1. Find all the Nash equilibria, including mixed-strategy equilibria, of the following game.

\[
\begin{array}{ccc}
1 & R & 2 \\
L & 1 & 1 \\
M & 0 & 4 \\
\end{array}
\]

2. There is an ongoing conflict between Country 1 and Country 2. A superpower (Country 3) has put pressure on the two to reach a peaceful settlement. Consider the following game. Country 1 either makes a serious peace proposal to Country 2 or refuses to engage in serious talks with Country 2. If Country 1 makes a serious proposal, Country 2 can either accept, in which case peace is achieved (outcome \(z_1\)), or reject the proposal. If peace is not achieved then Country 3 cannot tell whether it was because Country 1 refused to engage in serious talks or because Country 2 rejected the serious proposal of Country 1 (each would claim it was the other party’s lack of cooperation). Then Country 3 has to decide whether to set an embargo against Country 1 or set an embargo against Country 2. Let the outcomes be as follows:

- \(z_2\) : peace not achieved because 2 rejected the serious proposal of 1 and 3 sets an embargo on 1
- \(z_3\) : peace not achieved because 2 rejected the serious proposal of 1 and 3 sets an embargo on 2
- \(z_4\) : peace not achieved because 1 refused to talk about peace and 3 sets an embargo on 1
- \(z_5\) : peace not achieved because 1 refused to talk about peace and 3 sets an embargo on 2

(a) Draw an extensive game to represent this situation. Don’t worry about payoffs for the moment (just write the outcomes).

(b) Write the corresponding strategic form (again, don’t worry about payoffs, just write the corresponding outcomes). Assign the rows to Country 1, the columns to Country 2, etc.
The rankings of the outcomes are as follows (the top outcome is the best and the bottom outcome is the worst): For Country 1 \[
\begin{pmatrix}
z_3 \\
z_5 \\
z_1 \\
z_4 \\
z_2
\end{pmatrix},
\] for Country 2: \[
\begin{pmatrix}
z_2, z_4 \\
z_1 \\
z_3, z_5
\end{pmatrix}
\] and for Country 3: \[
\begin{pmatrix}
z_1 \\
z_2 \\
z_3, z_5
\end{pmatrix}
\]. Thus, for example, Country 2 is indifferent between \(z_2\) and \(z_4\), considers either of them better than \(z_1\) and considers \(z_1\) better than either \(z_3\) or \(z_5\) and is indifferent between \(z_3\) and \(z_5\). All three countries satisfy the axioms of expected utility.

**Country 1** is indifferent between the following two lotteries: \[
\begin{pmatrix}
z_2 & z_3 \\
\frac{1}{3} & \frac{2}{3}
\end{pmatrix}
\] and \[
\begin{pmatrix}
z_5 \\
1
\end{pmatrix}
\]. It is also indifferent between the following two lotteries: \[
\begin{pmatrix}
z_2 & z_3 \\
\frac{5}{9} & \frac{4}{9}
\end{pmatrix}
\] and \[
\begin{pmatrix}
z_1 \\
1
\end{pmatrix}
\]. Furthermore, it is also indifferent between the following two lotteries: \[
\begin{pmatrix}
z_2 & z_3 \\
\frac{2}{3} & \frac{1}{3}
\end{pmatrix}
\] and \[
\begin{pmatrix}
z_4 \\
1
\end{pmatrix}
\].

**Country 2** is indifferent between the following two lotteries: \[
\begin{pmatrix}
z_2 & z_3 \\
\frac{4}{9} & \frac{5}{9}
\end{pmatrix}
\] and \[
\begin{pmatrix}
z_1 \\
1
\end{pmatrix}
\].

**Country 3** is indifferent between the following two lotteries: \[
\begin{pmatrix}
z_1 & z_3 \\
\frac{1}{4} & \frac{3}{4}
\end{pmatrix}
\] and \[
\begin{pmatrix}
z_2 \\
1
\end{pmatrix}
\].

(c) Write the reduced strategic form corresponding to the extensive game (that is, the normal form of part (b) with the outcomes replaced by the corresponding normalized von Neumann-Morgenstern payoffs for each player).

(d) Find all the pure-strategy Nash equilibria of this game.

(e) Find the mixed-strategy Nash equilibrium at which Country 2’s strategy is to reject the proposal with probability 1.

(f) What are the players’ expected payoffs at the mixed-strategy Nash equilibrium of part (e)?