(i) $\mathbf{Q} = \mathbf{A}.\overline{\mathbf{B}} + \mathbf{B}$

....

....

....

....

B \ A	0	1
0		
1		

[2]

Q = ...

(ii) $\mathbf{Q} = \overline{\mathbf{A}}.\overline{\mathbf{B}}.\overline{\mathbf{C}}.\overline{\mathbf{D}} + \overline{\mathbf{A}}.\mathbf{B}.\overline{\mathbf{C}}.\overline{\mathbf{D}} + \overline{\mathbf{B}}.\overline{\mathbf{C}}.\mathbf{D} + \mathbf{B}.\overline{\mathbf{C}}.\mathbf{D}$

....

....

....

....

....

....

....

DC \ BA	00	01	11	10
00				
01				
11				
10				

[3]

Q = ...

(ii) $\mathbf{Q} = \mathbf{A}.\mathbf{B} + \overline{\mathbf{A}}.\mathbf{B}.\mathbf{C} + \overline{\mathbf{A}}.\overline{\mathbf{B}}.\mathbf{C} + \mathbf{A}.\overline{\mathbf{B}}.\overline{\mathbf{C}}$

....

....

....

....

....

Q = ... [3]

C \ BA	00	01	11	10
0				
1				

11. The following truth table defines the logic conditions for a particular application.

Inputs				Output
D	**C**	**B**	**A**	**Q**
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	0
0	1	1	1	0
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

Write the simplified Boolean expression for the truth table

Complete the Karnaugh map below for the same logic function using either the truth table or your logic expression from (a)

DC \ BA	00	01	11	10
00				
01				
11				
10				

Draw the circuit

A

B

Q

C

D

6.

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

	BA			
DC	00	01	11	10
00				
01				
11				
10				

10.

$$\mathbf{Q} = \overline{\mathbf{A}}.\overline{\mathbf{B}}.\overline{\mathbf{C}}.\overline{\mathbf{D}} + \overline{\mathbf{A}}.\mathbf{B}.\overline{\mathbf{C}}.\overline{\mathbf{D}} + \overline{\mathbf{B}}.\overline{\mathbf{C}}.\mathbf{D} + \mathbf{B}.\overline{\mathbf{C}}.\mathbf{D}$$

	BA			
DC	00	01	11	10
00				
01				
11				
10				

Use the rules of Boolean algebra to join the expression in column 1 to the equivalent expression in column 2 with a line. One has already been done for you.

Column 1	**Column 2**
$X \cdot \overline{Y} + X \cdot Z$	$\overline{X + \overline{Y}} + X \cdot Z$
$\overline{X} \cdot Y + X \cdot Z$	$\overline{X} \cdot (Y + Z)$
$\overline{X} \cdot Y + \overline{X} \cdot Z$	$\overline{X} \cdot Y + X \cdot Z + Y \cdot Z$
$X \cdot Y + X \cdot Z$	$\overline{\overline{X \cdot \overline{Y}}} + X \cdot Z$
$(X + Y) \cdot (\overline{X} + Z)$	$X \cdot Y + X \cdot Z + \overline{Y} \cdot Y$

	$v\cdot\overline{x} + \overline{v + y}$
$\overline{v}\cdot y$	
	$\overline{v\cdot x\cdot y}$
$\overline{v + x + y}$	$\overline{v}\cdot\overline{x}\cdot\overline{y}$
	$v\cdot\overline{x}\cdot y$
$v\cdot\overline{x} + \overline{v}\cdot\overline{y} + \overline{x}\cdot\overline{y}$	$v\cdot\overline{x}\cdot y + \overline{v}\cdot x\cdot y$
	$\overline{v}\cdot x\cdot y$
$\left(\overline{\overline{v} + x}\right)\cdot\left(\overline{v}\cdot y + v\cdot\overline{x}\cdot y\right)$	
	$\overline{v}\cdot y + \overline{v}\cdot x\cdot y$

(b) Apply DeMorgan's theorem to the following expression **and** simplify the result.

$$Q = \overline{(\overline{A+B}).A.\overline{B}}$$

....

....

....

....

