

LOGIC CIRCUITS

1.

(a) Tick (✓) **one** box to identify the correct logic statement for this truth table.

A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

- ☐ NOT (A AND B AND C)
- ☐ (A XOR B) NOR C
- ☐ (A OR B OR C) NOR C
- ☐ NOT A AND NOT B AND NOT C

[1]

(b) Draw a logic circuit for the logic expression:

$$X = \text{NOT} (\text{NOT } A \text{ AND } (\text{NOT } B \text{ XOR } C))$$



[2]

2.

(ii) The video doorbell has a solid state (flash) secondary storage device.

Complete the table by writing the answer or answers to each statement about the principal operation of solid state (flash) memory.

Statement	Answer
the two types of logic gate that can be used to create solid state devices	1 2
the number of transistors contained in each cell	
the type of gate that can retain electrons without power	
the type of gate that allows or stops current from passing through	

[4]

3.

(a) Describe the operation of each of the following logic gates:

NAND

.....

NOR

.....

XOR

.....

OR

.....

[4]

(b) Draw a logic circuit for this logic expression:

$$X = \text{NOT} ((A \text{ AND } B) \text{ OR } (C \text{ AND } D))$$



[2]

4.

Each of the following truth tables has three inputs (**A**, **B** and **C**) and one output (**X**).

Draw **one** line to match each truth table with its logic expression.

Truth table

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

Logic expression

NOT (A XOR B) AND C

(A OR C) AND NOT B

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

A NAND B NAND C

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	1

(A NAND B) OR C

NOT (A AND B AND C)

[3]

5.

(a) Complete the truth table for the logic expression:

$$X = (A \text{ XOR } B) \text{ NAND } (A \text{ AND } (B \text{ XOR } C))$$

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]

(b) Draw the logic circuit for the logic expression:

$$W = P \text{ NAND } ((Q \text{ OR NOT } R) \text{ XOR } (P \text{ XOR } Q))$$



[2]

(c) Draw the logic circuit for the logic expression:

$$X = ((\text{NOT } A \text{ AND } (B \text{ AND } C)) \text{ OR } (B \text{ NAND } C)) \text{ AND NOT } A$$



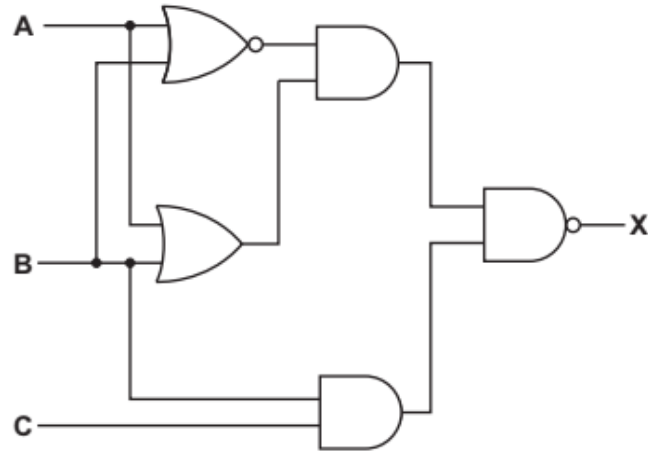
[2]

6.

(a) Describe the operation of a 2-input XOR gate.

