

Rules for Probability

Electrical Circuits Example

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Multiplicative Rule of Probability

$$P(A \cap B) = P(A)P(B|A) = P(B)P(A|B)$$

Independent Events

Two events A and B are said to be independent if

$$P(A|B) = P(A)$$

If two events A and B are independent then

$$P(A \cap B) = P(A)P(B)$$

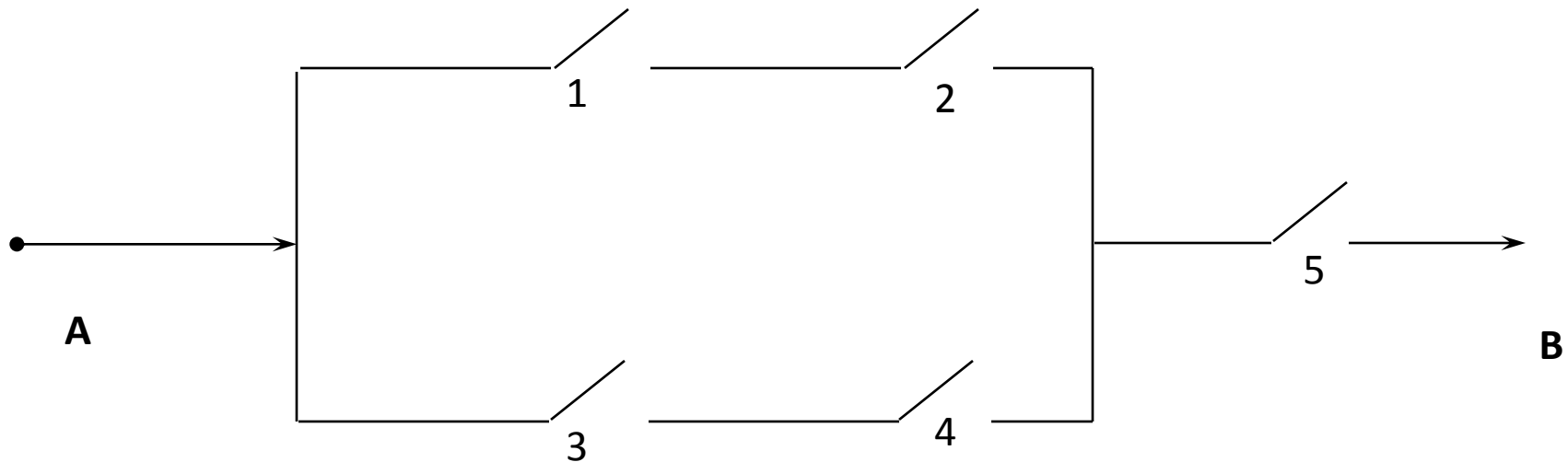
Law of Total Probability

$$P(A) = P(A|B)P(B) + P(A|B^c)P(B^c)$$

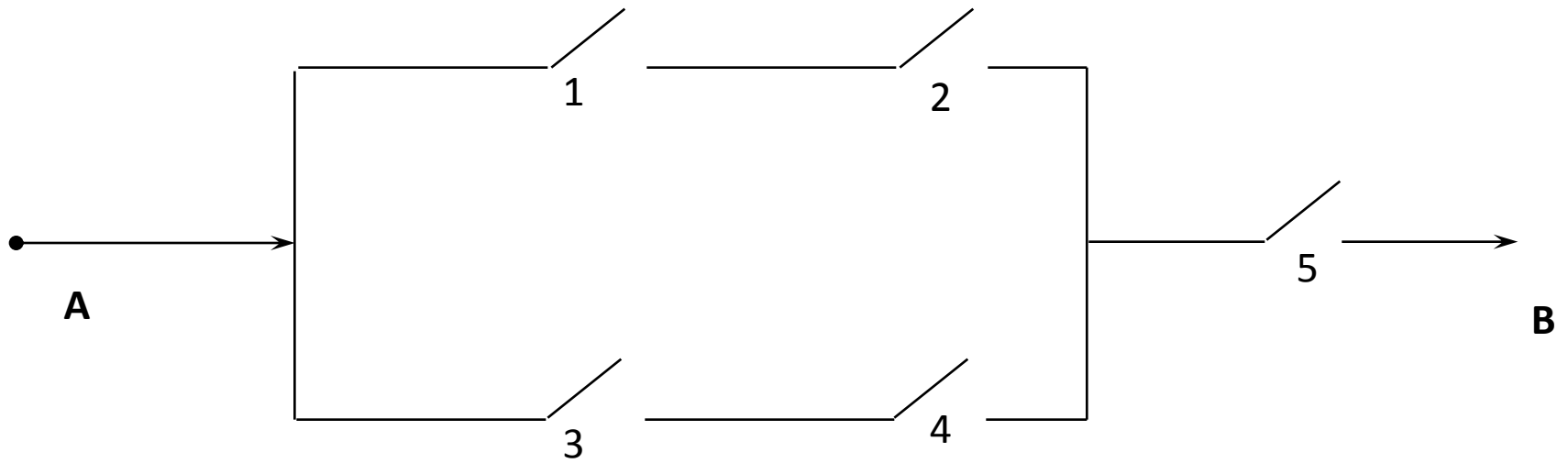
Electrical Circuit 1

The probabilities of closing the i th relay in the circuit shown below are

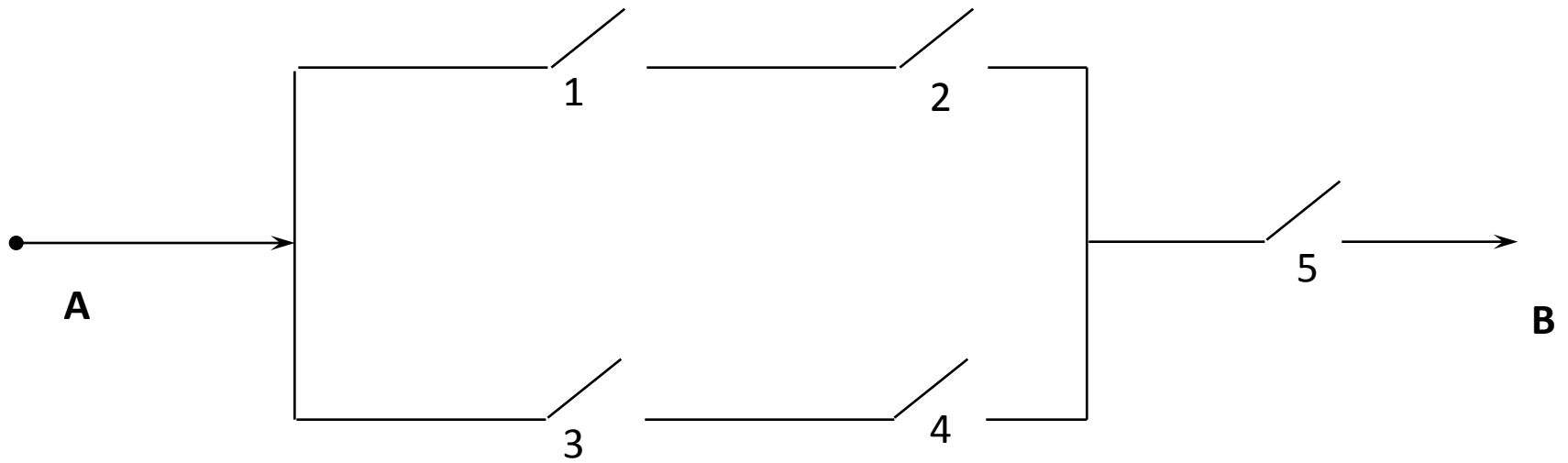
Circuit	1	2	3	4	5
P(closure)	.70	.60	.65	.65	.97



