

- 1 Using the rules for manipulating Boolean expressions simplify the following:

$$A \wedge B \vee A \wedge (B \vee C) \vee B \wedge (B \vee C)$$

----- [4]

- 2 State the simplified versions of the following Boolean expressions:

(i) $\neg \neg A$

----- [1]

(ii) $(\neg A \wedge \neg B)$

----- [1]

(iii) $\neg(\neg A \wedge \neg B)$

----- [1]

3 A Boolean expression for a logic system is shown below:

$$Q \equiv \neg (\neg A \wedge \neg B)$$

- (i) Simplify this Boolean expression so that it does not include any negation. You must explain which Boolean algebra rule(s) you are using at each step.

----- [2]

4 A cinema offers discounted tickets, but only under one of the following conditions:

- Customer is under 18 and has a student card.
- Customer is over 60 and has ID which proves this.

Let:

A be Customer is under 18

B be Customer has a student card

C be Customer is over 60

D be Customer has ID

Q be Discount ticket issued

The cinema has a voucher which promises free popcorn when the voucher is produced whilst buying a soft drink or bottle of water.

Let:

E be Voucher is shown

F be Soft drink is bought

G be Bottle of water is bought

R be Free popcorn given.

This could be written as:

$$R \equiv (E \wedge F) \vee (E \wedge G)$$

(i) Complete the truth table below.

E	F	G	$(E \wedge F)$	$(E \wedge G)$	$(E \wedge F) \vee (E \wedge G)$
1	1	1			
1	1	0			
1	0	1			
1	0	0			
0	1	1			
0	1	0			
0	0	1			
0	0	0			

[4]

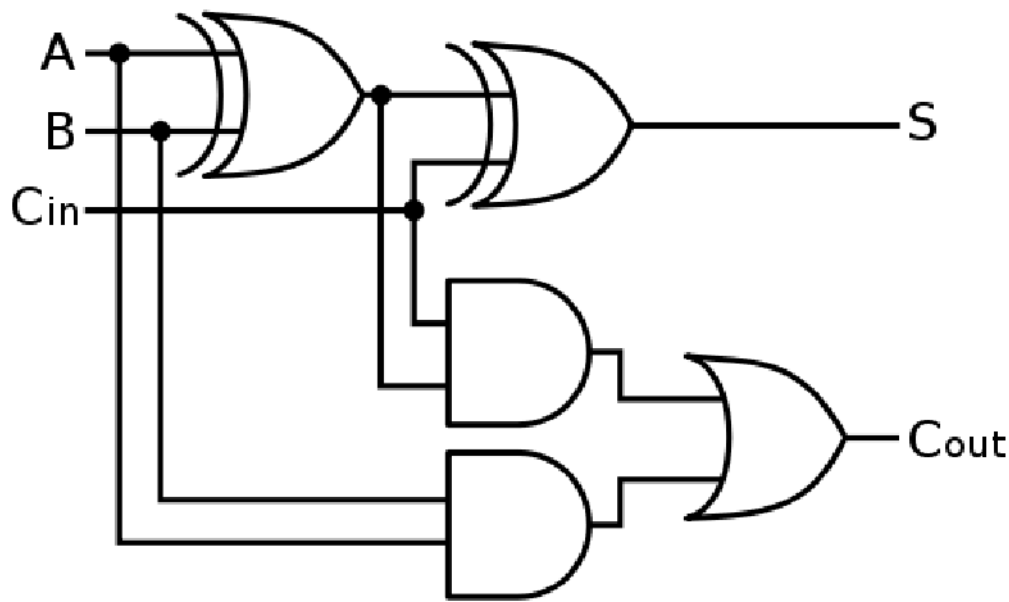
(ii) Simplify the expression

$$(E \wedge F) \vee (E \wedge G)$$

----- [2]

Most films are now distributed to cinemas digitally. A studio allows cinemas to download its latest film 5 days before the release date via a private download. It wants to ensure that no cinema shows it before the release date.

5(a) A set of logic gates are connected as below.



(i) Complete the Truth Table below:

A	B	C _{in}	S	C _{out}
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

[4]

(ii) Explain what the circuit does. You should refer to A, B, C_{in}, S and C_{out} in your answer.

----- [4]

(b)

- (i) Write a Boolean expression equivalent to S.

S \equiv

[1]

- (ii) Write a Boolean expression equivalent to C_{out}.

C_{out} \equiv

[2]

END OF QUESTION PAPER