2.4 Boolean Logic: Test Pack

OCR J277 · Calculators not allowed · about 20 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 In computer science, a Boolean is a data type that can only take one of two values.

(a) State the two values that a variable of Boolean data type can hold. **(1)**

(b) Give an example of a real-world question, other than a question about an alarm system, that has a Boolean (yes/no) answer. **(1)**

(Total for Question 1 is 2 marks)

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2 A house alarm system has two sensors: a door sensor D and a window sensor W. Each sensor outputs 1 if triggered and 0 if not triggered. Let A represent whether the alarm sounds (1 = sounds, 0 = silent).

(a) The alarm should sound if either sensor is triggered. Write a Boolean expression for A in terms of D and W. **(1)**

(b) The owner finds the alarm sounds too often because of a cat setting off one sensor. Write a new Boolean expression for A so that both sensors must be triggered at the same time before the alarm sounds. **(1)**

(Total for Question 2 is 2 marks)

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3 A program is written using OCR Exam Reference Language:

age = 16
hasID = True
if age ≥ 18 OR hasID == True then

```
    print("Entry allowed")
```

else

```
    print("Entry denied")
```

endif

(a) State the output produced when this code is run with the values shown above. **(1)**

(b) The line hasID = True is changed to hasID = False, with age still equal to 16. State the new output. **(1)**

(c) Complete a trace table showing the values of age, hasID and the OUTPUT produced for both runs described in parts (a) and (b). **(3)**

Run	age	hasID	OUTPUT
1			
2			

(Total for Question 3 is 5 marks)

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4 A student claims that NOT (A AND B) always produces the same output as (NOT A) OR (NOT B) for every combination of A and B.

(a) Complete the two truth tables below to test this claim. **(4)**

A	B	A AND B	NOT (A AND B)
0	0		
0	1		
1	0		
1	1		

A	B	NOT A	NOT B	(NOT A) OR (NOT B)
0	0			
0	1			
1	0			
1	1			

(b) State whether the student's claim is correct, using evidence from your completed tables. **(1)**

(Total for Question 4 is 5 marks)

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5 A vending machine dispenses an item if a coin has been inserted (coinInserted) and the selected item is in stock (stockAvailable), or if an engineer's override switch (overrideSwitch) is on, which bypasses the coin and stock requirements.

(a) Write a Boolean expression for dispense in terms of coinInserted, stockAvailable and overrideSwitch. **(2)**

(b) The engineer adds a safety interlock: a doorOpen sensor must be False before the machine is allowed to dispense anything, even when the override switch is on. Rewrite the expression for dispense to include this new rule. **(2)**

(Total for Question 5 is 4 marks)

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Mark scheme · 2.4 Boolean Logic: Test Pack

Question 1

(a) Both values given, oe (True and False, or 1 and 0) **B1**

(a) Answer: True and False (also accept 1 and 0)

(b) Any valid question with a genuine yes/no answer, oe **B1**

(b) Answer: e.g. 'Is the front door locked?' (accept any sensible yes/no question)

Question 2

(a) A = D OR W, oe **B1**

(a) Answer: A = D OR W

(b) A = D AND W, oe **B1**

(b) Answer: A = D AND W

Question 3

(a) "Entry allowed", cao **B1**

(a) Answer: Entry allowed

(b) "Entry denied", cao **B1**

(b) Answer: Entry denied

(c) Run 1: age=16, hasID=True, OUTPUT='Entry allowed' **B1**

(c) Run 2: age=16, hasID=False, OUTPUT='Entry denied' **B1**

(c) Both rows fully consistent with the code and with the answers to (a) and (b) **B1**

(c) Answer: Run 1: 16, True, Entry allowed. Run 2: 16, False, Entry denied.

Question 4

(a) First table: NOT(A AND B) column correct = 1, 1, 1, 0 **B1**

(a) Second table: NOT A and NOT B columns correct in all 4 rows **B1**

(a) Second table: (NOT A) OR (NOT B) column correct = 1, 1, 1, 0 **B1**

(a) Both final output columns fully correct and matching row for row **B1**

(a) Answer: Both final columns read: 1, 1, 1, 0

(b) Yes, the claim is correct because the output columns for NOT(A AND B) and (NOT A) OR (NOT B) are identical for all four rows, ft from part (a) **B1**

(b) Answer: Yes, correct; both expressions give the output pattern 1, 1, 1, 0 for all four input combinations.

Question 5

(a) coinInserted AND stockAvailable combined correctly, oe **M1**

(a) Full expression: dispense = (coinInserted AND stockAvailable) OR overrideSwitch, oe **A1**

(a) Answer: dispense = (coinInserted AND stockAvailable) OR overrideSwitch

(b) NOT doorOpen used as an additional condition **M1**

(b) Full expression: dispense = NOT doorOpen AND ((coinInserted AND stockAvailable) OR overrideSwitch), oe, ft from part (a) **A1**

(b) Answer: dispense = NOT doorOpen AND ((coinInserted AND stockAvailable) OR overrideSwitch)

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