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I. Problem 1.3 (Basic Probability)

1. $P(b) = P(a, b) + P(\neg a, b)$ is always true, because it is an application of the law of total probability.

2. $P(a) = P(a|b) + P(a, \neg b)$ is not correct. application of the law of total probability would be:
$P(a) = P(a|b) * P(b) + P(a, \neg b) * P(\neg b)$

3. $P(a, b) = P(a) * P(b)$ This equality is true if and only if events a and b are independent. If they are not independent, $P(a, b) = P(a|b) * P(b)$

4. $P(a, b|c) \cdot P(c) = P(c, a|b) * P(b)$ is always true,. It is an application of Bayes' theorem

5. $P(a \vee b) = P(a) + P(b)$ This equality is not always true. What if a and b are overlapped? Hence, $P(a \vee b) = P(a) + P(b) - P(a \wedge b)$

6. $P(a, \neg b) = (1 - P(b|a)) * P(a)$ is always true, because from joint probability $P(a, \neg b) = P(-b|a) * P(a)(1)$, and $P(-b|a) = 1 - P(b|a)(2)$,. Substituting (2) into (1) we have: $P(a, \neg b) = (1 - P(b|a)) * P(a)$