7) Let $A$ be the set of customers with checking accounts.
   Let $B$ be the set of regular savings accounts.
   Let $C$ be the set of money market savings.

   We are given: $|A \cup B \cup C| = 214$, $|A| = 189$, $|B| = 73$, $|C| = 114$
   $|A \cap B| = 69$ and $B \cap C = \emptyset$

   a) How many have checking and money market, i.e. find $|A \cap C| = x$

   So $|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C|$
   $214 = 189 + 73 + 114 - 69 - x - 0 + 0$

   So $x = 93$

   b) How many have checking but no savings, i.e. find $|A - (B \cup C)|$

   Recall for any sets $P, Q$: $|P - Q| = |P| - |P \cap Q|$

   So $|A - (B \cup C)| = |A| - |A \cap (B \cup C)|$
   $= |A| - |(A \cap B) \cup (A \cap C)|$ (by set identity)
   $= |A| - [|A \cap B| + |A \cap C|]$ (because $A \cap B$ and $A \cap C$ are disjoint)
   $= 189 - [69 + 93] = 27$

12) Every term in the equation on page 205 corresponds to a subset of $\{A_1, A_2, \ldots, A_n \}$ except $\emptyset$.

   There are $2^n$ subsets of $\{A_1, A_2, \ldots, A_n \}$
   so there are $2^n - 1$ terms in the equation.
18. In a group of 25 people, must there be at least 3 who were born in the same month?
Yes. This is the same concept as the pigeonhole principle. Even if all 25 items (people) were put into the 12 bins (months) as evenly as possible, we'd have the first 24 items go two to a bin, but the last item would have to be placed in some bin, so that bin would have at least three items. Note that \( 25 > 2 \times 12 \) at least one bin must have more than this # of items.

20. How many numbers must be selected from \( 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 \) to guarantee at least one pair adds up to 22?

There are five pairs: ① 2 and 20, ② 4 and 18, ③ 6 and 16, ④ 8 and 14, ⑤ 10 and 12 that add up to 22. Apply the pigeonhole principle, where there are five bins (pairs) and the numbers are the items. To guarantee at least one bin having two items (i.e. we have a pair of numbers that adds up to 22), we must select 6 items, one more than the number of bins.