Section 1.9: Laws of Logic

Answers

1. (d) is true because in logical symbols, $p \vee \overline{p} \Leftrightarrow 1$.

2. (a) is false because $p \wedge \overline{p} \Leftrightarrow 0$.

3. The two idempotent laws are true because the last column in each table is the same as for p.

p	p	p∨p
0	0	0
1	1	1

p	p	p^p
0	0	0
1	1	1

4. The four identity laws are true because the p^0 column is the same as 0, the p∨0 and p^1 columns are the same as p, and the p∨1 column is the same as 1.

p	0	1	p^0	p∨0	p^1	p∨1
0	0	1	0	0	0	1
1	0	1	0	1	1	1

5. identity
6. complement
7. complement
8. commutative
9. identity
10. idempotent
11. complement
12. associative
13. r, using the identity law
14. 1, complement
15. p, complement
16. $\overline{A}$, idempotent
17. $\overline{B}$, identity

Note: for the following questions, there may be several different ways to get to the simplest answer. Also, you may take steps in a different order. If you are concerned about a different solution, please show your instructor. (Also, I haven't explicitly written out any steps involving either the Commutative or Associative laws.)

18. $(p \wedge p) \vee (q \wedge \bar{q}) \Leftrightarrow p \vee (q \wedge \bar{q})$ Idempotent

$\Leftrightarrow p \vee 0$ Complement

$\Leftrightarrow p$ Identity

19. $(p \vee p) \wedge (q \vee 0) \Leftrightarrow p \wedge (q \vee 0)$ Idempotent

$\Leftrightarrow p \wedge q$ Identity

20. $p \vee (q \wedge \bar{q}) \Leftrightarrow p \vee 0$ Complement

$\Leftrightarrow p$ Identity

21. $(A + A)(B + \bar{B}) = A(B + \bar{B})$ Idempotent

$= A \cdot 1$ Complement

$= A$ Identity

22. $B \cdot 0 + AA = 0 + AA$ Identity

$= 0 + A$ Idempotent

$= A$ Identity

23. $(B + \bar{B})(A + 1) = 1 \cdot (A + 1)$ Complement

$= 1 \cdot 1$ Identity

$= 1$ Definition of "and"

24. $AB\bar{B} = A \cdot 0$ Complement

$= 0$ Identity

25. $(A\bar{A})\bar{B} = A(B\bar{B})$

$0 \cdot \bar{B} = A(B\bar{B})$ Complement

$0 \cdot \bar{B} = A \cdot 0$ Complement

$0 = A \cdot 0$ Identity

$0 = 0$ Identity

26. $B \cdot 1 + A\bar{A} = \overline{\overline{B} \cdot 1}$

$B + A\bar{A} = \overline{\overline{B}}$ Identity

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

$B = \overline{\overline{B}}$ Identity

	B = B		Complement
27.	$(A + 0)(B + \overline{B})$	= A	
	$A(B + \overline{B})$	= A	Identity
	$A \cdot 1$	= A	Complement
	A	= A	Identity
28.	$AA + \overline{B}\,\overline{B}$	= $A + \overline{B}$	
	$A + \overline{B}$	= $A + \overline{B}$	Idempotent