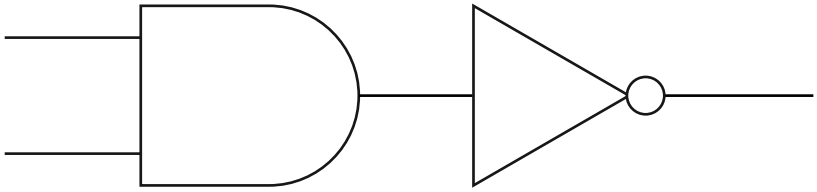
QUESTION 6.

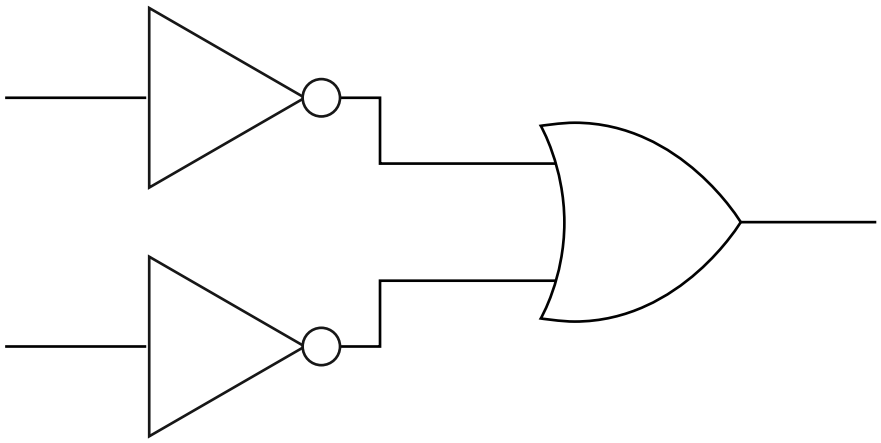
4 (a) (i) Complete the truth table for this logic circuit:



A	B	Working space	X
0	0		
0	1		
1	0		
1	1		

[1]

(ii) Complete the truth table for this logic circuit:



A	B	Working space	X
0	0		
0	1		
1	0		
1	1		

[1]

(b) A student decides to write an equation for **X** to represent the full behavio
circuit.

(i) Write the Boolean expression that will complete the required equation for **X**
circuit:

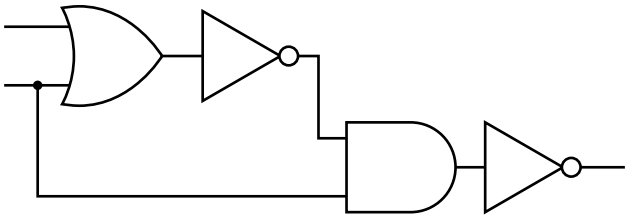
Circuit 1: **X** = ...

Circuit 2: **X** = ...[2]

(ii) Write the De Morgan's Law which is shown by your answers to **part (a)** and **part (b)(i)**.

.....[1]

(c) Write the Boolean algebraic expression corresponding to the following logic circuit:



.....[3]

(d) Using De Morgan's laws and Boolean algebra, simplify your answer to **part (c)**.

Show all your working.

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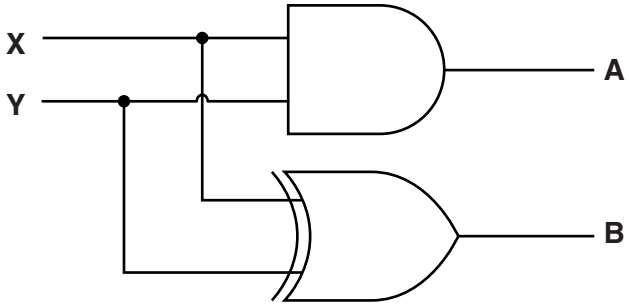
.....[3]

QUESTION 7.

4 **(a)** **(i)** Complete the truth table for this logic circuit.



Input		Output	
X	**Y**	**A**	**B**
0	0		
0	1		
1	0		
1	1		

[2]

(ii) State the name given to this logic circuit.

..... [1]

(iii) Name the labels usually given to **A** and **B**.

Label **A** .....

Label **B** .....

Explain why your answers are more appropriate for the **A** and **B** labels.