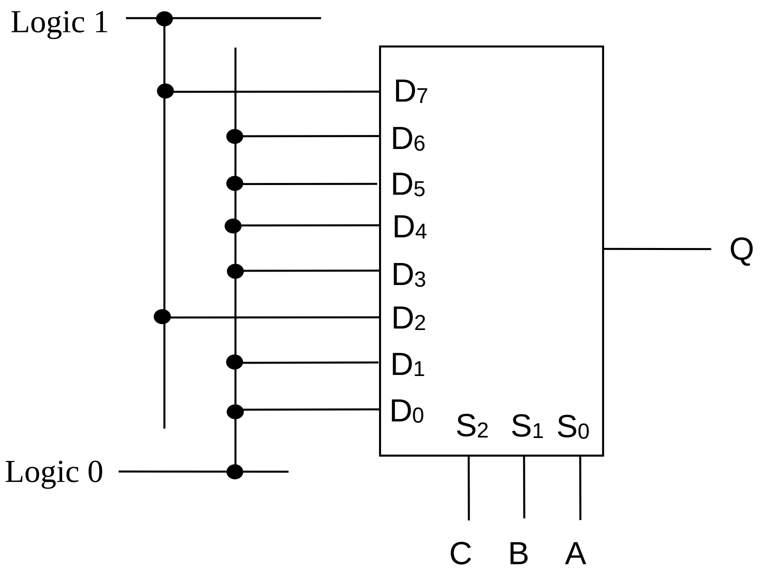
....

....

....

[3]

The diagram shows an 8 : 1 multiplexer used as a programmable logic system.



(a) Complete the truth table for this system.

Inputs			Output
C	**B**	**A**	**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	

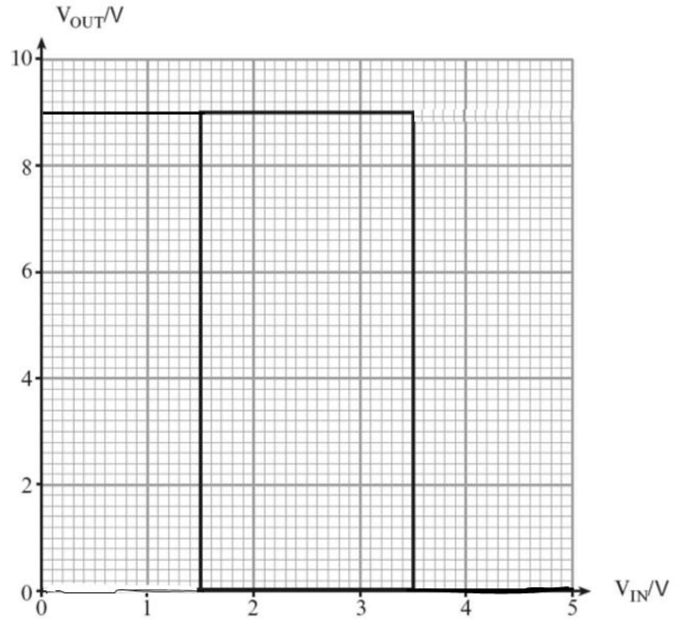
[2]

(b) Write down the Boolean expression for the output **Q**, in terms of **A**, **B** and **C**.

Q = ...

[2]

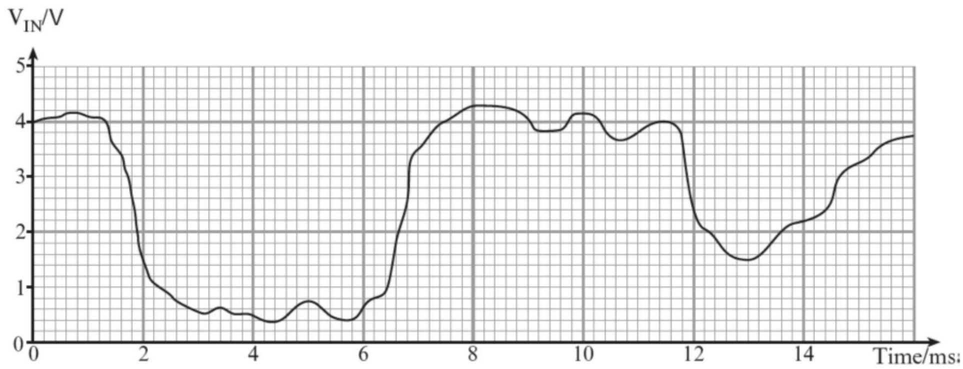
1. A Schmitt trigger circuit has the following characteristic.