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

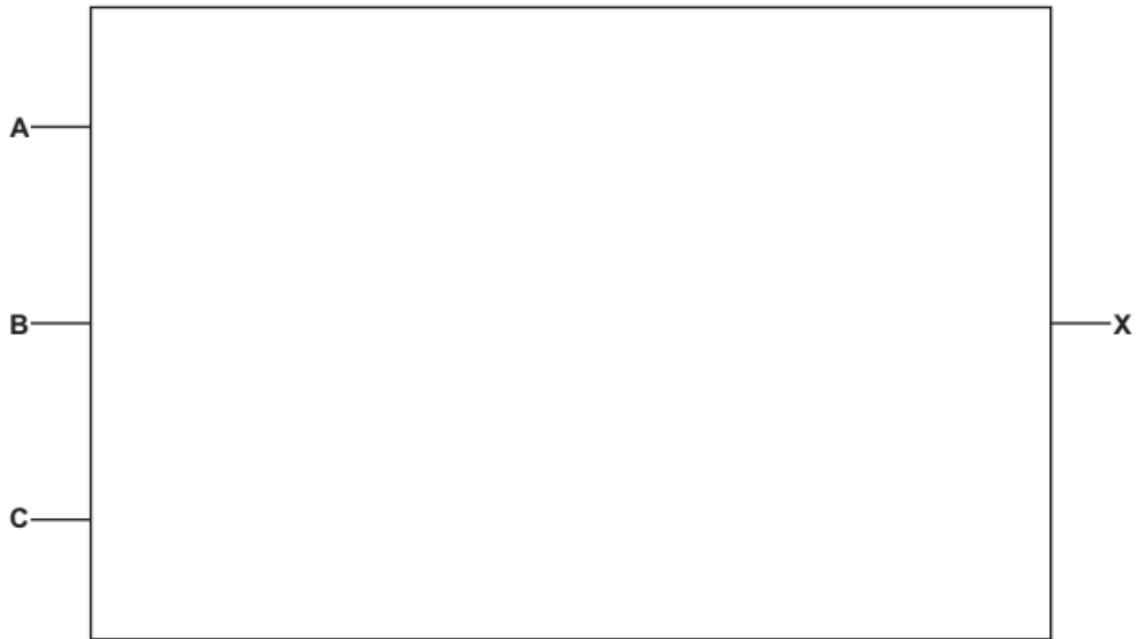
(b) Write the logic expression for the following logic circuit.



X =
..... [2]

(c) Draw the logic circuit for the logic expression:

$$X = ((\text{NOT } A \text{ AND } (B \text{ AND } C)) \text{ OR } (B \text{ NAND } C)) \text{ AND NOT } A$$



[2]

7.

(a) Complete the truth table for the logic expression:

$$X = \text{NOT } (A \text{ NAND } B) \text{ XOR } (\text{NOT } B \text{ AND } (B \text{ NOR } C))$$

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]

(b) Draw a logic circuit for the logic expression:

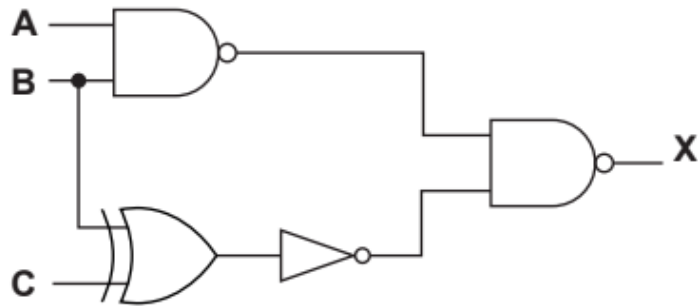
$$X = (A \text{ AND NOT } (B \text{ OR } C)) \text{ AND } (B \text{ NOR } C)$$



[2]

8.

(a) Write the Boolean expression that corresponds to the following logic circuit.



.....
..... [3]

(b) Complete the truth table for the logic expression:

$$X = A \text{ XOR } (B \text{ AND } (A \text{ NAND } B) \text{ AND NOT } C)$$

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]

9.

4 (a) Complete the truth table for the logic expression:

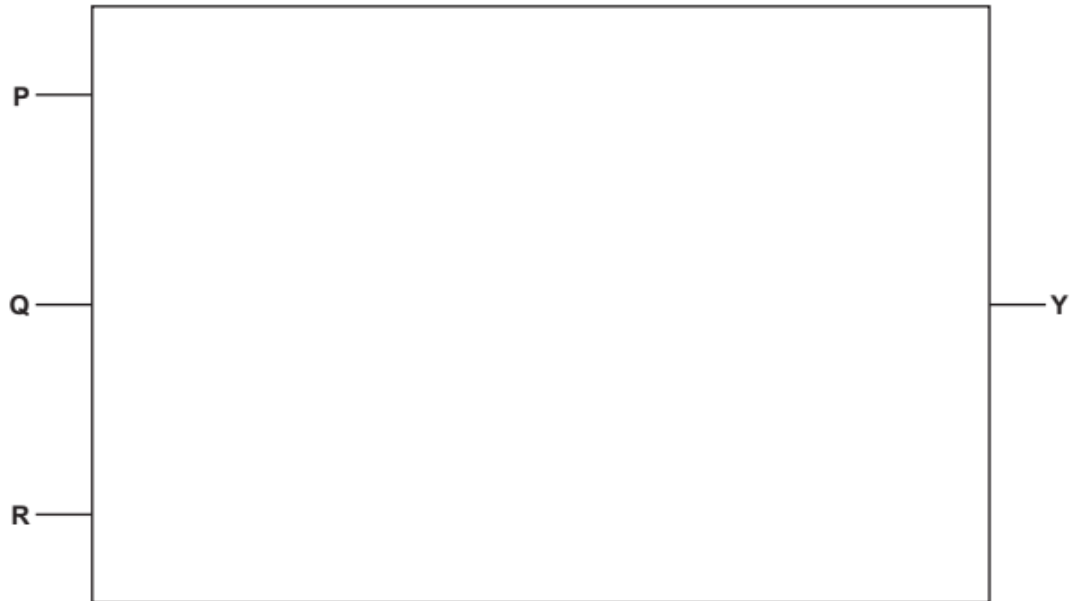
$$Y = ((P \text{ AND } Q) \text{ XOR } ((\text{NOT } Q) \text{ OR } R)) \text{ AND NOT } P$$