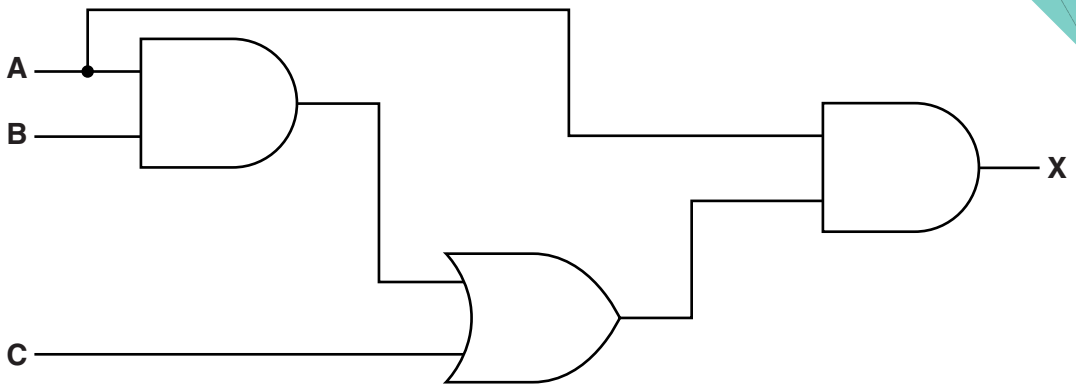
.....

.....

.....

..... [4]

(b) **(i)** Write the Boolean expression corresponding to the following logic circuit.



..... [2]

(ii) Use Boolean algebra to simplify the expression that you gave in **part (b)(i)**.

Show your working.

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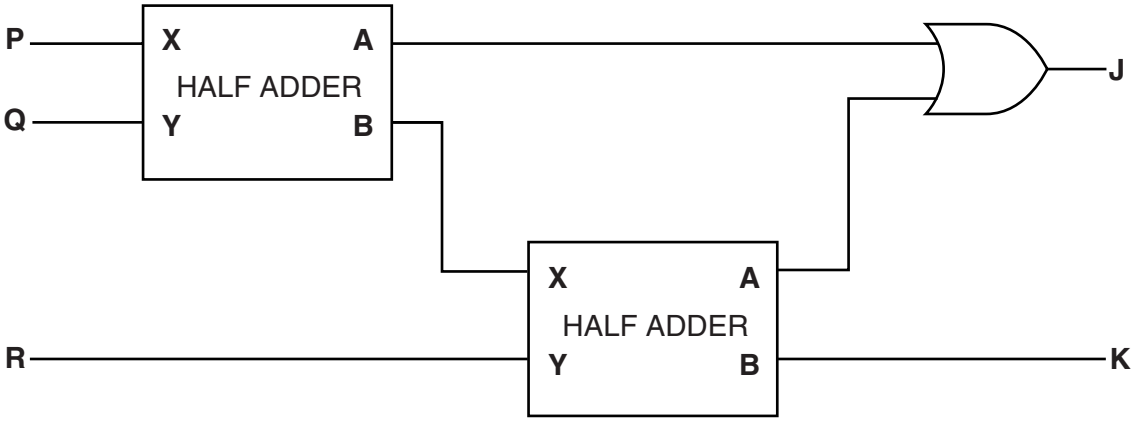
..... [3]

QUESTION 8.

5 (a) (i) A half adder is a logic circuit with the following truth table.

Input		Output	
X	**Y**	**A**	**B**
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

The following logic circuit is constructed.



Complete the following truth table for this logic circuit.

Input			Working space	Output	
P	**Q**	**R**		**J**	**K**
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]

(ii) State the name given to this logic circuit.

..... [1]

(iii) Name the labels usually given to **J** and **K**.

Label **J** .....

Label **K** .....

Explain why your answers are appropriate labels for these outputs.

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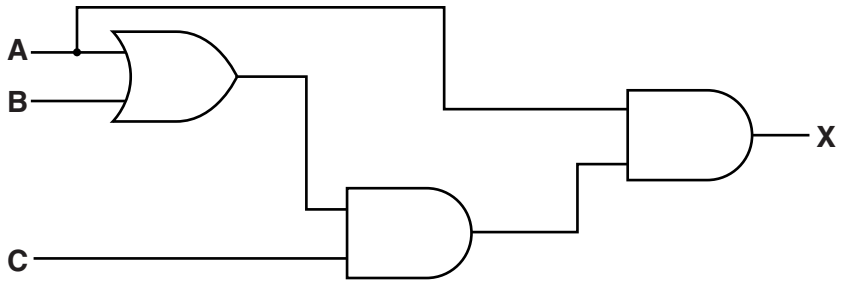
.....

.....

..... [4]

(b) (i) Write down the Boolean expression corresponding to the following logic circuit:



..... [2]

(ii) Use Boolean algebra to simplify the expression given in **part (b)(i)**.

Show your working.