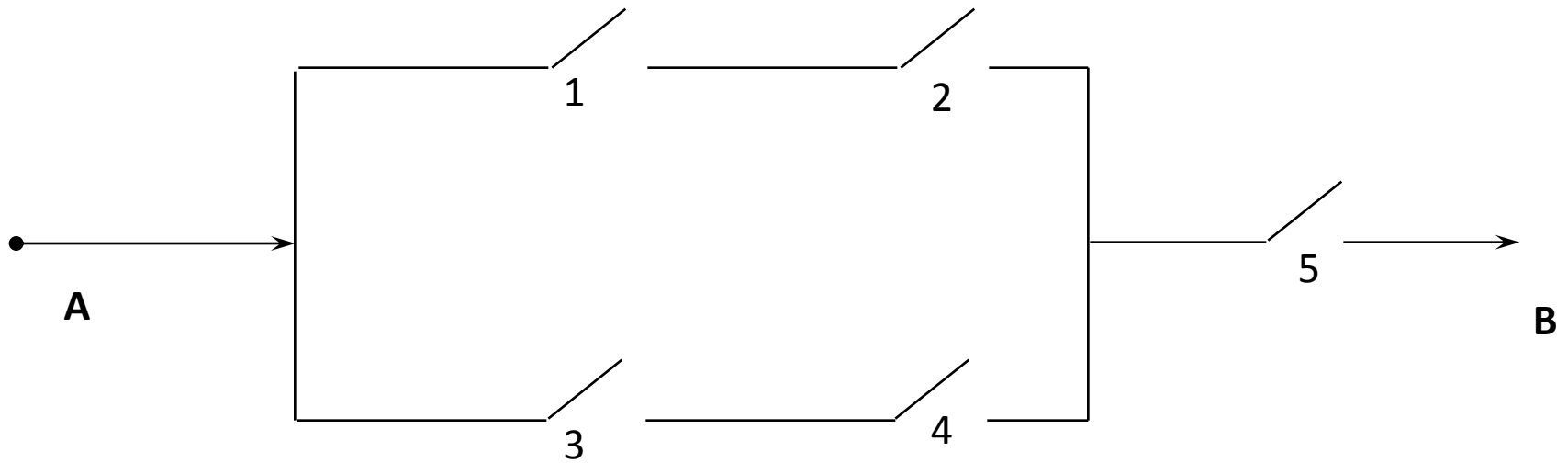
If all relays function independently, what is the probability that a current flows between A and B?



$P(\text{upper branch works}) = P(\text{C1 and C2})$



$$\begin{aligned} P(\text{upper branch works}) &= P(\text{C1 and C2}) \\ &= P(C1 \cap C2) \\ &= P(C1)P(C2) \end{aligned}$$



$$\begin{aligned} P(\text{upper branch works}) &= P(\text{C1 and C2}) \\ &= P(C1 \cap C2) \\ &= P(C1)P(C2) \\ &= (.70)(.60) = 0.42 \end{aligned}$$

$$P(\text{lower branch works}) = (0.65)(0.65) = 0.4225$$

P(upper branch **or** lower branch **or both** works) =

$$P(B1 \cup B2) = P(B1) + P(B2) - P(B1 \cap B2)$$

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$$= P(B1) + P(B2) - P(B1)P(B2)$$

$$= 0.42 + 0.4225 - (0.42)(0.4225)$$

$$= 0.66505$$

P(upper branch **or** lower branch **or both** works) =

$$\begin{aligned} P(B1 \cup B2) &= P(B1) + P(B2) - P(B1 \cap B2) \\ &= P(B1) + P(B2) - P(B1)P(B2) \\ &= 0.42 + 0.4225 - (0.42)(0.4225) \\ &= 0.66505 \end{aligned}$$

This is the probability that part 1 of our circuit works!!

$$\begin{aligned} P(\text{Whole Circuit Works}) &= P(C5 \cap (B1 \cup B2)) \\ &= (0.97)(0.66505) \\ &= 0.645 \end{aligned}$$

