**Matematyka dyskretna**

Logika - zadanie

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Ilość tautologii: 3

1. p | q

| p | q | p | q |
| --- | --- | --- |
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

2. p ↓ q

| p | q | p ↓ q |
| --- | --- | --- |
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

3. p ⊕ q

| p | q | p ⊕ q |
| --- | --- | --- |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

4. (p | q) | (p | q)

| p | q | p | q | p | q | (p | q) | (p | q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 |

5. (p ↓ q) ↓ (p ↓ q)

| p | q | p ↓ q | p ↓ q | (p ↓ q) ↓ (p ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 |

6. (p | p) ⊕ (q | q)

| p | q | p | p | q | q | (p | p) ⊕ (q | q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |

7. (p ↓ p) ⊕ (q ↓ q)

| p | q | p ↓ p | q ↓ q | (p ↓ p) ⊕ (q ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |

8. (p | q) ∧ (p ↓ q)

| p | q | p | q | p ↓ q | (p | q) ∧ (p ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |

9. (p ⊕ q) → (p ∧ q)

| p | q | p ⊕ q | p ∧ q | (p ⊕ q) → (p ∧ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 |

10. (p ⊕ q) ∨ (p | q)

| p | q | p ⊕ q | p | q | (p ⊕ q) ∨ (p | q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |

11. (p ↓ q) → (p | q)

| p | q | p ↓ q | p | q | (p ↓ q) → (p | q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 |

12. (p | p) → (q ↓ q)

| p | q | p | p | q ↓ q | (p | p) → (q ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 |

13. (p ⊕ q) ↔ (p ↓ q)

| p | q | p ⊕ q | p ↓ q | (p ⊕ q) ↔ (p ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 |

14. (p | q) ∧ (¬p ∨ q)

| p | q | ¬p | p | q | ¬p ∨ q | (p | q) ∧ (¬p ∨ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 | 1 |

15. (p ∧ q) ⊕ (¬p ∧ ¬q)

| p | q | p ∧ q | ¬p | ¬q | ¬p ∧ ¬q | (p ∧ q) ⊕ (¬p ∧ ¬q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 |

16. (p ↓ q) ∨ (¬p ∧ q)

| p | q | ¬p | p ↓ q | ¬p ∧ q | (p ↓ q) ∨ (¬p ∧ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 |

17. (p ∨ q) ⊕ (¬p ∨ ¬q)

| p | q | ¬p | ¬q | p ∨ q | ¬p ∨ ¬q | (p ∨ q) ⊕ (¬p ∨ ¬q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 | 1 |

18. (p | q) → (¬p ∨ q)

| p | q | ¬p | p | q | ¬p ∨ q | (p | q) → (¬p ∨ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 |

19. (p ∧ ¬q) | (¬p ∧ q) **TAUTOLOGIA**

| p | q | ¬p | ¬q | p ∧ ¬q | ¬p ∧ q | (p ∧ ¬q) | (¬p ∧ q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 |

20. (p → q) ↓ (q → ¬p)

| p | q | ¬p | p → q | q → ¬p | (p → q) ↓ (q → ¬p) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 0 | 0 |

21. (p ⊕ q) ∧ (p | q)

| p | q | p ⊕ q | p | q | (p ⊕ q) ∧ (p | q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |

22. (p ↓ q) ⊕ (p ∧ ¬q)

| p | q | ¬q | p ↓ q | p ∧ ¬q | (p ↓ q) ⊕ (p ∧ ¬q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 |

23. (p → ¬q) | (q → p)

| p | q | ¬q | p → ¬q | q → p | (p → ¬q) | (q → p) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 |

24. (p ∨ q) ↓ (¬p ∧ q)

| p | q | ¬p | p ∨ q | ¬p ∧ q | (p ∨ q) ↓ (¬p ∧ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 | 0 |

25. (p ⊕ q) | (¬p ⊕ ¬q)

| p | q | ¬p | ¬q | p ⊕ q | ¬p ⊕ ¬q | (p ⊕ q) | (¬p ⊕ ¬q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 |

26. (p ∧ q) ↓ (p ⊕ q)

| p | q | p ∧ q | p ⊕ q | (p ∧ q) ↓ (p ⊕ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 |

27. (p | q) ↔ (p ↓ q)

| p | q | p | q | p ↓ q | (p | q) ↔ (p ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 |