P	Q	R	Working space	Y
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) Draw a logic circuit for the logic expression:

$$Y = ((P \text{ AND } Q) \text{ XOR } ((\text{NOT } Q) \text{ OR } R)) \text{ AND NOT } P$$

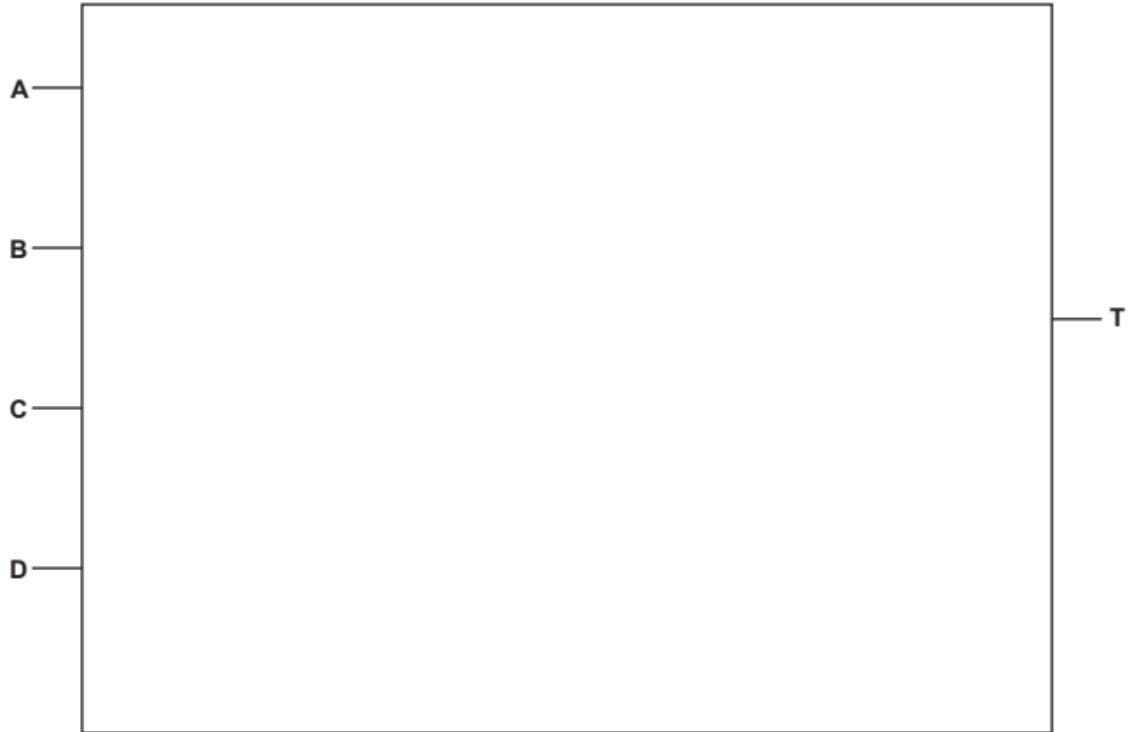


[2]

10.

5 (a) Draw the logic circuit for this logic expression:

$$T = (\text{NOT } A \text{ OR } B) \text{ XOR } (C \text{ NAND } D)$$



[2]

(b) Describe the function of the NAND and NOR logic gates.

NAND

.....

NOR

.....

[2]