MODULE Q BOOLEAN LOGIC · Q7

From problem statement to logic circuit

Original practice questions · 20 marks · ~25 minutes · Cambridge 0478 syllabus 10.2, 10.3

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. The marks for each part are shown in brackets [ ]. In every logic circuit, each gate must have a maximum of two inputs; do not simplify. The total for this worksheet is **20 marks**.

1

Total: 3 marks

Each phrase comes from a problem statement with two inputs, A and B. The output is 1 when the phrase is true. Identify the single logic gate that matches each phrase. **[3]**

Phrase	Logic gate
A or B, but not both	
neither A nor B	
not both A and B	

2

Total: 4 marks

A meeting room has a ventilation fan (F = 1 means the fan runs). It uses three sensors: W = 1 when the window is open, D = 1 when the door is open and C = 1 when the carbon dioxide level is high.
The fan runs when the carbon dioxide level is high **and** neither the window **nor** the door is open.

(a) Write the logic expression for this problem statement. **[2]**

F =

(b) Draw a logic circuit for this problem statement. **[2]**



3 **Total: 11 marks**

A bakery uses a monitoring system for its dough proving cabinet. The system has three inputs and lights a warning lamp (X = 1).

Input	Description	Input of 1 means	Input of 0 means
D	door sensor	the door is open	the door is closed
T	temperature sensor	the temperature is above 30 °C	the temperature is 30 °C or below
H	humidity sensor	the humidity is too low	the humidity is acceptable

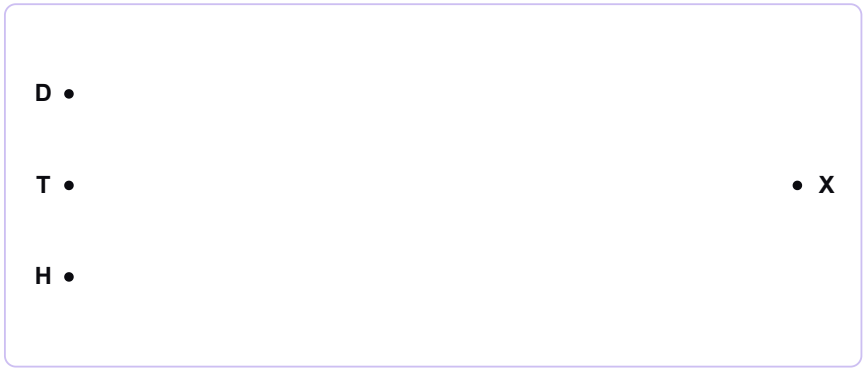
The warning lamp lights when:

- the door is open **and** the temperature is above 30 °C
- **or** the humidity is too low **and** the door is **not** open.

(a) Write the logic expression for this problem statement. **[3]**

X =

(b) Draw a logic circuit for this problem statement. **[4]**



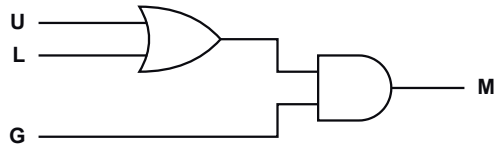
(c) Complete the truth table for this problem statement. **[4]**

D	T	H	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

4 **Total: 2 marks**

A goods lift has a button on each floor: U = 1 when the upper-floor button is pressed and L = 1 when the lower-floor button is pressed. G = 1 when the lift gate is closed.
The lift moves (M = 1) when the gate is closed **and** either the upper-floor button or the lower-floor button is pressed, **but not both**.

A technician drew this logic circuit for the lift.



(a) Give the values of U, L and G for which the technician's circuit gives the wrong output. **[1]**

U	L	G

(b) Identify the logic gate that should replace the OR gate in the technician's circuit. **[1]**

Total for this worksheet: 20 marks