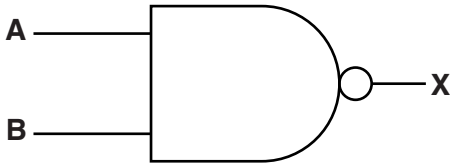
QUESTION 4.

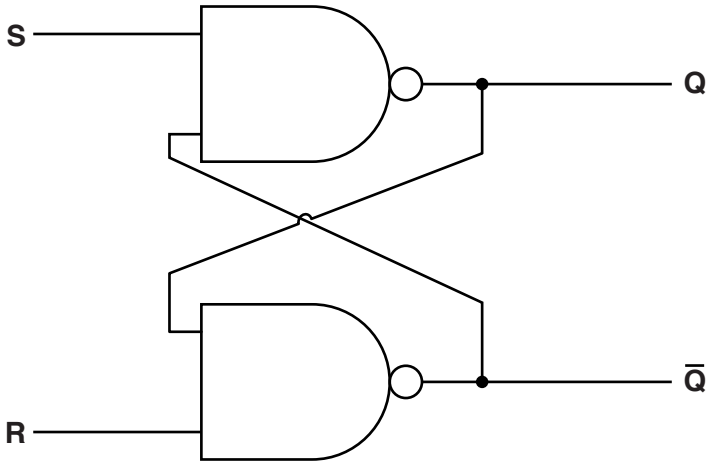
5 **(a)** Complete the truth table for this NAND gate:



A	B	X
0	0	
0	1	
1	0	
1	1	

[1]

A SR flip-flop is constructed using two NAND gates.



(b) **(i)** Complete the truth table for the SR flip-flop.

	S	R	Q	$\overline{Q}$
Initially	1	0	0	1
R changed to 1	1	1		
S changed to 0	0	1		
S changed to 1	1	1		
S and R changed to 0	0	0		

[4]

(ii) One of the combinations in the truth table should not be allowed to occur.

State the values of S and R that should not be allowed. Justify your choice.

S = ... R = ...

.....

.....

.....

.....[3]

Another type of flip-flop is the JK flip-flop.

(c) **(i)** Give one extra input present in the JK flip-flop.

.....

.....[1]

(ii) Give **one** advantage of the JK flip-flop.

.....

.....[1]

(d) Describe the role of flip-flops in a computer.

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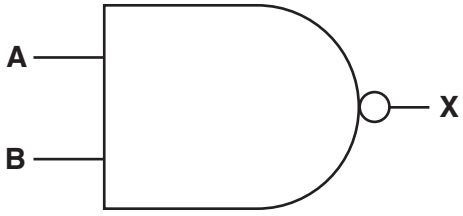
.....[2]

QUESTION 5.

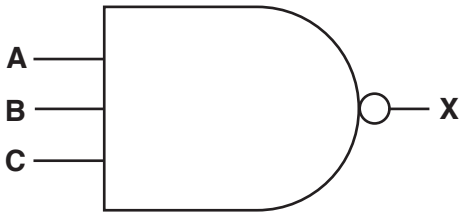
5 (a) (i) Complete the truth table for this 2-input NAND gate:



A	B	X
0	0	
0	1	
1	0	
1	1	

[1]

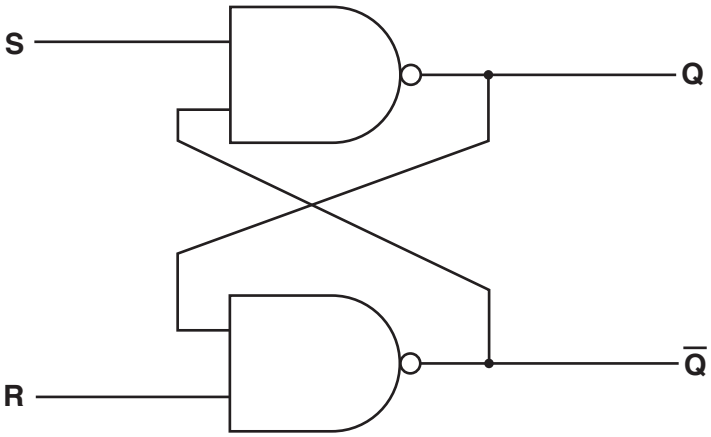
(ii) Complete the truth table for this 3-input NAND gate:



A	B	C	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	

[1]

(b) A SR flip-flop is constructed using two NAND gates.



(i) Complete the truth table for the SR flip-flop:

	S	R	Q	$\overline{Q}$
Initially	1	0	0	1
R changed to 1	1	1		
S changed to 0	0	1		
S changed to 1	1	1		
S and R changed to 0	0	0	1	1

[3]

(ii) The final row in the table in **part b(i)** shows that the output for both **Q** a

Explain why this is a problem.

.....

