

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** $a \ || \ b$

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 $\&\&$

3.3 Simplify or rewrite the following.

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

(b) Rewrite $!(x \geq 10)$ as a comparison. [1]

(c) State whether $!(\text{true})$ equals **false**. [1]

Solutions

2.1 they give the same result for every possible input.

2.2 $\neg a \vee \neg b$.

2.3 $x \leq 5$.

3.1 B.

3.2 B.

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