



1.4.3 Boolean Expressions

Q1

a) Simplify the Boolean expression $\neg A \vee \neg B$ using De Morgan's First Law.

[1 mark]

- $\neg(A \wedge B)$

b) Simplify the Boolean expression $\neg(\neg B)$ using double negation.

[1 mark]

- B

c) Simplify the Boolean expression $(A \vee B) \wedge (A \vee C)$ using distribution.

[2 marks]

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

d) Using the rules for manipulation Boolean expressions, simplify the following:

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

[4 marks]

- $(A \wedge B) \vee A \wedge (B \vee C) \vee B$ **by absorption**
- $(A \wedge B) \vee (A \wedge B) \vee (A \wedge C) \vee B$ **by distribution**
- $(A \wedge B) \vee (A \wedge C) \vee B$
- $(A \wedge C) \vee B$ **by absorption**

Q2

Complete the truth table to represent the following Boolean expression.

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

A	B	C	Q
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

[2 marks]





Q3

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

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

Let:

A be 'The customer is under 18'

B be 'The customer has a student card'

C be 'The customer is over 60'

D be 'The customer has ID'

Q be Discount ticket issued

a) Complete the Boolean expression below:

$$Q \equiv \underline{\hspace{5cm}}$$

[3 marks]

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

b) Complete the truth table for the Boolean expression $R \equiv (E \wedge F) \vee (E \wedge G)$.

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

[4 marks]

c) Simplify the Boolean expression $(E \wedge F) \vee (E \wedge G)$.

[2 marks]

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

