

Boolean Exercise: Set 1

Name	AND	OR
Identity Law	$1 \wedge x = x$	$0 \vee x = x$
Null Law	$0 \wedge x = 0$	$1 \vee x = 1$
Idempotent Law	$x \wedge x = x$	$x \vee x = x$
Inverse Law	$x \wedge \sim x = 0$	$x \vee \sim x = 1$
Commutative Law	$x \wedge y = y \wedge x$	$x \vee y = y \vee x$
Associative Law	$(x \wedge y) \wedge z = x \wedge (y \wedge z)$	$(x \vee y) \vee z = x \vee (y \vee z)$
Distributive Law	$x \vee (y \wedge z) = (x \vee y) \wedge (x \vee z)$	$x \wedge (y \vee z) = (x \wedge y) \vee (x \wedge z)$
Absorption Law	$x \wedge (x \vee y) = x$	$x \vee (x \wedge y) = x$
De Morgan's Law	$\sim(x \wedge y) = \sim x \vee \sim y$	$\sim(x \vee y) = \sim x \wedge \sim y$
Double Complement Law		$\sim(\sim x) = x$

1. $(X \wedge Y) \vee (X \wedge (Y \vee Z)) \vee (Y \wedge (Y \vee Z))$

a. **ANS: $X \wedge Z \vee Y$**

2. $\sim(X \wedge Y) \wedge (\sim X \vee Y) \wedge (\sim X \vee X)$

a. **ANS: $\sim X$**

3. $X \vee (Y \wedge \sim X)$

a. **ANS: $X \vee Y$**

4. $Y \wedge Z \wedge (\sim Z \vee W) \vee Z \wedge W \vee Z \vee \sim X$

a. **ANS: $Z \vee \sim X$**

5. $(\sim X \wedge Y \wedge \sim Z) \vee (\sim X \wedge Y \wedge Z)$

a. **ANS: $\sim X \wedge Y$**

6. $(X \wedge \sim Y) \vee (X \wedge Y \wedge Z)$

a. **ANS: $X \wedge (\sim Y \vee Z)$**

7. $Y \wedge (X \vee \sim Z) \vee X \vee X \wedge (\sim X \vee Y)$

a. **ANS: $X \vee (Y \wedge \sim Z)$**

8. $(X \wedge Y \wedge Z) \vee (\sim X \wedge Y) \vee (\sim X \wedge \sim Y)$

a. **ANS: $\sim X \vee (Y \wedge Z)$**

9. $(X \vee Y) \wedge (X \vee Y \vee \sim Z) \vee \sim Y$

a. **ANS: 1**

10. $(X \wedge Y \wedge \sim Z) \vee (Y \wedge Z) \vee (\sim X \wedge Y \wedge \sim Z) \vee (X \wedge Y \wedge \sim Y)$

a. **ANS: Y**

11. $(\sim A \wedge \sim B) \vee (A \wedge \sim B) \vee (\sim B \wedge \sim C)$

a. **ANS: $\sim B$**

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

a. **ANS: $(A \wedge C) \vee B$**

13. $(A \wedge B \wedge C \wedge D) \vee (A \wedge B \wedge D) \vee (A \wedge \sim B \wedge D) \vee (A \wedge \sim B \wedge C \wedge D) \vee (A \wedge C \wedge D) \vee (\sim A \wedge C \wedge D)$

a. **ANS: $D \wedge (A \vee C)$**

Boolean Exercise: Set 2

Name	AND	OR
Identity Law	$1 \wedge x = x$	$0 \vee x = x$
Null Law	$0 \wedge x = 0$	$1 \vee x = 1$
Idempotent Law	$x \wedge x = x$	$x \vee x = x$
Inverse Law	$x \wedge \sim x = 0$	$x \vee \sim x = 1$
Commutative Law	$x \wedge y = y \wedge x$	$x \vee y = y \vee x$
Associative Law	$(x \wedge y) \wedge z = x \wedge (y \wedge z)$	$(x \vee y) \vee z = x \vee (y \vee z)$
Distributive Law	$x \vee (y \wedge z) = (x \vee y) \wedge (x \vee z)$	$x \wedge (y \vee z) = (x \wedge y) \vee (x \wedge z)$
Absorption Law	$x \wedge (x \vee y) = x$	$x \vee (x \wedge y) = x$
De Morgan's Law	$\sim(x \wedge y) = \sim x \vee \sim y$	$\sim(x \vee y) = \sim x \wedge \sim y$
Double Complement Law		$\sim(\sim x) = x$

1. $(A \wedge B \wedge \sim C) \vee (A \wedge B \wedge C) \vee (A \wedge \sim B)$
2. $(\sim A \wedge B) \vee (A \wedge B \wedge \sim C) \vee (A \wedge B) \vee C$
3. $(\sim A \wedge B) \vee (\sim A \wedge B \wedge C) \vee (\sim A \wedge \sim B \wedge \sim C) \vee (A \wedge \sim B \wedge \sim C)$
4. $(B \wedge C \wedge (\sim C \vee D)) \vee (C \wedge D) \vee C \vee \sim A$
5. $(A \wedge B) \vee B$
6. $C \wedge (A \vee \sim C)$
7. $(A \wedge B \wedge \sim C) \vee (A \wedge \sim C) \vee (\sim A \wedge \sim C \wedge D) \vee (\sim A \wedge C \wedge \sim D)$
8. $(A \wedge C \wedge (\sim B \vee C)) \vee (B \wedge C) \vee B$
9. $(B \wedge (A \vee \sim C)) \vee A \vee (A \wedge (\sim A \vee B))$
10. $(A \wedge B \wedge \sim C) \vee (B \wedge C) \vee (\sim A \wedge B \wedge \sim C) \vee (A \wedge B \wedge \sim B)$
11. $(A \wedge B \wedge C) \vee (\sim A \wedge C) \vee (C \wedge (D \vee \sim C)) \vee A$
12. $\sim(\sim(A \vee \sim B) \wedge \sim(\sim C \vee D))$
13. $\sim(\sim(\sim(A \wedge \sim(C)) \wedge \sim B) \wedge D) \vee \sim(\sim C \wedge D)$
14. $\sim(A \vee B) \vee \sim A \wedge (C \vee B)$
15. $(A \wedge B \wedge C) \vee (B \wedge C \wedge D) \vee (B \wedge C \wedge \sim D) \vee (B \wedge \sim C \wedge D) \vee (A \wedge B \wedge \sim C) \vee (\sim A \wedge B \wedge \sim C)$
16. $(A \wedge B \wedge C \wedge D) \vee (A \wedge B \wedge D) \vee (A \wedge \sim B \wedge D) \vee (A \wedge \sim B \wedge D) \vee (A \wedge \sim B \wedge C \wedge D) \vee (A \wedge C \wedge D) \vee (\sim A \wedge C \wedge D)$
17. Show that $A \wedge \sim B \vee \sim(A \wedge B) \vee \sim(A \wedge \sim B) = \sim A$