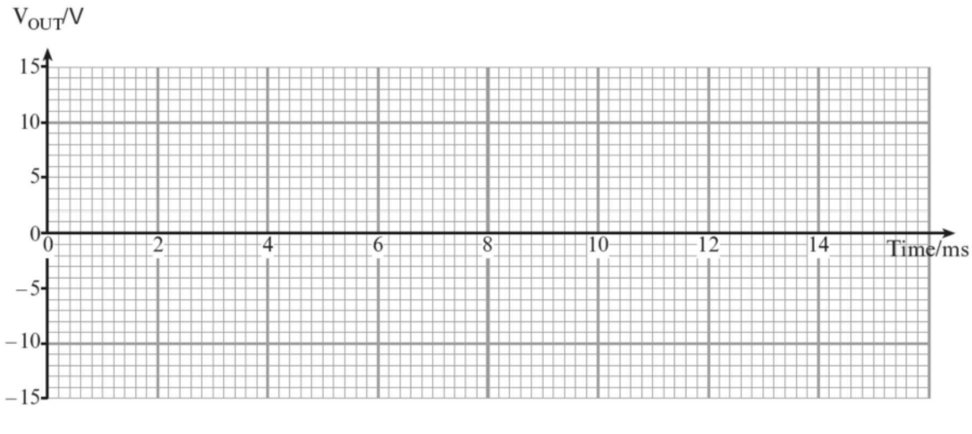


(ii) What are the switching thresholds for this Schmitt trigger?

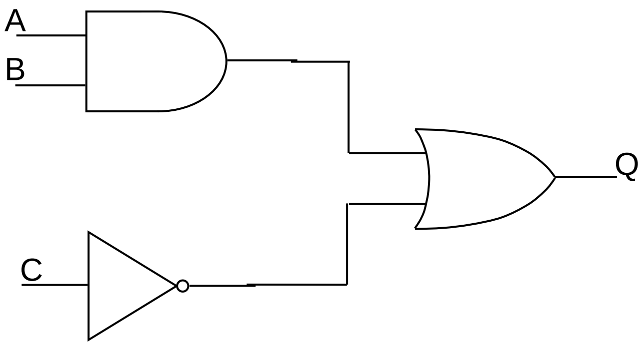
.... and .... [1]

(b) Draw the output for this Schmitt trigger when the following analogue signal is applied to the input. [3]

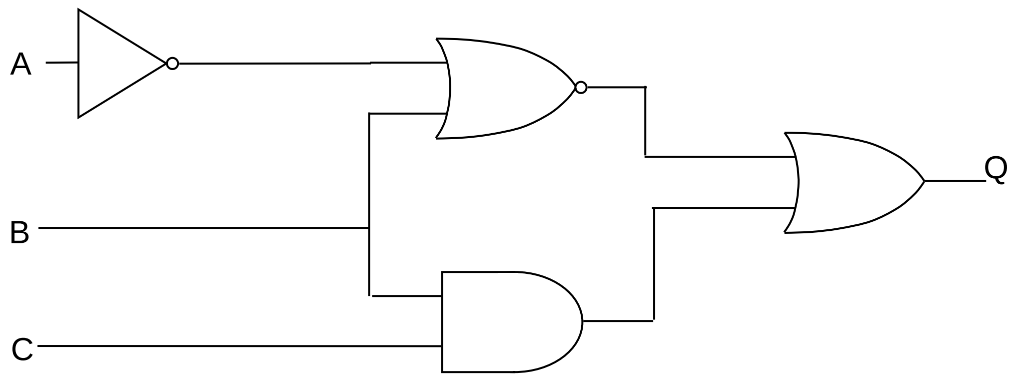




1. (a) Redraw the following logic circuit using 2 input NAND gates only.



2. (a) Redraw the following logic circuit using 2 input NAND gates only.



3. A logic system behaves according to this Boolean expression.

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

(a) Complete the truth table for this system. [1]

C	B	A	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	

(b) Use a Karnaugh map or Boolean algebra to simplify the expression for Q. [3]

C \ BA	00	01	11	10
0				
1				

(c) Apply DeMorgan's theorem to the following expression **and** simplify the result. [3]

$$Q = \overline{(\overline{A} + \overline{B}).(\overline{A}.B)}$$