Charlemagne’s Puzzle

Three jealous husbands with their wives must cross a river in a boat with no boatman. The boat can carry only two of them at once. How can they all cross the river so that no wife is left in the company of other men without her husband being present? Both men and women may row. All husbands are jealous in extreme. They do not trust their unaccompanied wives to be with another man, even if the other man’s wife is also present.

Group A

Problem 1

5 points
Solve the Charlemagne’s Puzzle with 4 pairs of spouses. If there is no solution prove that there is no solution.

Problem 2

5 points
Solve the Charlemagne’s Puzzle with $N$ pairs of spouses and with a boat which has $N - 1$ seats. Find the minimal number of steps needed to solve the puzzle. If there is no solution prove that there is no solution.

Group B

Problem 1

5 points
Solve the Charlemagne’s Puzzle with 5 pairs of spouses and with a boat which has 4 seats. Find the minimal number of steps needed to solve the puzzle. If there is no solution prove that there is no solution.
Problem 2

5 points
Solve the Charlemagne’s Puzzle with 5 pairs of spouses and with a boat which has 3 seats. Find the minimal number of steps needed to solve the puzzle. If there is no solution prove that there is no solution.

Group C

Problem 1

(a) (5 points) Solve the Charlemagne’s Puzzle with 4 pairs of spouses and with a boat which has 3 seats. Find the minimal number of steps needed to solve the puzzle. If there is no solution prove that there is no solution.

(a) (5 points) Write all situations which are legitimate according to the jealousy rule. How many such situations are there?