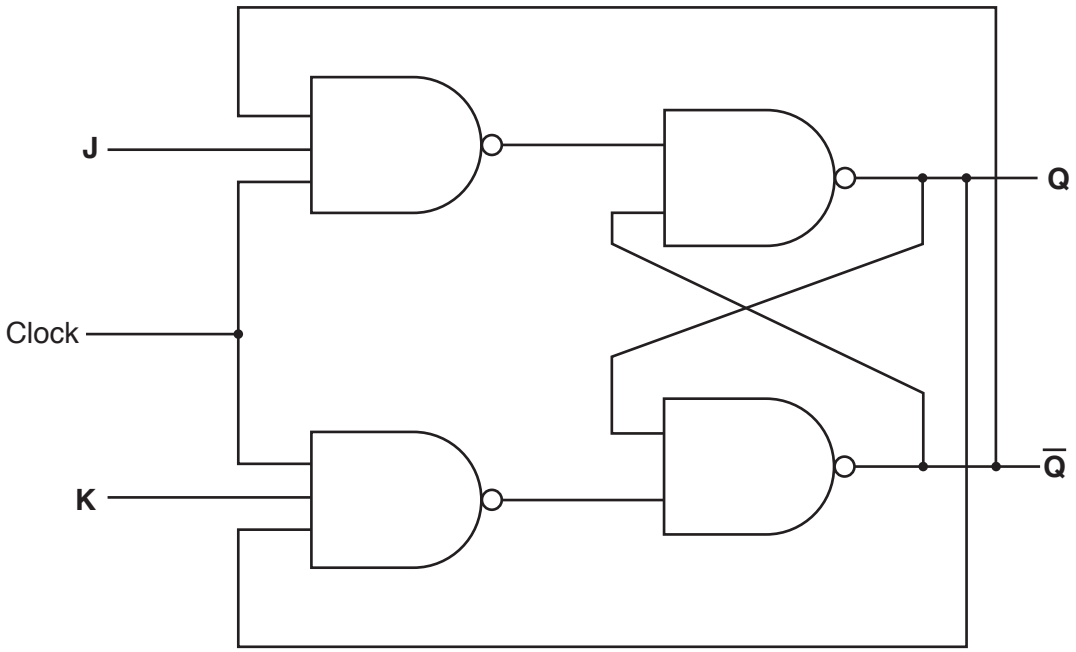
.....

.....

..... [2]

(c) Another type of flip-flop is the JK flip-flop.

A JK flip-flop is constructed as follows:



(i) Complete this truth table for the JK flip-flop.

J	K	Clock	Working space	Initial values		Final values	
				Q	$\overline{Q}$	Q	$\overline{Q}$
0	0	1		1	0	1	0
0	0	1		0	1	0	1
0	1	1		1	0	0	1
0	1	1		0	1	0	1
1	0	1		1	0		
1	0	1		0	1		
1	1	1		1	0		
1	1	1		0	1		

[4]

(ii) Explain why the JK flip-flop is an improvement on the SR flip-flop.

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..... [2]

(d) Explain the role of flip-flops in a computer.

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QUESTION 6.

6 The environment in a very large greenhouse is managed by a computer system. T
a number of different sensors that include temperature sensors. In addition, the sys
number of heaters, windows and sprinklers.

(a) State **one** other type of sensor that could be used with this system.

Justify your choice.

Sensor .....

Justification .....

.....

[2]

(b) Describe why feedback is important in this system.

.....

.....

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.....

.....[3]

(c) **(i)** The system makes use of a number of parameters. These parameters are used in the code that runs the system.

State **one** of the parameters used in controlling the temperature in the greenhouse.

.....[1]

(ii) Explain how the parameter identified in **part (c)(i)** is used in the feedback process.

.....

.....

.....

.....[2]

Another type of flip-flop is the JK flip-flop. The JK flip-flop is an improvement on the SR flip-flop.

(c) (i) The JK flip-flop has three inputs. Two of the inputs are the Set (J) and the Reset (K).

State the third input.

.....[1]

(ii) There are **two** problems with the SR flip-flop that the JK flip-flop overcomes.

State each problem and state why it does not occur for the JK flip-flop.

Problem 1 .....

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.....

Problem 2 .....

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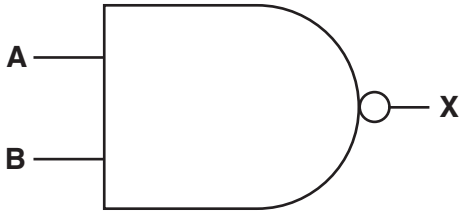
.....

[4]

QUESTION 7.

