Boolean Algebra

1. **02-03 C2 Boolean Algebra**

   Simplify: (NOT A OR A AND NOT B) AND (NOT A AND B)

2. **02-03 C2 Boolean Algebra**

   Find all ordered triples that make the following expression TRUE:

   NOT A AND C OR B AND (NOT (A OR C))

3. **03-04 C2 Boolean Algebra**

   Find all ordered pairs that make the following expression TRUE: $\overline{A}\ B\ +\ \overline{(A+\overline{B})}$

4. **03-04 C2 Boolean Algebra**

   Simplify the following expression. $A(\overline{A}+B)+B(B+C)+B$

5. **04-05 C2 Boolean Algebra**

   Simplify: $\overline{A(\overline{A}+B)}+B$

6. **04-05 C2 Boolean Algebra**

   List all the ordered pairs that make the following expression TRUE: $\overline{A+B}+\overline{A}B$

7. **05-06 C2 Boolean Algebra**

   Simplify $\overline{A\overline{B}+\overline{A+B}}$

8. **05-06 C2 Boolean Algebra**

How many ordered triples make the following expression TRUE?

$$A\overline{B} + \overline{A}C + B\overline{C}$$

9. **06-07 C2 Boolean Algebra**

Simplify completely: $\overline{A}B(A + \overline{B})$

10. **06-07 C2 Boolean Algebra**

How many ordered triples make the following expression TRUE?

$$(\overline{A} + BC)(A\overline{B} + C)$$

11. **07-08 C2 Boolean Algebra**

Simplify the following Boolean expression: $\overline{A\overline{B}} + A(\overline{B} + 1)$

12. **07-08 C2 Boolean Algebra**

Which ordered triples make the following expression TRUE? $AB + B(C + \overline{A})$

13. **08-09 C2 Boolean Algebra**

Simplify completely: $\overline{A}(A\overline{B}C + \overline{A}B\overline{C})C$

14. **08-09 C2 Boolean Algebra**

List all ordered triples that make the following expression true: $(AB + \overline{C})\overline{\overline{A}B}$

15. **09-10 C2 Boolean Algebra**

Simplify the following Boolean expression: $A(A\overline{B} + \overline{A}) + \overline{B}(\overline{A}B + A)$

16. **09-10 C2 Boolean Algebra**

Which ordered triples make the following Boolean expression FALSE?

$$AB + \overline{C}(A + \overline{B}) + \overline{B}C$$

17. **10-11 C2 Boolean Algebra**

How many ordered triples make the following Boolean expression TRUE?

$$A(\overline{B} + C) + B(\overline{A} + \overline{C})$$

18. **10-11 C2 Boolean Algebra**

Simplify the following Boolean expression: $A(\overline{A + B}) + B(\overline{A} + B)$

19. **11-12 C3 Boolean Algebra**

Simplify the following Boolean expression: $A(\overline{A}B + B) + B$

20. **11-12 C3 Boolean Algebra**

Find all ordered triples that make the following Boolean expression TRUE.

$$A(\overline{B} + C) + B(A + \overline{C})$$

21. **12-13 C3 Boolean Algebra**

Simplify the following Boolean expression: $A(\overline{A} + B) + \overline{A}B$

22. **12-13 C3 Boolean Algebra**

How many ordered triples make the following Boolean expression true?

$$(AB + \overline{C})(A + \overline{B})(BC + A)$$

23. **13-14 C3 Boolean Algebra**

Which ordered pairs make the following Boolean expression TRUE? $A(\overline{A}B + \overline{B})$

24. **13-14 C3 Boolean Algebra**

How many ordered triples make the following circuit TRUE? $\overline{A} + B\overline{C} + A(\overline{B} + C)$

25. **14-15 C3 Boolean Algebra**

Simplify the following Boolean expression: $A(\overline{B}C) + (\overline{\overline{A} + B})$

26. **14-15 C3 Boolean Algebra**

Which of the following Boolean Algebra expressions are equivalent?

a) $\overline{A\overline{B}} + \overline{B\overline{C}}$ b) $\overline{A} + C$ c) $\overline{\overline{A}C}$ d) 1

27. **15-16 C3 Boolean Algebra**

How many ordered pairs make the following Boolean expression TRUE?

