John, John) \)?