Propositional Logic(Exercises:31-41)

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Truth Table Rows Calculation

31.

Formula: The number of rows in a truth table is calculated as 2^n , where n is the number of distinct variables.

- (a) Distinct variables: 1 (p), Number of rows: $2^1 = 2$
- (b) Distinct variables: 4 (p, r, q, s), Number of rows: $2^4 = 16$
- (c) Distinct variables: 6 (p, q, r, s, t, u), Number of rows: $2^6 = 64$
- (d) Distinct variables: 4 (p, q, r, t), Number of rows: $2^4 = 16$

32.

- (a) Distinct variables: 2 (p, q), Number of rows: $2^2 = 4$
- (b) Distinct variables: 3 (p, s, t), Number of rows: $2^3 = 8$
- (c) Distinct variables: 5 (p, r, s, t, u, v), Number of rows: $2^6 = 64$
- (d) Distinct variables: 5 (p, q, r, s, t), Number of rows: $2^5 = 32$

Truth Tables

33-41

1. $p \wedge \neg p$		
р	$\neg p$	$p \wedge \neg p$
Т	F	F
F	Т	F

Figure 1: Figure 33(a)

2. $p \lor \lnot p$		
р	$\neg p$	$p ee \lnot p$
Т	F	Т
F	Т	Т

Figure 2: Figure 33(b)

3. $(p ee eg q) o q$						
р	q	$\neg q$	$p \lor \lnot q$	$(p \vee \neg q) \to q$		
Т	Т	F	Т	Т		
Т	F	Т	Т	F		
F	Т	F	F	Т		
F	F	Т	Т	F		

Figure 3: Figure 33(c)

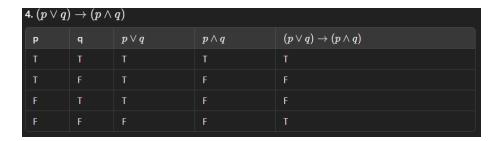


Figure 4: Figure 33(d)



Figure 5: Figure 33(e)

6. ($p ightarrow$	6. $(p o q) o (q o p)$							
р	q	p o q	q o p	(p o q) o (q o p)				
T	T	Т	Т	Т				
T	F	F	Т	Т				
F	T	Т	F	F				
F	F	T	T	Т				

Figure 6: Figure 33(f)

1. $p ightarrow eg p$						
р	$\neg p$	p ightarrow eg p				
Т	F	F				
F	Т	Т				

Figure 7: Figure 34(a)

2. $p \leftrightarrow \neg p$						
р	$\neg p$	$p \leftrightarrow eg p$				
Т	F	F				
F	Т	F				

Figure 8: Figure 34(b)

3. $p \oplus (p \lor q)$	3. $p \oplus (p \lor q)$							
р	q	$p \lor q$	$p \oplus (p \lor q)$					
Т	Т	Т	F					
Т	F	Т	F					
F	Т	Т	Т					
F	F	F	F					

Figure 9: Figure 34(c)

4. $(p \wedge q)$	4. $(p \wedge q) o (p \vee q)$							
Р	q	$p \wedge q$	$p \lor q$	$(p \wedge q) o (p ee q)$				
T	T	T	T	Т				
Т	F	F	Т	Т				
F	Т	F	Т	Т				
F	F	F	F	Т				

Figure 10: Figure 34(d)

5. ($q ightarrow$	5. $(q ightarrow eg p) \leftrightarrow (p \leftrightarrow q)$								
р	q	$\neg p$	q ightarrow eg p	$p \leftrightarrow q$	$(q ightarrow eg p) \leftrightarrow (p \leftrightarrow q)$				
Т	T	F	F	Т	F				
Т	F	F	Т	F	F				
F	T	T	Т	F	F				
F	F	T	Т	Т	Т				

Figure 11: Figure 34(e)

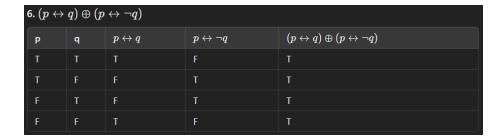


Figure 12: Figure 34(f)

1. $(p \lor q)$	1. $(pee q) o (p\oplus q)$							
р	q	$p \lor q$	$p\oplus q$	$(p ee q) o (p \oplus q)$				
T	T	Т	F	F				
T	F	Т	Т	Т				
F	T	T	Т	Т				
F	F	F	F	Т				

Figure 13: Figure 35(a)