$\overline{A}(B + A\overline{B}) + \overline{AB}$

28. **15-16 C3 Boolean Algebra**

Simplify the following Boolean algebra expression: $\overline{\overline{A}B} + \overline{B + C} + A(\overline{B} + C)$

Solution

1. **02-03 C2 Boolean Algebra**

(NOT A OR A AND NOT B) AND (NOT A AND B) = NOT A AND B
(NOT A AND NOT A AND B) OR (A AND NOT A AND B AND NOT B) =
NOT A AND B OR 0 =
NOT A AND B

2. **02-03 C2 Boolean Algebra**

NOT A AND C OR B AND (NOT (A OR C)) = $\overline{A}C + B(\overline{A+C})$ (0,0,1),(0,1,0),(0,1,1)

A	B	C	$\overline{A}C$	$\overline{A+C}$	$B(\overline{A+C})$	OR
0	0	0	0	1	0	0
0	0	1	1	0	0	1
0	1	0	0	1	1	1
0	1	1	1	0	0	1
1	0	0	0	0	0	0
1	0	1	0	0	0	0
1	1	0	0	0	0	0
1	1	1	0	0	0	0

3. **03-04 C2 Boolean Algebra**

$\overline{A}\ B\ +\ \overline{(A+\overline{B})} = \overline{A}B + \overline{A}B = \overline{A}B$ (0,1)
If $\overline{A}B = 1$ then $\overline{A} = 1$ AND $B = 1 \Rightarrow A = 0$ AND $B = 1$

4. **03-04 C2 Boolean Algebra**

$A(\overline{A}+B) + B(B+C) + B = A\overline{A} + AB + BB + BC + B =$ B
$0 + AB + B + BC = B(A+1+C) = B(1) = B$

5. **04-05 C2 Boolean Algebra**

$\overline{A(\overline{A}+B)} + B = \overline{A\overline{A} + AB} + B = \overline{0+AB} + B = \overline{AB} + B =$ 1
$\overline{A} + \overline{B} + B = \overline{A} + 1 = 1$

6. **04-05 C2 Boolean Algebra**

$\overline{A+B}+\overline{A}B$ (0,0) , (0,1)

A	B	$A+B$	$\overline{A+B}$	$\overline{A}$	$\overline{A}B$	$\overline{A+B}+\overline{A}B$
0	0	0	1	1	0	1
0	1	1	0	1	1	1
1	0	1	0	0	0	0
1	1	1	0	0	0	0

7. **05-06 C2 Boolean Algebra**

Simplify B

$\overline{A\overline{B}+\overline{A+B}}=\overline{A\overline{B}+\overline{A}\overline{B}}=\overline{\overline{B}(A+\overline{A})}=\overline{\overline{B}*1}=\overline{\overline{B}}=B$

8. **05-06 C2 Boolean Algebra**

The truth table is shown below. There are 6 that make the expression TRUE. 6

A	B	C	$\overline{A}$	$\overline{B}$	$\overline{C}$	$A\overline{B}$	$\overline{A}C$	$B\overline{C}$	+
0	0	0	1	1	1	0	0	0	0
0	0	1	1	1	0	0	1	0	1
0	1	0	1	0	1	0	0	1	1
0	1	1	1	0	0	0	1	0	1
1	0	0	0	1	1	1	0	0	1
1	0	1	0	1	0	1	0	0	1
1	1	0	0	0	1	0	0	1	1
1	1	1	0	0	0	0	0	0	0

9. **06-07 C2 Boolean Algebra**

$\overline{A}B(A+\overline{B})=\overline{A}BA+\overline{A}B\overline{B}=0$ 0

10. **06-07 C2 Boolean Algebra**

$(\overline{A}+BC)(A\overline{B}+C)=\overline{A}A\overline{B}+\overline{A}C+AB\overline{B}C+BCC=$ 3

$0+\overline{A}C+0+BC=C(\overline{A}+B)\Rightarrow C=1 \text{ and } \overline{A}+B=1$

If $B=1$ then A = *. If $B=0$ then $A=0$.