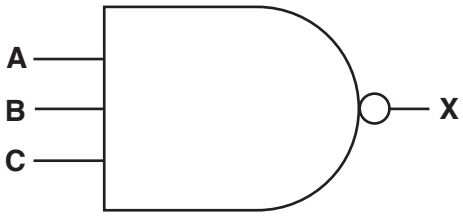
5 (a) (i) Complete the truth table for this 2-input NAND gate:



A	B	X
0	0	
0	1	
1	0	
1	1	

[1]

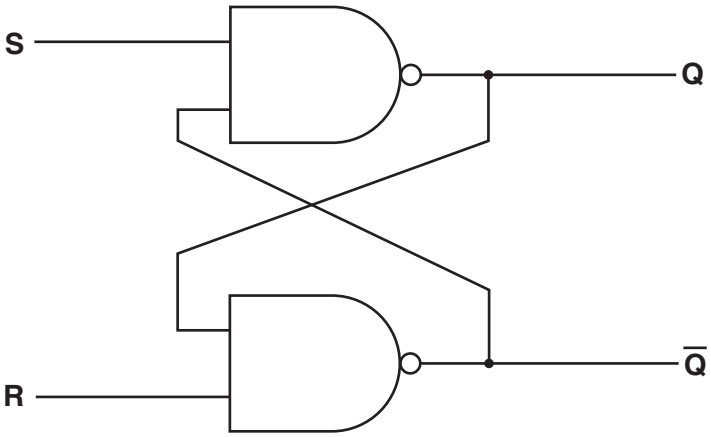
(ii) Complete the truth table for this 3-input NAND gate:



A	B	C	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	

[1]

(b) A SR flip-flop is constructed using two NAND gates.



(i) Complete the truth table for the SR flip-flop:

	S	R	Q	$\overline{Q}$
Initially	1	0	0	1
R changed to 1	1	1		
S changed to 0	0	1		
S changed to 1	1	1		
S and R changed to 0	0	0	1	1

[3]

(ii) The final row in the table in **part b(i)** shows that the output for both **Q** a

Explain why this is a problem.

.....

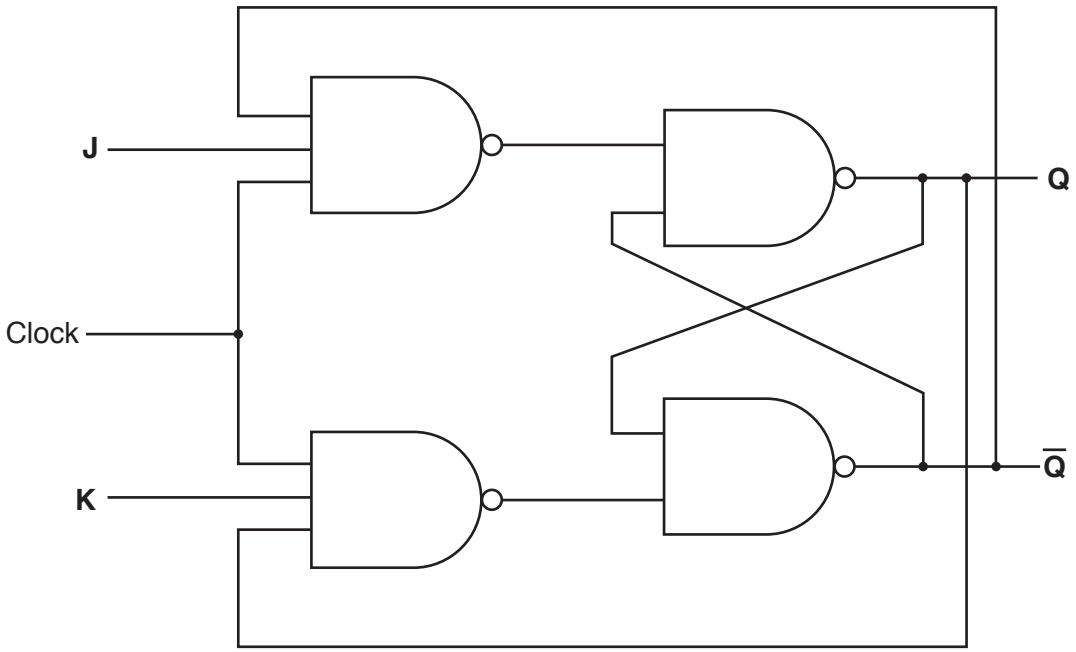
.....

.....

..... [2]

(c) Another type of flip-flop is the JK flip-flop.

A JK flip-flop is constructed as follows:



(i) Complete this truth table for the JK flip-flop.

J	K	Clock	Working space	Initial values		Final values	
				Q	$\overline{Q}$	Q	$\overline{Q}$
0	0	1		1	0	1	0
0	0	1		0	1	0	1
0	1	1		1	0	0	1
0	1	1		0	1	0	1
1	0	1		1	0		
1	0	1		0	1		
1	1	1		1	0		
1	1	1		0	1		

[4]

(ii) Explain why the JK flip-flop is an improvement on the SR flip-flop.

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..... [2]

(d) Explain the role of flip-flops in a computer.

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