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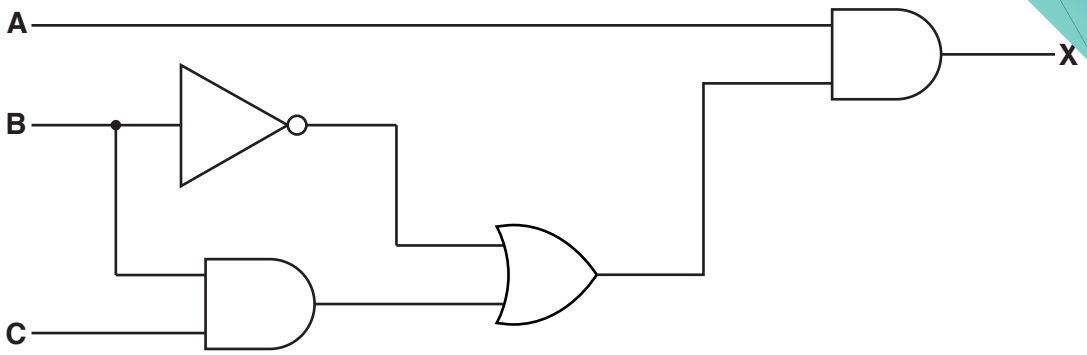
..... [4]

QUESTION 9.

3 Consider the following logic circuit, which contains a redundant logic gate.



(a) Write the Boolean algebraic expression corresponding to this logic circuit.

X = ...[3]

(b) Complete the truth table for this logic circuit.

A	B	C	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		

[2]

(c) **(i)** Complete the Karnaugh Map (K-map) for the truth table in **part (b)**.

		AB			
		00	**01**	**11**	**10**
C	**0**				
	1				

[1]

The K-map can be used to simplify the expression in **part (a)**.

(ii) Draw loop(s) around appropriate groups to produce an optimal sum-of-products. [2]

(iii) Write a simplified sum-of-products expression, using your answer to **part (ii)**.

X = ...[2]

(d) One Boolean identity is:

$$A + \overline{A}.B = A + B$$

Simplify the expression for X in **part (a)** to the expression for X in **part (c)(iii)**. You shou
the given identity.

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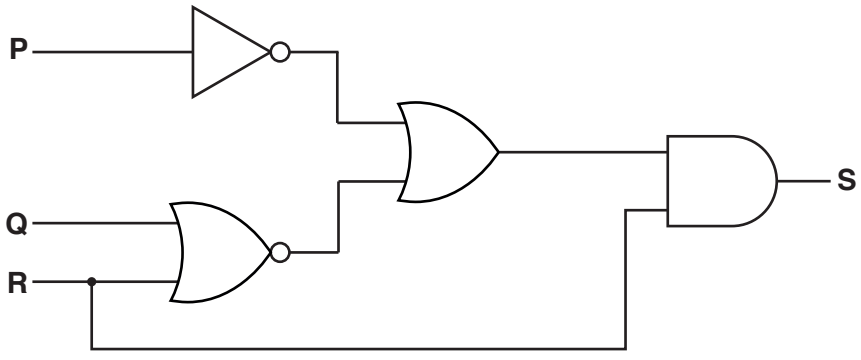
.....[2]

QUESTION 10.

3 A logic circuit is shown:



(a) Write the Boolean algebraic expression corresponding to this logic circuit:

S = ...[4]

(b) Complete the truth table for this logic circuit:

P	Q	R	Working space	S
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) **(i)** Complete the Karnaugh Map (K-map) for the truth table in **part (b)**.

		PQ			
		00	**01**	**11**	**10**
R	**0**				
	1				

[1]

The K-map can be used to simplify the function in **part (a)**.

(ii) Draw loop(s) around appropriate groups to produce an optimal sum-of-products. [1]

(iii) Write a simplified sum-of-products expression, using your answer to **part (ii)**.

S = ...[1]

(d) One Boolean identity is:

$$(A + B) \,.\, C = A \,.\, C + B \,.\, C$$

Simplify the expression for S in **part (a)** to the expression for S in **part (c)(iii)**.

You should use the given identity and De Morgan's Laws.

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.....[3]

QUESTION 11.

3 **(a)** Consider the following Boolean expression.

$$A \cdot \overline{B} \cdot \overline{C} + A \cdot B \cdot \overline{C} + A \cdot B \cdot C$$

Use Boolean algebra to simplify the expression.

