1 Proofs

Give a formal proof for the following statement.

If the following propositions are true

1. \neg p \land q
2. r \to p
3. \neg r \to s
4. s \to t

Then t holds.

2 Sets I

For the following statement, if it is true, then give a formal prove; if it is false, then give a specific counter example.

\[ A \setminus (B \cap C) = (A \setminus B) \cap (A \setminus C) \]
3 Sets II

Mark each of the following as True or False, please justify your answers. Recall that \( \mathcal{P} \) is the power set.

- \( \emptyset \in \mathbb{R} \)

- \( \emptyset \subseteq \{1, 2, 3\} \)

- \( 0 \in \{\emptyset, \{0\}\} \)

- \( 0 \subset \{\emptyset, 0\} \)

- \( \{0, 1, 2\} \subseteq \mathcal{P}(\{0, 1, 2\}) \)

- \( \{12\} \in \mathcal{P}(\mathbb{Z}) \)

- \( |\emptyset| = 1 \)

- \( |\mathcal{P}(\emptyset)| = 1 \)

4 Sets III

Let \( A, B \) be subsets of a finite universal set \( U \). List the following in nondecreasing order.

\[ |A|, |A \cup B|, |A \cap B|, |U|, |\emptyset| \]