3.5 Boolean Expressions

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

KEY WORDS boolean expression • logical operators • relational operators • list • string

Objective

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

You must be able to:

- explain how a **Boolean expression** evaluates to true or false
- build one with **relational operators** (equal to, greater than, less than)
- combine conditions with the **logical operators** AND, OR, NOT
- predict the result of a compound Boolean expression

1 Key knowledge and worked examples

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

Boolean expression

Always evaluates to **true** or **false**.

Operators

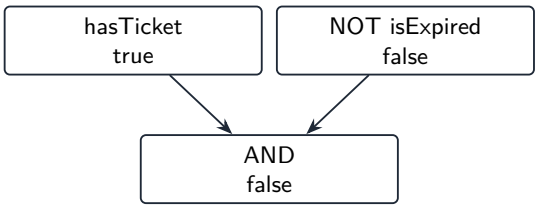
- **Relational**: $=$, $>$, $<$ (and $\geq$, $\leq$).
- **Logical**: **AND** (both true), **OR** (either true), **NOT** (the opposite).

Compound expressions

Evaluate each part, then combine: $(5 > 3)$ AND $(2 > 4)$ = true AND false = **false**.

Worked application: Separate AND from inclusive OR

A fictional access rule uses `hasTicket AND NOT isExpired`. If a visitor has a ticket but it has expired, the first condition is true and `NOT isExpired` is false, so access is false. By contrast, `hasTicket OR hasInvitation` is true when both are true as well as when only one is true: OR is inclusive. Work out each simple condition before combining it, and check all possible input combinations with a truth table. Replacing AND with OR could admit a visitor without a valid ticket; the operator represents a policy choice, not a formatting preference.



2 Practice

2.1 State what a Boolean expression evaluates to. [1]

2.2 Evaluate $(7 > 2)$ AND $(4 > 9)$. [2]

2.3 State what the NOT operator does. [1]

3 Exam-style questions

3.1 A Boolean expression evaluates to [1]

- **A** a number
- **B** a string
- **C** true or false
- **D** a list

3.2 The expression $(3 > 1)$ OR $(5 < 2)$ is [1]

- **A** true
- **B** false
- **C** undefined
- **D** 3

3.3 Given $a = 5$ and $b = 8$:

(a) evaluate $a < b$. [1]

(b) evaluate $(a < b)$ AND $(b < 10)$. [1]

(c) evaluate NOT $(a < b)$. [1]

3.4 A rule is `(score >= 60) AND NOT absent`. For score 60 and `absent = true`, evaluate both components and the final result. Then state the result if `absent = false` while score stays 60. [4]

Solutions

Each answer shows the steps, then the **result**.

2.1

- either true or false

2.2

- $7 > 2$ is true; $4 > 9$ is false; true AND false = **false**

2.3

- it reverses a Boolean value (true becomes false and vice versa)

3.1 C

- true or false.

3.2 A

- the first part is true, so OR is true

3.3

(a)

- true

(b)

- true (both parts true)

(c)

- false

3.4

`score >= 60` is true; `NOT absent` is false; true AND false is false; with `absent = false`, both required conditions are true and the result is true.