28. (p ⊕ q) ∧ (¬p ⊕ ¬q)

| p | q | ¬p | ¬q | p ⊕ q | ¬p ⊕ ¬q | (p ⊕ q) ∧ (¬p ⊕ ¬q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 |

29. (p | q) ⊕ (p ↓ q)

| p | q | p | q | p ↓ q | (p | q) ⊕ (p ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 |

30. (p ∧ ¬q) ↓ (¬p ∨ q)

| p | q | ¬p | ¬q | p ∧ ¬q | ¬p ∨ q | (p ∧ ¬q) ↓ (¬p ∨ q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 |

31. (p → q) | (q → p)

| p | q | p → q | q → p | (p → q) | (q → p) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 |

32. (p ⊕ q) ↓ (¬p ∧ q)

| p | q | ¬p | p ⊕ q | ¬p ∧ q | (p ⊕ q) ↓ (¬p ∧ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 |

33. (p | q) ↔ (¬p | ¬q)

| p | q | ¬p | ¬q | p | q | ¬p | ¬q | (p | q) ↔ (¬p | ¬q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 |

34. (p ⊕ q) ∧ (p ↓ q)

| p | q | p ⊕ q | p ↓ q | (p ⊕ q) ∧ (p ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |

35. (p ↓ q) ⊕ (¬p ↓ ¬q)

| p | q | ¬p | ¬q | p ↓ q | ¬p ↓ ¬q | (p ↓ q) ⊕ (¬p ↓ ¬q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 | 1 |

36. (p | q) ∧ (¬p ⊕ q)

| p | q | ¬p | p | q | ¬p ⊕ q | (p | q) ∧ (¬p ⊕ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 |

37. (p ⊕ q) → (p ↓ q)

| p | q | p ⊕ q | p ↓ q | (p ⊕ q) → (p ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 |

38. (p ↓ q) ∧ (p | ¬q)

| p | q | ¬q | p ↓ q | p | ¬q | (p ↓ q) ∧ (p | ¬q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 |

39. (p ∧ q) ⊕ (¬p | q)

| p | q | ¬p | p ∧ q | ¬p | q | (p ∧ q) ⊕ (¬p | q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 |

40. (p → ¬q) ↓ (q → ¬p)

| p | q | ¬p | ¬q | p → ¬q | q → ¬p | (p → ¬q) ↓ (q → ¬p) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 |

41. (p | q) ↔ (¬p ⊕ ¬q)

| p | q | ¬p | ¬q | p | q | ¬p ⊕ ¬q | (p | q) ↔ (¬p ⊕ ¬q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 |

42. (p ⊕ q) ∨ (p ↓ q)

| p | q | p ⊕ q | p ↓ q | (p ⊕ q) ∨ (p ↓ q) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 |

43. (p ↓ q) → (¬p | q) **TAUTOLOGIA**

| p | q | ¬p | p ↓ q | ¬p | q | (p ↓ q) → (¬p | q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 |

44. (p | q) ⊕ (p ∧ ¬q)

| p | q | ¬q | p | q | p ∧ ¬q | (p | q) ⊕ (p ∧ ¬q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 |

45. (p ∧ q) ↓ (¬p ⊕ q)

| p | q | ¬p | p ∧ q | ¬p ⊕ q | (p ∧ q) ↓ (¬p ⊕ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 |

46. (p ⊕ q) | (¬p ∧ q)

| p | q | ¬p | p ⊕ q | ¬p ∧ q | (p ⊕ q) | (¬p ∧ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 1 |

47. (p → q) ⊕ (q → p)

| p | q | p → q | q → p | (p → q) ⊕ (q → p) |
| --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 |

48. (p ↓ q) ∧ (¬p ↓ ¬q)

| p | q | ¬p | ¬q | p ↓ q | ¬p ↓ ¬q | (p ↓ q) ∧ (¬p ↓ ¬q) |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 |

49. (p | q) ⊕ (¬p | q)

| p | q | ¬p | p | q | ¬p | q | (p | q) ⊕ (¬p | q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 |

50. (p ⊕ q) ↓ (¬p ⊕ q)

| p | q | ¬p | p ⊕ q | ¬p ⊕ q | (p ⊕ q) ↓ (¬p ⊕ q) |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 | 0 |