

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 | B |
| C | D |
- A $!a \ || \ !b$
B $!a \ \&\& \ !b$
C $a \ \&\& \ b$
D $a \ || \ b$

3.2 Two Boolean expressions are equivalent if they [1]

- | | |
|---|---|
| A | B |
| C | D |
- 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]