

# Truth Tables and Equivalent Statements

## Contemporary Math (MAT-130)

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Let  $p$  and  $r$  represent true statements. Let  $q$  represent a false statement. Find the truth values of the given compound statements.

1.  $p$
2.  $\sim p$
3.  $\sim q$
4.  $p \wedge q$
5.  $p \vee q$
6.  $\sim p \vee r$
7.  $\sim(p \wedge \sim r)$
8.  $p \wedge \sim p$
9.  $(p \wedge q) \wedge r$
10.  $(p \vee q) \vee r$
11.  $(p \wedge q) \vee r$
12.  $p \wedge (q \vee r)$
13.  $\sim(p \vee r) \wedge (\sim q \wedge p)$
14.  $\sim[(p \vee r) \wedge q]$
15.  $p \wedge \sim[q \vee (\sim p \wedge \sim r)]$

Let  $p$  represent the statement  $9 = 9$ . Let  $q$  represent the statement  $4 \geq 1$ . Let  $r$  represent the statement  $3 \nless 12$ . Find the truth values of the given compound statements.

16.  $q$
17.  $\sim p$
18.  $p \wedge \sim r$
19.  $(\sim p \vee r) \wedge (p \vee \sim q)$
20.  $\sim[(p \wedge q) \wedge (\sim p \wedge \sim q)]$

Give the number of rows in the truth tables for the following statements

21.  $p \wedge q$
22.  $(p \vee \sim q) \wedge (r \vee s)$
23.  $p$
24.  $(p \wedge q) \vee [\sim p \wedge (r \wedge \sim q)]$
25.  $\{q \wedge [p \vee (s \vee t)]\} \wedge r$

If a truth table for a compound statement has the following number of rows, how many component statements does it have?

26. 4
27. 8
28. 64
29. 125
30. 32

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Construct a truth table for each compound statement.

31.  $p \vee \sim q$

32.  $p \wedge (\sim p \vee q)$

33.  $(p \wedge q) \vee (q \vee \sim r)$

34.  $\sim[r \wedge (\sim p \wedge q)]$

35.  $\sim(p \wedge q) \vee [p \vee (s \wedge r)]$

Use one of De Morgan's laws to write the negation of each statement.

36.  $\sim(p \wedge q)$

37.  $\sim(p \vee q)$

38.  $\sim(\sim p \wedge q)$

39.  $\sim(p \vee \sim q)$

40.  $\sim(\sim p \wedge \sim q)$

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### **Solutions:**

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|----------------------------|-------|
| 1. T                       | 11. T |
| 2. F                       | 12. T |
| 3. T                       | 13. F |
| 4. F                       | 14. T |
| 5. T                       | 15. T |
| 6. T                       | 16. T |
| 7. T                       | 17. F |
| 8. F                       | 18. T |
| 9. F                       | 19. F |
| 10. T                      | 20. T |
| 21. 4                      |       |
| 22. 16                     |       |
| 23. 2                      |       |
| 24. 8                      |       |
| 25. 32                     |       |
| 26. 2                      |       |
| 27. 3                      |       |
| 28. 6                      |       |
| 29. Not possible           |       |
| 30. 5                      |       |
| 31. TTFT                   |       |
| 32. TFFF                   |       |
| 33. TTFTTFT                |       |
| 34. TTTFTTT                |       |
| 35. Tautology              |       |
| 36. $\sim p \vee \sim q$   |       |
| 37. $\sim p \wedge \sim q$ |       |
| 38. $p \vee \sim q$        |       |
| 39. $\sim p \wedge q$      |       |
| 40. $p \vee q$             |       |