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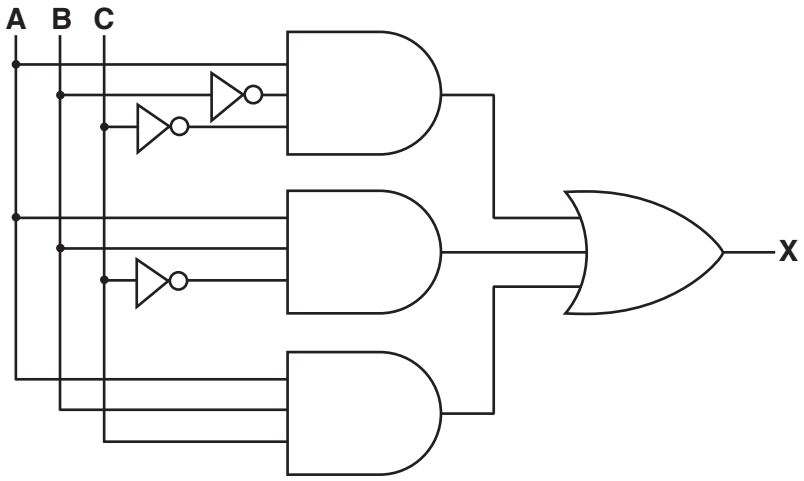
.....[4]

(b) (i) Complete the truth table for the following logic circuit.



A	B	C	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		

[2]

(ii) Complete the Karnaugh Map (K-map) for the truth table in **part (b)(i)**.

		AB			
		00	**01**	**11**	**10**
C	**0**				
	1				

[1]

(iii) Draw loops around appropriate groups of 1s in the table in **part (b)(ii)** to produce an optimal sum-of-products. [2]

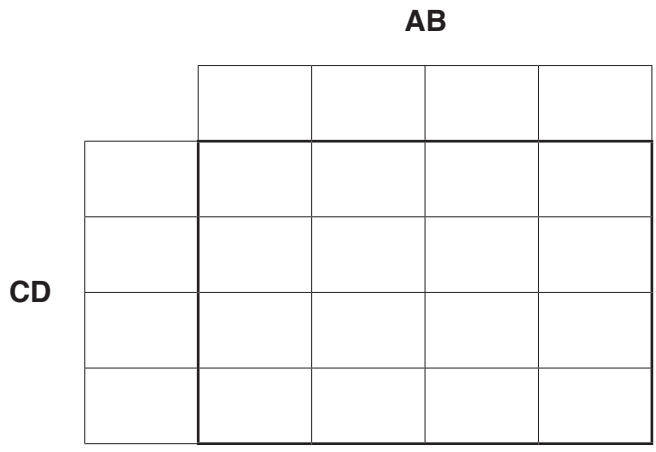
(iv) Using your answer to **part (b)(iii)**, write a simplified sum-of-products Boolean expression.

X = ...[2]

(c) The truth table for a logic circuit with four inputs is shown.

INPUT				OUTPUT
A	**B**	**C**	**D**	**X**
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

(i) Complete the K-map for the truth table in **part (c)**.



[4]

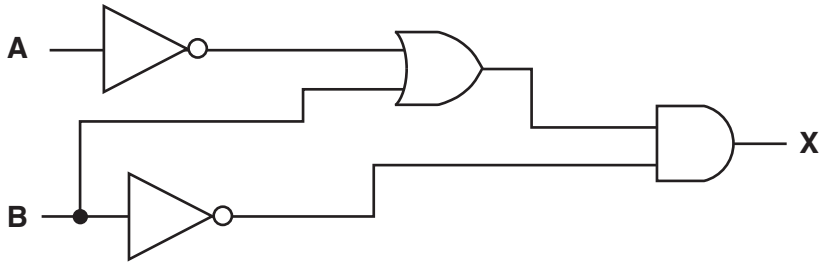
(ii) Draw loops around appropriate groups of 1s in the table in **part (c)(i)** to produce an optimal sum-of-products. [2]

(iii) Using your answer to **part (c)(ii)**, write a simplified sum-of-products Boolean expression.

X = ...[2]

QUESTION 12.

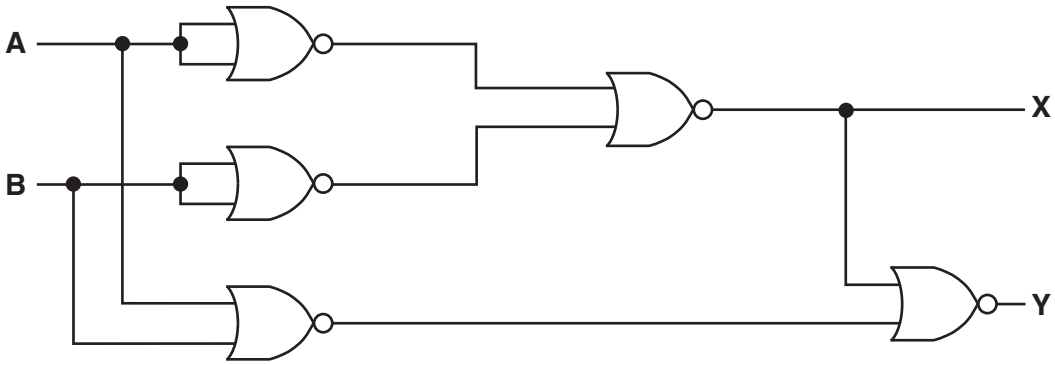
3 **(a)** The following logic circuit can be simplified to use only one gate.