The triplets are (*,1,1) and (0,0,1)

11. **07-08 C2 Boolean Algebra**

$\overline{A\overline{B}} + A(\overline{B}+1) = \overline{A} + \overline{\overline{B}} + A \bullet 1 = \overline{A} + B + A = 1 + B =$ **1** **1**

12. **07-08 C2 Boolean Algebra**

First simplify: (1,1,1)

$AB + B(C + \overline{A}) = AB + BC + \overline{A}B$ (1,1,0)

$= B(A + C + \overline{A})$ (0,1,1)

$= B(1 + C) = B$ (0,1,0)

So A = *, B = 1, C = * and the triples are (*,1,*)

13. **08-09 C2 Boolean Algebra**

$\overline{A}(A\overline{B}C + \overline{A}B\overline{C})C = \overline{A}A\overline{B}CC + \overline{A}\overline{A}B\overline{C}C = 0 + 0 = 0$ 0

14. **08-09 C2 Boolean Algebra**

The truth table is shown below. (0,0,0),(1,0,0),(1,1,0),(1,1,1)

A	B	C	AB	$\overline{C}$	$AB + \overline{C}$	$\overline{A}$	$\overline{A}B$	$\overline{\overline{A}B}$	$(AB + \overline{C})\overline{\overline{A}B}$
0	0	0	0	1	1	1	0	1	1
0	0	1	0	0	0	1	0	1	0
0	1	0	0	1	1	1	1	0	0
0	1	1	0	0	0	1	1	0	0
1	0	0	0	1	1	0	0	1	1
1	0	1	0	0	0	0	0	1	0
1	1	0	1	1	1	0	0	1	1
1	1	1	1	0	1	0	0	1	1

15. **09-10 C2 Boolean Algebra**

$A(A\overline{B} + \overline{A}) + \overline{B}(\overline{A}B + A) = AA\overline{B} + A\overline{A} + AB\overline{B} + A\overline{B}$ $A\overline{B}$

$= A\overline{B} + 0 + 0 + A\overline{B} = A\overline{B}$

16. **09-10 C2 Boolean Algebra**

The truth table is as follows: (0,1,0), (0,1,1)

A	B	C	$\overline{B}$	$\overline{C}$	AB	$A+\overline{B}$	$\overline{C}(A+\overline{B})$	$\overline{B}C$	$AB+\overline{C}(A+\overline{B})+\overline{B}C$
0	0	0	1	1	0	1	1	0	1
0	0	1	1	0	0	1	0	1	1
0	1	0	0	1	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0
1	0	0	1	1	0	1	1	0	1
1	0	1	1	0	0	1	0	1	1
1	1	0	0	1	1	1	1	0	1
1	1	1	0	0	1	1	0	0	1

Therefore, (0,1,0) and (0,1,1) make the statement FALSE.

17. **10-11 C2 Boolean Algebra**

$A(\overline{B}+C)+B(\overline{A}+\overline{C}) = A\overline{B}+AC+B\overline{A}+B\overline{C}$ 6

A	B	C	$A\overline{B}$	AC	$B\overline{A}$	$B\overline{C}$	$A\overline{B}+AC+B\overline{A}+B\overline{C}$
0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	1	0	0	0	1	1	1
0	1	1	0	0	1	0	1
1	0	0	1	0	0	0	1
1	0	1	1	1	0	0	1
1	1	0	0	0	0	1	1
1	1	1	0	1	0	0	1

18. **10-11 C2 Boolean Algebra**

$$A(\overline{\overline{A}+B})+B(\overline{A}+B) = A(\overline{A}\,\overline{B})+\overline{A}B+BB \qquad B$$
$$= 0+B(\overline{A}+1) = B$$

19. **11-12 C3 Boolean Algebra**

$$A(\overline{A}B+B)+B = A\overline{A}B+AB+B \qquad B$$
$$= 0+B(A+1)$$
$$= B$$

20. **11-12 C3 Boolean Algebra**

$$A(\overline{B}+C)+B(A+\overline{C}) = A\overline{B}+AC+AB+B\overline{C}) \qquad A+B\overline{C}$$
$$= A(\overline{B}+C+B)+B\overline{C})$$
$$= A(1+C)+B\overline{C}$$
$$= A+B\overline{C}$$

