(a) To find the joint probability mass function (PMF) of X, Y, and Z, we need to determine the probability of each combination of values (x, y, z) for X, Y, and Z, respectively.

The total number of players is n, and each player independently and randomly chooses between Rock, Scissors, and Paper with equal probabilities. Therefore, we can use a multinomial distribution to calculate the joint PMF.

The joint PMF of X, Y, and Z can be expressed as:

P(X = x, Y = y, Z = z) = (n! / (x! \* y! \* z!)) \* (1/3)^(n)

where x, y, and z satisfy the conditions:

x + y + z = n

x, y, z ≥ 0

(b) The game is decisive if exactly two of the three choices (Rock, Scissors, and Paper) appear when everyone reveals their choice. There are three possible decisive scenarios:

X > 0, Y > 0, Z = 0

X = 0, Y > 0, Z > 0

X > 0, Y = 0, Z > 0

To find the probability that the game is decisive, we sum the probabilities of these three scenarios:

P(game is decisive) = ∑[P(X > 0, Y > 0, Z = 0) + P(X = 0, Y > 0, Z > 0) + P(X > 0, Y = 0, Z > 0)]

Simplifying further:

P(game is decisive) = P(X > 0, Y > 0, Z = 0) + P(X = 0, Y > 0, Z > 0) + P(X > 0, Y = 0, Z > 0)

To calculate these probabilities, we need to consider the possible values for x, y, and z that satisfy the conditions of each scenario and sum up their probabilities from the joint PMF.

(c) For n = 5, let's calculate the probability that the game is decisive.

Scenario 1: X > 0, Y > 0, Z = 0

The possible values for x and y are (1, 1) or (2, 1) since only Rock and Scissors should appear. The remaining player must choose from the two available choices. So, the probabilities are:

P(X = 1, Y = 1, Z = 0) = (5! / (1! \* 1! \* 0!)) \* (1/3)^5 = 10/243

P(X = 2, Y = 1, Z = 0) = (5! / (2! \* 1! \* 0!)) \* (1/3)^5 = 20/243

Scenario 2: X = 0, Y > 0, Z > 0

The possible values for y and z are (1, 1) or (2, 1) since only Scissors and Paper should appear. The remaining player must choose from the two available choices. So, the probabilities are:

P(X = 0, Y = 1, Z = 1) = (5! / (0! \* 1! \* 1!)) \* (1/3)^5 = 10/243

P(X = 0, Y = 2, Z = 1) = (5! / (0! \* 2! \* 1!)) \* (1/3)^5 = 10/243

Scenario 3: X > 0, Y = 0, Z > 0

The possible values for x and z are (1, 1) or (1, 2) since only Rock and Paper should appear. The remaining player must choose from the two available choices. So, the probabilities are:

P(X = 1, Y = 0, Z = 1) = (5! / (1! \* 0! \* 1!)) \* (1/3)^5 = 10/243

P(X = 1, Y = 0, Z = 2) = (5! / (1! \* 0! \* 2!)) \* (1/3)^5 = 10/243

Summing up these probabilities:

P(game is decisive) = (10 + 20 + 10 + 10 + 10) / 243 = 60/243 = 20/81

The probability that the game is decisive for n = 5 is 20/81.

As n approaches infinity (n → ∞), the limiting probability that a game is decisive can be intuitively understood as 1. This is because with a large number of players, the chance of having exactly two out of the three choices appearing becomes increasingly likely. Thus, the game will almost always be decisive.