2. $(p \oplus q)$	2. $(p\oplus q) o (p\wedge q)$							
р	q	$p\oplus q$	$p \wedge q$	$(p\oplus q) o (p\wedge q)$				
Т	T	F	Т	Т				
T	F	Т	F	F				
F	T	Т	F	F				
F	F	F	F	Т				

Figure 14: Figure 35(b)

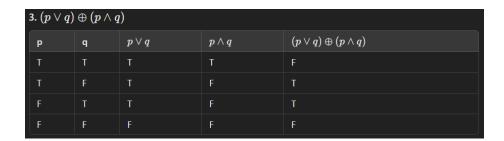


Figure 15: Figure 35(c)

4. $(p \leftrightarrow$	4. $(p \leftrightarrow q) \oplus (\lnot p \leftrightarrow q)$							
Р	q	$p \leftrightarrow q$	$\neg p$	$ eg p \leftrightarrow q$	$(p \leftrightarrow q) \oplus (\lnot p \leftrightarrow q)$			
Т	T	T	F	F	Т			
Т	F	F	F	Т	Т			
F	T	F	T	Т	F			
F	F	T	Т	F	Т			

Figure 16: Figure 35(d)

5. (p <	5. $(p \leftrightarrow q) \oplus (\lnot p \leftrightarrow \lnot r)$									
р	q	r	$p \leftrightarrow q$	$\neg p$	$\neg r$	$ eg p \leftrightarrow eg r$	$(p \leftrightarrow q) \oplus (\lnot p \leftrightarrow \lnot r)$			
Т	Т	T	Т	F	F	Т	F			
Т	Т	F	Т	F	T	F	Т			
Т	F	T	F	F	F	Т	Т			
Т	F	F	F	F	T	F	F			
F	Т	T	F	T	F	F	Т			
F	T	F	F	T	T	Т	F			
F	F	T	Т	Т	F	F	Т			
F	F	F	Т	Т	Т	Т	F			

Figure 17: Figure 35(e)

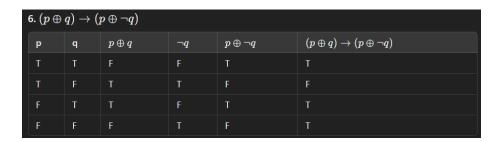


Figure 18: Figure 35(f)

1. $p\oplus p$		
р	р	$p\oplus p$
Т	Т	F
F	F	F

Figure 19: Figure 36(a)



Figure 20: Figure 36(b)



Figure 21: Figure 36(c)



Figure 22: Figure 36(d)

5. $(p \oplus q) \lor (p \oplus \lnot q)$								
р	q	$p\oplus q$	$\neg q$	$p \oplus \neg q$	$(p \oplus q) \vee (p \oplus \neg q)$			
T	T	F	F	T	Т			
Т	F	Т	Т	F	Т			
F	T	Т	F	F	Т			
F	F	F	Т	Т	Т			

Figure 23: Figure 36(e)

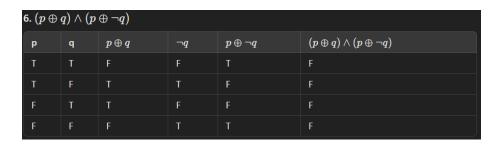


Figure 24: Figure 36(f)

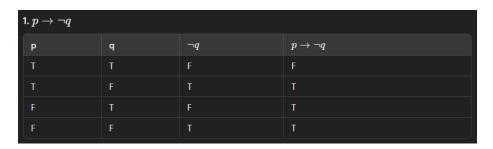


Figure 25: Figure 37(a)

2. $\neg p \leftrightarrow q$								
р	q	$\neg p$	$ eg p \leftrightarrow q$					
Т	T	F	F					
Т	F	F	Т					
F	Т	Т	Т					
F	F	Т	F					

Figure 26: Figure 37(b)

3. $(p ightharpoonup$	3. $(p o q)ee (eg p o q)$								
р	q	p o q	$\neg p$	eg p o q	(p o q)ee (eg p o q)				
Т	T	Т	F	Т	Т				
Т	F	F	F	Т	Т				
F	T	Т	Т	Т	Т				
F	F	Т	T	F	Т				

Figure 27: Figure 37(c)

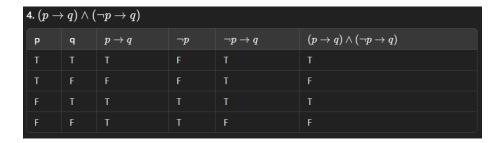


Figure 28: Figure 37(d)

