Thm. (Basic rules)

1). Chain rule

$$P(A_1 \cap A_2 \cap \cdots \cap A_n) = P(A_1) P(A_2 | A_1) P(A_3 | A_1, A_2)$$
$$\cdots\cdots P(A_n | A_1, A_2, \cdots, A_{n-1})$$

2) Total probability formula

For $\{B_i\}_1^k$ as a partition of the sample space,

$$P(A) = \sum_{i=1}^{k} P(A | B_i) P(B_i)$$

3) Bayes' Thm.

$$P(B_j | A) = \frac{P(A | B_j) P(B_j)}{\sum_{i=1}^{k} P(A | B_i) P(B_i)}$$

Motivation: easier to calculate $P(A | B_i)$
than $P(B_i | A)$

Suggestion. Always start with the mathematical
definition of the term you are asked
to compute or show