

MATH 0401 Discrete Mathematical Structures

Fall 2021, Homework 1

Print all pages and *staple* them.

1 . Is there a logical difference between $a \wedge (b \vee \neg c)$ and $a \wedge b \vee \neg c$? Explain your answer. [2 points]

2 . Which of the following represents "neither A nor B"?
(Circle all possible answers.) [2]

$$\neg(p \wedge q)$$

$$\neg p \wedge \neg q$$

$$\neg(p \vee q)$$

$$\neg(p \vee q)$$

3 . Write down the dual of $\neg(a \vee b) \wedge c \equiv p$. [2]

4 . Suppose that the logical variable are $p \equiv T$, $q \equiv F$, and $r \equiv T$. What are the truth values of the following: [4]

$$\neg(p \wedge \neg q \vee r) \equiv$$

$$p \rightarrow (\neg q \oplus \neg r) \equiv$$

$$\neg(r \leftrightarrow p) \vee q \equiv$$

$$q \vee \neg q \wedge \neg r \rightarrow q \equiv$$

5 . Negate the following propositions. [6]

$$p \wedge \neg q$$

$$r \vee (\neg p \wedge \neg q)$$

Even though the sun shines, I feel cold.

Some birds fly and swim.

John is 20 or both Kathy and Carl are 23.

The car is blue or the tree is not green.

6 . Suppose a represents "Ann was born in the United States", b represents "Barbara was born in the United States" and c represents "Cathy was born in the United States". Write down symbolic representations for the following sentences: [6]

Either Ann or Barbara but not both was born in the United States.

Ann was born in the United States but Barbara was not.

If both Ann and Barbara were not born in the United States,
then neither was Cathy.

At least one of Ann, Barbara, Cathy were born in the United States.

7 . Using the meanings from Question 6, write English sentences for the following expressions: [6]

$$\neg c \wedge a$$

$$a \wedge \neg b \wedge c$$

$$c \rightarrow \neg a \vee b$$

$$a \leftrightarrow c$$

Do the following questions on a separate sheet and staple it to your question sheet.

8 . Verify the following are tautologies: [6]

$$\neg(p \vee \neg q) \leftrightarrow (\neg p \wedge q)$$

$$(p \wedge \neg q) \rightarrow (p \vee \neg q)$$

9 . Additional Exercises from zybook: 1.2.1, 1.2.4, 1.2.5, 1.3.1, 1.3.4, and 1.4.4.