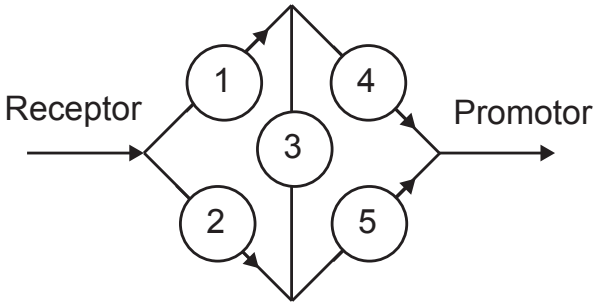
A. Two fair dice are rolled, one after the other.

i. Let E_6 be the event that the sum of the dice is 6. Let F_4 be the event that the first die is 4. Are these two events independent?

ii. Let E_7 be the event that the sum of the dice is 7. Let F_4 be the event that the first die is 4. Are these two events independent?

iii. Let E_i be the event that the sum of the dice is i. Let F_j be the event that the first die is j. For what values of i and j are these two events independent?

B. Suppose a cell signaling network has five components. Each component acts independently with probability p_i, $i = 1, 2, 3, 4, 5$. These components form a signaling pathway shown in the diagram below. The system is said to work



if a signal originating at the left end of the diagram (the receptor) can reach the right end (the promotor), where it can pass through a component only if that component is working. For instance, if components 1 and 4 both work, then the system works. Component 3 can transduce a signal in either direction (some *scaffold proteins* in cells provide such multivalent functions). What is the probability that the system works?