10 The truth table below has two inputs, A and B, and two outputs, S and C.

INPUTS		OUTPUTS	
A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

(a)

(i) Write a logic expression for S in terms of A and B.

……

……

……**[1]**

(ii) Write a logic expression for C in terms of A and B.

……

……

……**[1]**

(iii) Use the expressions for S and C to draw a single logic circuit for the truth table.

(b) Using the rules for manipulating Boolean expressions simplify the following:

$A \wedge B \vee A \wedge (B \vee C) \vee B \wedge (B \vee C)$

……

……

……

……

……**[4]**

4 A cinema offers discounted tickets, but only under one of the following conditions:

- Customer is under 18 and has a student card.
- Customer is over 60 and has ID which proves this.

Let:

A be Customer is under 18

B be Customer has a student card

C be Customer is over 60

D be Customer has ID

Q be Discount ticket issued

(a) Complete the Boolean expression below:

$Q \equiv$ .....

[3]

(b) The cinema has a voucher which promises free popcorn when the voucher is produced whilst buying a soft drink or bottle of water.

Let:

E be Voucher is shown

F be Soft drink is bought

G be Bottle of water is bought

R be Free popcorn given.

This could be written as:

$R \equiv (E \wedge F) \vee (E \wedge G)$

(i) Complete the truth table below.

E	F	G	(E∧F)	(E∧G)	(E∧F)∨(E∧G)
1	1	1			
1	1	0			
1	0	1			
1	0	0			
0	1	1			
0	1	0			
0	0	1			
0	0	0			

[4]

(ii) Simplify the expression

(E∧F) ∨ (E∧G)

.....

..... **[2]**

(b) Draw the logic gates represented by the Karnaugh Map below. Show your working.

CD \ AB	00	01	11	10
00	1	1	0	0
01	1	1	0	0
11	0	0	1	1
10	0	0	1	1

[4]

(f) Show the byte below after having an AND applied with the masking byte.

Byte	1	0	1	1	1	0	0	1
AND	1	1	1	1	1	1	1	1
Result								

[1]

(g) Show the byte below after having an OR applied with the masking byte.

Byte	1	0	1	1	1	0	0	1
OR	1	1	1	1	1	1	1	1
Result								

[1]

10 **(a)** Draw a logic gate diagram to represent the Boolean expression

$Q \equiv \neg A \vee B$

[2]

(b) Find the Boolean expression represented in the Karnaugh Map below. Show your working.

		AB			
		00	01	11	10
CD	00	1	1	1	1
	01	0	0	1	1
	11	0	0	0	1
	10	0	0	0	1

[5]

9 Complete the truth table to represent the following Boolean expression.

$Q \equiv \neg (A \wedge B) \vee C$

A	B	C	Q
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[2]

(c) Bertie Butler's circuitry is designed to only listen out for "Hey Bertie" under certain circumstances, which are:

The privacy button (**P**) must be off and the microphone must generate a signal (**S**) to say a sound has been heard.

(i) Complete the truth table for whether the device is listening (**L**).

P	S	L
False	False	
False	True	
True	False	
True	True	

[2]

(ii) Draw logic gates to represent the circuitry needed.

[3]