From a standard deck of cards, one card is drawn. What is the probability that the card is black and a jack? \( P(\text{Black and Jack}) \)

\[
P(\text{Black}) = \frac{26}{52} \text{ or } \frac{1}{2}, \quad P(\text{Jack}) = \frac{4}{52} \text{ or } \frac{1}{13} \quad \text{so } \quad P(\text{Black and Jack}) = \frac{1}{2} \times \frac{1}{13} = \frac{1}{26}
\]

A standard deck of cards is shuffled and one card is drawn. Find the probability that the card is a queen or an ace. \( P(\text{Q or A}) = P(\text{Q}) = \frac{4}{52} \text{ or } \frac{1}{13} + P(\text{A}) = \frac{4}{52} \text{ or } \frac{1}{13} = \frac{2}{13} \)

WITHOUT REPLACEMENT: If you draw two cards from the deck without replacement, what is the probability that they will both be aces? \( P(\text{AA}) = \frac{4}{52} \times \frac{3}{51} = \frac{1}{221} \).

WITHOUT REPLACEMENT: What is the probability that the second card will be an ace if the first card is a king? \( P(\text{A|K}) = \frac{4}{51} \) since there are four aces in the deck but only 51 cards left after the king has been removed.

WITH REPLACEMENT: Find the probability of drawing three queens in a row, with replacement. We pick a card, write down what it is, then put it back in the deck and draw again. To find the \( P(\text{QQQ}) \), we find the probability of drawing the first queen which is \( \frac{4}{52} \). The probability of drawing the second queen is also \( \frac{4}{52} \) and the third is \( \frac{4}{52} \). We multiply these three individual probabilities together to get \( P(\text{QQQ}) = \frac{4}{52} \times \frac{4}{52} \times \frac{4}{52} = \frac{1}{221} \).

Probability of getting a royal flush = \( P(10 \text{ and Jack and Queen and King and Ace of the same suit}) \)

What's the probability of being dealt a royal flush in a five card hand from a standard deck of cards? (Note: A royal flush is a 10, Jack, Queen, King, and Ace of the same suit. A standard deck has 4 suits, each with 13 distinct cards, including these five above.) (NB: The order in which the cards are dealt is unimportant, and you keep each card as it is dealt -- it's not returned to the deck.)

The probability of drawing any card which could fit into some royal flush is \( \frac{5}{13} \). Once that card is taken from the pack, there are 4 possible cards which are useful for making a royal flush with that first card, and there are 51 cards left in the pack. Therefore the probability of drawing a useful second card (given that the first one was useful) is \( \frac{4}{51} \). By similar logic you can calculate the probabilities of drawing useful cards for the other three. The probability of the royal flush is therefore the product of these numbers, or \( \frac{5}{13} \times \frac{4}{51} \times \frac{3}{50} \times \frac{2}{49} \times \frac{1}{48} = 0.0000154 \).