2-89.  
   a) \( P(A \cap B) = P(A|B)P(B) = (0.4)(0.5) = 0.20 \)
   b) \( P(A' \cap B) = P(A'|B)P(B) = (0.6)(0.5) = 0.30 \)

2-90.
   \[
   P(A) = P(A \cap B) + P(A \cap B') \\
   = P(A|B)P(B) + P(A|B')P(B') \\
   = (0.2)(0.8) + (0.3)(0.2) \\
   = 0.16 + 0.06 = 0.22
   \]

2-91.  
   Let \( F \) denote the event that a connector fails.  
   Let \( W \) denote the event that a connector is wet.
   \[
   P(F) = P(F|W)P(W) + P(F|W')P(W') \\
   = (0.05)(0.10) + (0.01)(0.90) = 0.014
   \]

2-93.  
   Let \( R \) denote the event that a product exhibits surface roughness.  
   Let \( N, A, \) and \( W \) denote the events that the blades are new, average, and worn, respectively.  
   Then,
   \[
   P(R) = P(R|N)P(N) + P(R|A)P(A) + P(R|W)P(W) \\
   = (0.01)(0.25) + (0.03)(0.60) + (0.05)(0.15) \\
   = 0.028
   \]

2-95. a) \( (0.88)(0.27) = 0.2376 \)
   b) \( (0.12)(0.13+0.52) = 0.078 \)

2-101.  
   \( P(A') = 1 - P(A) = 0.7 \) and \( P(A'|B) = 1 - P(A|B) = 0.7 \)  
   Therefore, \( A' \) and \( B \) are independent events.
2-103. a) \( P(B \mid A) = 4/499 \) and
\[
P(B) = P(B \mid A)P(A) + P(B \mid A')P(A') = (4/499)(5/500) + (5/499)(495/500) = 5/500
\]
Therefore, A and B are not independent.
b) A and B are independent.

2-105. a) \( P(A \cap B) = 22/100 \), \( P(A) = 30/100 \), \( P(B) = 77/100 \), Then \( P(A \cap B) \neq P(A)P(B) \), therefore, A and B are not independent.
b) \( P(B \mid A) = P(A \cap B) / P(A) = (22/100) / (30/100) = 0.733 \)

2-107. It is useful to work one of these exercises with care to illustrate the laws of probability. Let \( H_i \) denote the event that the ith sample contains high levels of contamination.
a) \( P(H_1 \cap H_2 \cap H_3 \cap H_4 \cap H_5) = P(H_1)P(H_2)P(H_3)P(H_4)P(H_5) \)
by independence. Also, \( P(H_1) = 0.9 \). Therefore, the answer is \( 0.9^5 = 0.59 \)
b) \( A_1 = (H_1 \cap H_2 \cap H_3 \cap H_4 \cap H_5) \)
\( A_2 = (H_1 \cap H_2 \cap H_3 \cap H_4 \cap H_5') \)
\( A_3 = (H_1 \cap H_2 \cap H_3 \cap H_4 \cap H_5') \)
\( A_4 = (H_1 \cap H_2 \cap H_3 \cap H_4 \cap H_5) \)
\( A_5 = (H_1 \cap H_2 \cap H_3 \cap H_4 \cap H_5) \)
The requested probability is the probability of the union \( A_1 \cup A_2 \cup A_3 \cup A_4 \cup A_5 \) and these events are mutually exclusive. Also, by independence \( P(A_1) = 0.9^4(0.1) = 0.0656 \). Therefore, the answer is \( 5(0.0656) = 0.328 \).
c) Let B denote the event that no sample contains high levels of contamination. The requested probability is \( P(B') = 1 - P(B) \). From part (a), \( P(B') = 1 - 0.59 = 0.41 \).

2-109. (a) \( 3(0.2^4) = 0.0048 \)
(b) \( 3(4 \times 0.2^3 \times 0.8) = 0.0768 \)

2-114. Let A denote the upper devices function. Let B denote the lower devices function.
\( P(A) = (0.9)(0.8)(0.7) = 0.504 \)
\( P(B) = (0.95)(0.95)(0.95) = 0.8574 \)
\( P(A \cap B) = (0.304)(0.8574) = 0.4321 \)
Therefore, the probability that the circuit operates \( = P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.9293 \)