(1) Draw the following sets on the number line:
   (a) Set of all numbers x satisfying $x \leq 2$ and $x \geq -5$;
   (b) Set of all numbers x satisfying $x \leq 2$ or $x \geq -5$
   (c) Set of all numbers x satisfying $x \leq -5$ or $x \geq 2$

(2) For each of the sets below, draw it on the number line and then describe its complement:
   (a) $[0, 2]$ (b) $(-\infty, 1] \cup [3, \infty)$ (c) $(0, 5) \cup (2, \infty)$

(3) Let $A = [1, 3] = \{x \mid 1 \leq x \leq 3\}$, $B = \{x \mid x \geq 2\}$, $C = \{x \mid x \leq 1.5\}$. Draw on the number line the following sets: $\overline{A}$, $\overline{B}$, $\overline{C}$, $A \cap B$, $A \cap C$, $A \cap (B \cup C)$, $A \cap B \cap C$.

(4) Long ago, in some town a phone number consisted of a letter followed by 3 digits (e.g. K651). How many possible phone numbers could there be in that town?[Note: digits could be zero, so a number like X000 was allowed.]

(5) If we roll 3 dice (one red, the other white, and the third one, black), how many combinations are possible? How many combinations in which the sum of values is exactly 4?

(6) A **subset** of a set A is a set formed by taking some (possibly all) elements of A; for example, the set $\{2, 4, 6, 8\}$ is a subset of the set $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$.

   List all subsets of the set $S = \{1, 2, 3\}$ (do not forget the empty set which contains no elements at all and S itself).

   Can you guess the general rule: if set S has n elements, how many subsets does it have?

(7) (a) Using Venn diagrams, explain why $\overline{A \cap B} = \overline{A} \cup \overline{B}$. Does it remind you of one of the logic laws we had discussed before?
(b) Do the same for formula $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$.

(8) In this problem, we denote by $|A|$ the number of elements in a finite set A.
(a) Show that for two sets A, B, we have $|A \cup B| = |A| + |B| - |A \cap B|$.

(b) $(*)$ Can you come up with a similar rule for three sets? That is, write a formula for $|A \cup B \cup C|$ which uses $|A|, |B|, |C|$, $|A \cap B|$, $|A \cap C|$, $|B \cap C|$.

(9) In a class of 33 students, 12 are girls, 10 play soccer, and 10 play chess. Moreover, it is known that 6 of the soccer players are girls, that 2 of the chess players also play soccer, and that there is exactly one girl who plays both chess and soccer. Finally, 4 girls play neither soccer nor chess. Can you figure out how many boys play soccer? chess? both? neither?

(10) 150 people at a Van Halen concert were asked if they knew how to play piano, drums or guitar.
(a) 18 people could play none of these instruments.
(b) 10 people could play all three of these instruments.
(c) 77 people could play drums or guitar but could not play piano.
(d) 73 people could play guitar.
(e) 49 people could play at least two of these instruments.
(f) 13 people could play piano and guitar but could not play drums.
(g) 21 people could play piano and drums.
How many people can play piano? drums?

(11) $(*)$ A barber in a small town decides that he will shave all men who do not shave themselves (and only them). Should he shave himself? [Of course, the barber is a man.]