

Three players,  $P_1$ ,  $P_2$ ,  $P_3$ , are seated at a round table and take turns rolling a die. Player  $P_1$  rolls first, followed by  $P_2$ , etc. Once a player has rolled a 6, the game is stopped and that player is declared the winner. If no 6 has been obtained after each of  $P_1$ ,  $P_2$ ,  $P_3$  have rolled the die once, then player  $P_1$  gets to roll again, followed by  $P_2$ , etc. Find the probability that the first player,  $P_1$ , wins this game.