Give the name of this single gate.

..... [1]

(b) **(i)** Complete the truth table for the logic circuit.



A	B	Working space	X	Y
0	0			
0	1			
1	0			
1	1			

[2]

(ii) Give the name of the logic circuit that has this truth table.

..... [1]

(iii) Give the uses for outputs **X** and **Y**.

X .....

Y .....

[2]

(c) Consider the following Boolean algebraic expression:

$$\overline{A} \cdot \overline{B} \cdot \overline{C} \cdot \overline{D} + \overline{A} \cdot \overline{B} \cdot \overline{C} \cdot D + \overline{A} \cdot \overline{B} \cdot C \cdot D + \overline{A} \cdot \overline{B} \cdot C \cdot \overline{D} + \overline{A} \cdot B \cdot \overline{C} \cdot \overline{D}$$

Use Boolean algebra to simplify the expression. Show your working.

Working .....

.....

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Simplified expression ..... [5]

QUESTION 13.

3 **(a)** A Boolean algebraic expression produces the following truth table.

INPUT			OUTPUT
A	**B**	**C**	**X**
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

(i) Complete the Karnaugh Map (K-map) for the truth table.

		AB			
		00	**01**	**11**	**10**
C	**0**				
	1				

[1]

The K-map can be used to simplify the expression that produced the truth table in **part (a)**.

(ii) Draw loops around appropriate groups of 1s in the K-map to produce an optimal sum-of-products. [2]

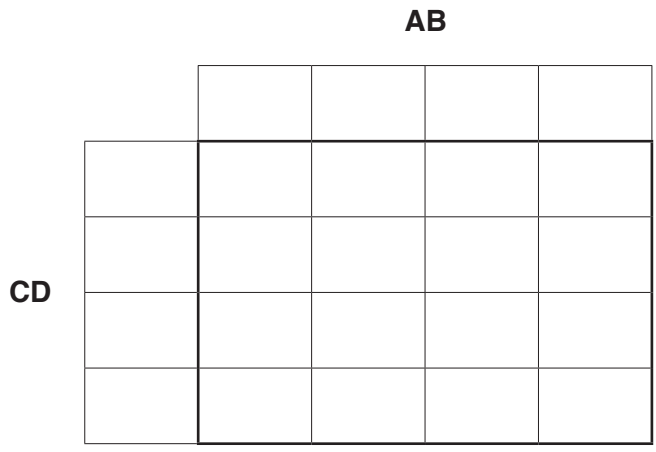
(iii) Write the simplified sum-of-products Boolean expression for the truth table.

X = ... [2]

(b) A logic circuit with four inputs produces the following truth table.

INPUT				OUTPUT
A	**B**	**C**	**D**	**X**
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	0
1	1	1	1	0

(i) Complete the K-map for the truth table.



[4]

(ii) Draw loops around appropriate groups of 1s in the K-map to produce an optimal sum-of-products. [2]

(iii) Write the simplified sum-of-products Boolean algebraic expression for the truth table.

X = ... [2]

QUESTION 14.

2 **(a)** A Boolean expression produces the following truth table.

INPUT			OUTPUT
A	**B**	**C**	**X**
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

(i) Write the Boolean expression for the truth table by applying the sum-of-products.

X = ...

..... [3]

(ii) Complete the Karnaugh Map (K-map) for the truth table in **part (a)**.

		AB			
		00	**01**	**11**	**10**
C	**0**				
	1				

[1]

The K-map can be used to simplify the function in **part (a)(i)**.

(iii) Draw loop(s) around appropriate groups in the table in **part (a)(ii)**, to produce an optimal sum-of-products. [2]

(iv) Write, using your answer to **part (a)(iii)**, a simplified Boolean expression for your Karnaugh map.

X = ... [2]

(b) Simplify the following expression using De Morgan's laws. Show your workin

$$\overline{(\overline{W} + X) \bullet (Y + \overline{Z})}$$

.....

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..... [3]