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# Sub-Subject: Propositional Logic

## Topic: Conditional Statement and its Inverse

**Given:**

Formula \((p \to q)\), where \(p\) and \(q\) are propositional variables.

**Objective:**

Find specific propositions for \(p\) and \(q\) which make \( (p \to q) \) true but the inverse \((\neg p \to \neg q)\) false.

**Step-by-Step Solution:**

**Step 1: Understand the formula \(p \to q\)**

The conditional statement \(p \to q\) (if \(p\) then \(q\)) is true in all cases except when \(p\) is true and \(q\) is false.

Supporting statement: It is essential to know when a conditional statement is true or false to determine the specific propositions.

**Step 2: Identify the inverse of \(p \to q\)**

The inverse of \(p \to q\) is \(\neg p \to \neg q\), which is interpreted as "if not \(p\) then not \(q\)."

Supporting statement: The inverse is important in this situation because we need the inverse to be false.

**Step 3: Determine truth values for \( (p \to q) \)**

To satisfy \( (p \to q) \) being true:

- If \(p\) is true, \(q\) must be true.
- If \(p\) is false, \(q\) can be either true or false.

Supporting statement: Setting specific truth values for \(p\) and \(q\) will help in achieving the desired condition.

**Step 4: Determine truth values for \((\neg p \to \neg q)\)**

To make \(\neg p \to \neg q\) false, \(\neg p\) must be true, and \(\neg q\) must be false. Hence, \(p\) must be false and \(q\) must be true.

Supporting statement: It is critical to have \(\neg p\) true and \(\neg q\) false to make the inverse false.

**Step 5: Choose specific propositions for \(p\) and \(q\)**

Let:

- \[ p = \text{false} \]
- \[ q = \text{true} \]

Supporting statement: These propositions ensure that \( (p \to q) \) is true and \( \neg p \to \(\neg q)\) is false.

**Verification:**

For \(p =\text{false}\):

- \(\neg p = \text{true}\)
- \( (p \to q) = (\text{false} \to \text{true}) = \text{true} \)
- Inverse: \( (\neg p \to \(\neg q)\) \(=\text{true} \to \text{false}) = \text{false} \)

Supporting statement: These propositions align with the required conditions.
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Final Solution:

To make \((p \to q) \) true but \((\neg p \to \(\neg q)\) false, choose the propositions:

- \[p = \text{false} \]
- \[q = \text{true} \]

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