

2.6 Comparing Boolean Expressions

Name: _____ Class: _____ Date: _____

Total: 8 marks

KEY WORDS equivalent 等价 • de morgan's laws 德摩根定律 • boolean expression 布尔表达式

Objective

Build the skills to answer exam questions on **comparing Boolean expressions**.

You must be able to:

- determine whether two Boolean expressions are **equivalent** 等价
- apply **De Morgan's Laws** 德摩根定律 to rewrite $!(a \ \&\& \ b)$ and $!(a \ || \ b)$
- simplify a compound Boolean expression

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Equivalent expressions

Two Boolean expressions are **equivalent** if they always give the **same** result for every input.

■ De Morgan's Laws

$$!(a \ \&\& \ b) = !a \ || \ !b, \quad !(a \ || \ b) = !a \ \&\& \ !b.$$

■ Simplifying

$!(x > 5)$ is simply $x \leq 5$.

2 Practice

2.1 State what it means for two Boolean expressions to be equivalent. [1]

2.2 Rewrite `!(a && b)` using De Morgan's Law. [1]

2.3 Rewrite `!(x > 5)` as a simpler comparison. [1]

3 Exam-style questions

3.1 `!(a || b)` is equivalent to [1]

- **A** `!a || !b`
 - **B** `!a && !b`
 - **C** `a && b`
 - **D** `a || b`
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3.2 Two Boolean expressions are equivalent if they [1]

- **A** look the same
 - **B** always give the same result
 - **C** are both `true`
 - **D** both use `&&`
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3.3 Simplify or rewrite the following.

(a) Rewrite `!(p && q)`. [1]

(b) Rewrite `!(x >= 10)` as a comparison. [1]

(c) State whether `!(true)` equals `false`. [1]

Solutions

2.1 they give the same result for every possible input.

2.2 $\neg a \mid \mid \neg b$.

2.3 $x \leq 5$.

3.1 B.

3.2 B.

3.3 (a) $\neg p \mid \mid \neg q$. (b) $x < 10$. (c) yes.