5. $(p \leftrightarrow$	5. $(p \leftrightarrow q) \lor (\lnot p \leftrightarrow q)$								
P	q	$p \leftrightarrow q$	eg p	$ eg p \leftrightarrow q$	$(p \leftrightarrow q) \lor (\neg p \leftrightarrow q)$				
Т	T	Т	F	F	Т				
Т	F	F	F	Т	Т				
F	T	F	Т	Т	Т				
F	F	Т	Т	F	Т				

Figure 29: Figure 37(e)

6. $(\neg p$	6. $(\neg p \leftrightarrow \neg q) \leftrightarrow (p \leftrightarrow q)$								
Р	q	$\neg p$	$\neg q$	$ eg p \leftrightarrow eg q$	$p \leftrightarrow q$	$(\lnot p \leftrightarrow \lnot q) \leftrightarrow (p \leftrightarrow q)$			
Т	Т	F	F	T	Т	Т			
Т	F	F	T	F	F	Т			
F	T	T	F	F	F	Т			
F	F	T	Т	Т	Т	Т			

Figure 30: Figure 37(f)

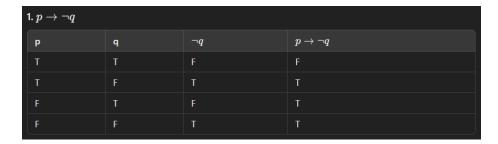


Figure 31: Figure 37(a)

2. $\neg p \leftrightarrow q$								
р	q	$\neg p$	$ eg p \leftrightarrow q$					
Т	Т	F	F					
Т	F	F	Т					
F	Т	Т	Т					
F	F	Т	F					

Figure 32: Figure 37(b)

3. ($p ightarrow$	3. $(p o q)ee (eg p o q)$								
р	q	p o q	$\neg p$	eg p o q	(p o q)ee (eg p o q)				
Т	T	Т	F	Т	Т				
Т	F	F	F	Т	Т				
F	T	Т	Т	Т	Т				
F	F	Т	T	F	Т				

Figure 33: Figure 37(c)

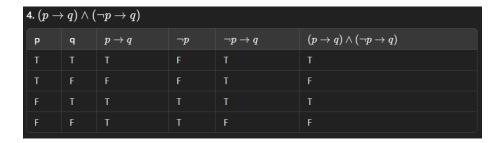


Figure 34: Figure 37(d)

5. ($p \leftrightarrow$	5. $(p \leftrightarrow q) \lor (\lnot p \leftrightarrow q)$								
р	q	$p \leftrightarrow q$	$\neg p$	$ eg p \leftrightarrow q$	$(p \leftrightarrow q) \lor (\lnot p \leftrightarrow q)$				
Т	T	T	F	F	Т				
Т	F	F	F	Т	Т				
F	T	F	Т	Т	Т				
F	F	T	Т	F	Т				

Figure 35: Figure 37(e)

6. $(\neg p$	6. $(\neg p \leftrightarrow \neg q) \leftrightarrow (p \leftrightarrow q)$								
Р	q	$\neg p$	$\neg q$	$ eg p \leftrightarrow eg q$	$p \leftrightarrow q$	$(\lnot p \leftrightarrow \lnot q) \leftrightarrow (p \leftrightarrow q)$			
Т	Т	F	F	T	Т	Т			
Т	F	F	T	F	F	Т			
F	T	T	F	F	F	Т			
F	F	T	Т	Т	Т	Т			

Figure 36: Figure 37(f)

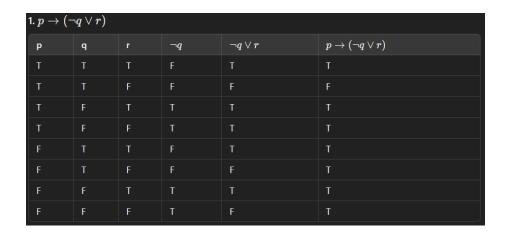


Figure 37: Figure 39(a)

2. $\neg p ightarrow$	2. $ eg p o (q o r)$								
р	q	r	$\neg p$	q ightarrow r	eg p o (q o r)				
Т	T	Т	F	Т	Т				
Т	T	F	F	F	Т				
Т	F	T	F	Т	Т				
Т	F	F	F	F	Т				
F	Т	Т	Т	Т	Т				
F	T	F	Т	F	F				
F	F	Т	Т	Т	Т				
F	F	F	Т	F	F				

