MTH202 Assignment 1 Solution Fall 2026

Discrete Mathematics (MTH202) | Assignment 1 | Fall 2026 | Total Marks: 20 | Due Date: 9th November 2026

Question 1 (5 Marks)

Statement: If a number is divisible by 6, then it is divisible by 3.

Converse: If a number is divisible by 3, then it is divisible by 6.

Inverse: If a number is not divisible by 6, then it is not divisible by 3.

Contrapositive: If a number is not divisible by 3, then it is not divisible by 6.

The contrapositive is logically equivalent to the original statement.

Question 2 (7 Marks)

Boolean expression for the first circuit: $(P \land Q) \lor (\neg P \land Q) \lor (P \land \neg Q)$

Boolean expression for the second circuit: $P \lor Q$

Proof using the laws of logic:

$(P \land Q) \lor (\neg P \land Q) \lor (P \land \neg Q)$

$= [(P \land Q) \lor (\neg P \land Q)] \lor (P \land \neg Q)$ (Associative law)

$= [(P \lor \neg P) \land Q] \lor (P \land \neg Q)$ (Distributive law)

$= [T \land Q] \lor (P \land \neg Q)$ (Negation law: $P \lor \neg P \equiv T$)

$= Q \lor (P \land \neg Q)$ (Identity law)

$= (Q \lor P) \land (Q \lor \neg Q)$ (Distributive law)

$= (Q \lor P) \land T$ (Negation law: $Q \lor \neg Q \equiv T$)

$= Q \lor P$ (Identity law)

$= P \lor Q$ (Commutative law)

Hence both expressions are logically equivalent.

Question 3 (3 Marks)

Given: p: $x > 1$, q: $x < 9$, r: $x = 1$.

i. $x \leq 1$: $\neg p$

ii. $1 \leq x < 9$: $(p \vee r) \wedge q$

iii. $x \geq 9$: $\neg q$

Question 4 (5 Marks)

Given: $A \cap B = \{2, 5\}$, $A \cap C = \{5, 7\}$, $A - (B \cup C) = \{1, 3\}$, $B - C = \{2, 4, 6\}$, $C - B = \{7, 8\}$.

Since 5 is in both $A \cap B$ and $A \cap C$, 5 is in $B \cap C$. So $B \cap C = \{5\}$.

$B = (B - C) \cup (B \cap C) = \{2, 4, 6\} \cup \{5\} = \{2, 4, 5, 6\}$

$C = (C - B) \cup (B \cap C) = \{7, 8\} \cup \{5\} = \{5, 7, 8\}$

$A = (A \cap B) \cup (A \cap C) \cup (A - (B \cup C)) = \{2, 5\} \cup \{5, 7\} \cup \{1, 3\} = \{1, 2, 3, 5, 7\}$

Answer: $A = \{1, 2, 3, 5, 7\}$, $B = \{2, 4, 5, 6\}$, $C = \{5, 7, 8\}$

Check: $A \cap B = \{2, 5\}$, $A \cap C = \{5, 7\}$, $A - (B \cup C) = \{1, 3\}$, $B - C = \{2, 4, 6\}$, $C - B = \{7, 8\}$. All five given conditions hold.