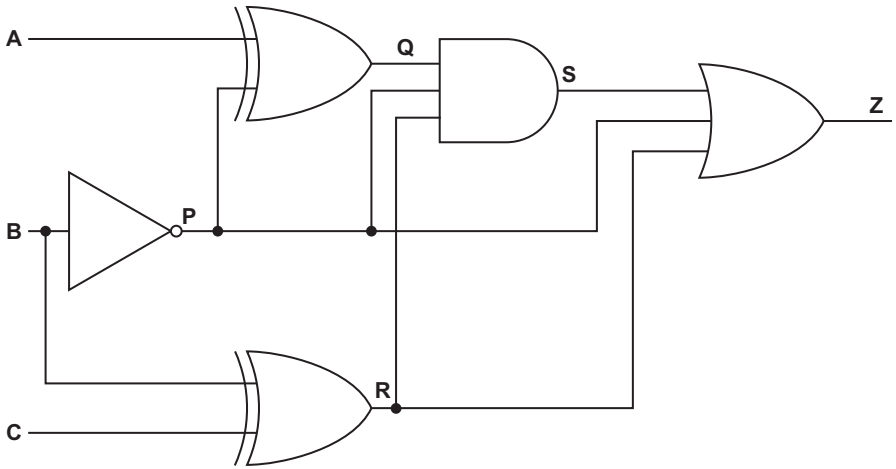
6 **(a)** The diagram shows a logic circuit.



Complete the truth table for the given logic circuit.
Show your working.

			Working space				
A	**B**	**C**	**P**	**Q**	**R**	**S**	**Z**
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					
1	1	1					

[3]

(b) **(i)** Complete the Karnaugh map (K-map) for the Boolean expression:

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

A \ BC	00	01	11	10
0				
1				

[2]

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

(iii) Write the Boolean expression from your answer to part **b(ii)** as a simplified sum-of-products. Do **not** carry out any further simplification.

.....

..... [2]

6 **(a)** The Karnaugh map (K-map) represents a logic circuit with four inputs.

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

(i) Draw loop(s) around appropriate group(s) in the K-map to produce an optimal sum-of-products. [3]

(ii) Write the Boolean expression from your answer to part **a(i)** as a simplified sum-of-products. Do **not** carry out any further simplification.

.....

..... [2]

(b) Simplify the following expression using De Morgan's laws and Boolean algebra.

Show all the stages in your simplification.

$\mathbf{X} = \overline{\mathbf{A}+\mathbf{B}+\mathbf{C}}+\overline{\overline{\mathbf{B}}+\mathbf{C}}$

.....

.....

.....

.....

.....

..... [3]

6 The truth table for a logic circuit is shown.

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

(a) Write the Boolean logic expression that corresponds to the given truth table as the sum-of-products.

X = ...

..... [3]

(b) Complete the Karnaugh map (K-map) for the given truth table.

CD \ AB	00	01	11	10
00				
01				
11				
10				

[2]

(c) Draw loop(s) around appropriate group(s) in the K-map to produce an optimal sum-of-products. [2]

(d) Write the Boolean logic expression from your answer to part **(c)** as the simplified sum-of-products.

X = ...

..... [2]

7 The truth table for a logic circuit is shown.

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

(a) Write the Boolean logic expression that corresponds to the given truth table as the sum-of-products.

T = ...

..... [3]

(b) Complete the Karnaugh map (K-map) for the given truth table.

CD \ AB	00	01	11	10
00				
01				
11				
10				

[2]

(c) Draw loop(s) around appropriate group(s) in the K-map to produce an optimal sum-of-products. [2]

(d) **(i)** Write the Boolean logic expression from your answer to part **(c)** as the simplified sum-of-products.

T = ...

..... [2]

(ii) Use Boolean algebra to write your answer to part **(d)(i)** in its simplest form.

T = ... [1]