Figure 38: Figure 39(b)

3. (<i>p</i> –	3. $(p o q)ee (eg p o r)$								
Р	q	r	p o q	$\neg p$	eg p o r	(p o q)ee (eg p o r)			
Т	Т	Т	Т	F	Т	Т			
Т	Т	F	Т	F	T	Т			
Т	F	Т	F	F	Т	Т			
Т	F	F	F	F	Т	Т			
F	T	Т	Т	T	T	Т			
F	Т	F	Т	T	F	Т			
F	F	Т	F	T	Т	Т			
F	F	F	F	T	F	F			

Figure 39: Figure 39(c)

4. (p –	4. $(p o q) \wedge (\lnot p o r)$								
Р	q	r	p o q	$\neg p$	eg p o r	$(p o q)\wedge (eg p o r)$			
T	T	Т	T	F	T	Т			
Т	T	F	T	F	T	Т			
Т	F	Т	F	F	Т	F			
Т	F	F	F	F	Т	F			
F	T	Т	Т	T	Т	Т			
F	T	F	Т	T	F	F			
F	F	Т	F	T	Т	F			
F	F	F	F	Т	F	F			

Figure 40: Figure 39(d)

5. (<i>p</i> ←	5. $(p \leftrightarrow q) \lor (\lnot q \leftrightarrow r)$								
р	q	r	$p \leftrightarrow q$	$\neg q$	$ eg q \leftrightarrow r$	$(p \leftrightarrow q) \lor (\neg q \leftrightarrow r)$			
Т	T	Т	T	F	F	Т			
Т	T	F	T	F	Т	Т			
Т	F	T	F	T	Т	Т			
Т	F	F	F	T	F	F			
F	T	T	F	F	F	F			
F	T	F	F	F	Т	Т			
F	F	T	Т	T	Т	Т			
F	F	F	T	T	F	Т			

Figure 41: Figure 39(e)

6. (¬ <i>p</i>	6. $(\neg p \leftrightarrow \neg q) \leftrightarrow (q \leftrightarrow r)$									
Р	q	r	$\neg p$	$\neg q$	$ eg p \leftrightarrow eg q$	$q \leftrightarrow r$	$(\lnot p \leftrightarrow \lnot q) \leftrightarrow (q \leftrightarrow r)$			
Т	T	Т	F	F	T	Т	Т			
Т	Т	F	F	F	T	F	F			
T	F	T	F	T	F	Т	F			
T	F	F	F	T	F	F	Т			
F	T	T	Т	F	F	Т	F			
F	Т	F	T	F	F	F	Т			
F	F	T	T	T	Т	Т	Т			
F	F	F	Т	Т	Т	F	F			

Figure 42: Figure 39(f)

Truth Table:									
р	q	r	s	p o q	(p o q) o r	((p o q) o r) o s			
Т	T	T	T	Т	Т	Т			
Т	Т	Т	F	Т	Т	F			
Т	Т	F	Т	Т	F	Т			
Т	Т	F	F	Т	F	F			
Т	F	Т	Т	F	Т	Т			
Т	F	Т	F	F	Т	F			
Т	F	F	Т	F	Т	Т			
Т	F	F	F	F	Т	F			
F	T	Т	T	Т	Т	Т			
F	Т	Т	F	Т	Т	F			
F	Т	F	Т	Т	F	Т			
F	Т	F	F	Т	F	F			
F	F	Т	Т	Т	Т	Т			
F	F	T	F	Т	Т	F			
F	F	F	Т	Т	F	Т			
F	F	F	F	Т	F	F			

Figure 43: Figure 40

Truth [*]	Truth Table:								
р	q	r	s	$p \leftrightarrow q$	$r \leftrightarrow s$	$(p \leftrightarrow q) \leftrightarrow (r \leftrightarrow s)$			
Т	T	Т	T	Т	Т	Т			
Т	T	T	F	Т	F	F			
T	T	F	T	T	F	F			
Т	T	F	F	T	Т	Т			
T	F	T	T	F	Т	F			
T	F	T	F	F	F	Т			
T	F	F	T	F	F	Т			
T	F	F	F	F	Т	F			
F	T	T	T	F	Т	F			
F	T	T	F	F	F	Т			
F	T	F	T	F	F	Т			
F	T	F	F	F	Т	F			
F	F	T	T	T	T	Т			
F	F	T	F	Т	F	F			
F	F	F	T	T	F	F			
F	F	F	F	Т	Т	T			

Figure 44: Figure 41