For these problems, you should justify your answers. You do not need to provide a rigorous mathematical proof, but rather an informal argument.

Problem 1. Consider the sets

$$A = \{(x, y) \in \mathbb{R}^2 \,:\, x^2 + y^2 \leq 6\} \quad \text{and} \quad B = \{(x, y) \in \mathbb{R}^2 \,:\, y \geq x^2\}.$$

For each of the ten sets

$$A,\ B,\ A \cup B,\ A \cap B,\ A - B,\ B - A,\ \overline{A},\ \overline{B},\ \overline{A \cup B},\ \overline{A \cap B}$$

(i) Shade the relevant portion of the plane.
(ii) Describe the set in set-builder notation using inequalities.

(Note: Don't try to illustrate too many of the sets in the same picture; give multiple pictures, and consider using colors.)

Solution. □

Problem 2. For each $\alpha \in \mathbb{R}$, define $A_\alpha = \{(x, \alpha x) \in \mathbb{R}^2 \,:\, -1 \leq x \leq 1\}$.

(i) Describe in words the set A_π.
(ii) Describe $\bigcup_{\alpha \in \mathbb{R}} A_\alpha$ and $\bigcap_{\alpha \in \mathbb{R}} A_\alpha$ in set-builder notation.

Solution. □