21. **12-13 C3 Boolean Algebra**

$$A(\overline{A}+B)+\overline{A}B = A\overline{A}+AB+\overline{A}B \qquad B$$
$$= 0+AB+\overline{A}B = B(A+\overline{A}) = B$$

22. **12-13 C3 Boolean Algebra**

$X = (AB+\overline{C})(A+\overline{B})(BC+A)$ 3

A	B	C	$\overline{B}$	$\overline{C}$	AB	$AB+\overline{C}$	$A+\overline{B}$	BC	$BC+A$	X
0	0	0	1	1	0	1	1	0	0	0
0	0	1	1	0	0	0	1	0	0	0
0	1	0	0	1	0	1	0	0	0	0
0	1	1	0	0	0	0	0	1	1	0
1	0	0	1	1	0	1	1	0	1	1
1	0	1	1	0	0	0	1	0	1	0
1	1	0	0	1	1	1	1	0	1	1
1	1	1	0	0	1	1	1	1	1	1

23. **13-14 C3 Boolean Algebra**

$A(\overline{A}B+\overline{B}) = A\overline{A}B+A\overline{B} = 0+A\overline{B} = A\overline{B}$ (1,0)

$A\overline{B}=1 \rightarrow A=1 \wedge \overline{B}=1 \rightarrow A=1 \wedge B=0 \rightarrow (1, 0)$

24. **13-14 C3 Boolean Algebra**

$X = \overline{A} + B\overline{C} + A(\overline{B} + C)$ 8

A	B	C	$\overline{B}$	$\overline{C}$	$\overline{A}$	$B\overline{C}$	$\overline{B} + C$	$A(\overline{B} + C)$	X
0	0	0	1	1	1	0	1	0	1
0	0	1	1	0	1	0	1	0	1
0	1	0	0	1	1	1	0	0	1
0	1	1	0	0	1	0	1	0	1
1	0	0	1	1	0	0	1	1	1
1	0	1	1	0	0	0	1	1	1
1	1	0	0	1	0	1	0	0	1
1	1	1	0	0	0	0	1	1	1

This is a tautology so all 8 of the possible inputs make it TRUE.

25. **14-15 C3 Boolean Algebra**

$A(\overline{B}C) + (\overline{\overline{A} + B}) = A\overline{B}C + \overline{\overline{A}}\overline{B} = A\overline{B}C + A\overline{B} = A\overline{B}(C + 1) = A\overline{B}$ $A\overline{B}$

26. **14-15 C3 Boolean Algebra**

a. $\overline{A\overline{\overline{B}}} + \overline{B\overline{\overline{C}}} = \overline{A} + \overline{\overline{B}} + \overline{B} + \overline{\overline{C}} = \overline{A} + B + \overline{B} + C = \overline{A} + 1 + C = 1$ a and d

b. $\overline{A} + C$ **c.** $\overline{\overline{A}C} = A + \overline{C}$ **d.** 1

27. **15-16 C3 Boolean Algebra**

$\overline{A}(B + A\overline{B}) + \overline{A\overline{B}} = \overline{A}B + \overline{A}AB + \overline{A} + \overline{B} = \overline{A}B + 0 + \overline{A} + \overline{B}$ 3

$= \overline{A}(B + 1) + \overline{B} = \overline{A} + \overline{B} = \overline{AB}$

If $\overline{AB} = 1$, then $AB = 0$. So $A = 0 \vee B = 0$. Therefore 3 ordered pairs make the expression TRUE. (0,1), (1,0), (0,0)

28. **15-16 C3 Boolean Algebra**

$\overline{\overline{A}B} + \overline{B + C} + A(\overline{B} + C) = \overline{\overline{A}} + \overline{B} + \overline{B}\overline{C} + A\overline{B} + AC$ $A + \overline{B}$

$= A + AC + \overline{B} + A\overline{B} + \overline{B}\overline{C}$

$= A(1 + C) + \overline{B}(1 + A + \overline{C})$

$= A + \overline{B}$