Term: 2022

Name: Solution Set

Instructor: Patricia Wrean

MATH 156
Practice Test 2B

Total = $\overline{}$ 30

- **All of the work on this test must be your own.**
- You may use a scientific calculator. You may not use a calculator with graphing capability or a smartphone app.

GOOD LUCK!

1. (5 points) Simplify the logical expression $(\sim q \oplus 1) \vee (q \wedge p)$. Use a truth table to justify your answer.

p	q	$\sim q$	1	$\sim q \oplus 1$	$q \wedge p$	$(\sim q \oplus 1) \vee (q \wedge p)$
0	0	1	1	0	0	0
0	1	0	1	1	0	1
1	0	1	1	0	0	0
1	1	0	1	1	1	1

$\boxed{q}$

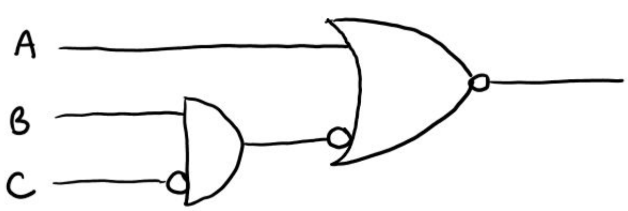
$-\frac{1}{2}$ per mistake for max of -1 per column

-1 no conclusion

-1 only simplified to $\sim q \oplus 1$

2. (3 points) Write the Boolean expression that corresponds to the following gate diagram. Do not simplify!

$\overline{A + \overline{B\bar{C}}}$



-1 not Boolean (used $\vee$, $\wedge$, $\sim$)

-1 incorrect negations

-1 mixed "and" vs "or" gates

3. (4 points) The following statement is true: “If the roads are icy, then driving is unsafe”. Given that, answer the following by selecting the correct choice.

   (a) The roads are not icy. Is driving unsafe? Yes / No / Maybe

   (b) Driving is unsafe. Are the roads icy? Yes / No / Maybe

   (c) Driving is safe. Are the roads icy? Yes / No / Maybe

   (d) The roads are icy. Is driving safe? Yes / No / Maybe

4. (4 points) Consider the following statements. et p = “The door is locked”

   (a) The door is locked or unlocked. $p \vee \sim p \Leftrightarrow 1$

   (b) The door is locked and unlocked. $p \wedge \sim p \Leftrightarrow 0$ } complement

   (c) The door is locked or not unlocked. $p \vee \sim(\sim p) \Leftrightarrow p \vee p \Leftrightarrow p$

   (d) The door is locked and not unlocked. $p \wedge \underbrace{\sim(\sim p)}_{\text{complement}} \Leftrightarrow p \wedge p \Leftrightarrow p$ } idempotent

   Which of the above statements is always false? b

   Which of the above statements is the negation of “The door is unlocked”? c, d

-1 omitting a correct answer
-1 each incorrect answer
for max -2 each part

5. (3 points) Let p = "Everything is awesome", q = "You are part of a team", and r = "You are living the dream". Rewrite the following English sentences into logical symbols. Do not simplify!

   (a) If you are part of a team, then everything is awesome. $q \to p$

   (b) If everything is awesome, then you are living the dream and vice versa. $p \Leftrightarrow r$ *

   (c) You are not part of a team or you are living the dream. $\sim q \vee r$

* also okay: $(p \to r) \wedge (r \to p)$
$(-\frac{1}{2})$ if used $\Leftrightarrow$ instead of $\leftrightarrow$)

6. (4 points) Is the expression $(p \wedge \sim q) \to 0$ logically equivalent to $\sim q \to \sim p$? Use a truth table to justify your answer.

p	q	$\sim p$	$\sim q$	0	$p \wedge \sim q$	$(p \wedge \sim q) \to 0$	$\sim q \to \sim p$
0	0	1	1	0	0	1	1
0	1	1	0	0	0	1	1
1	0	0	1	0	1	0	0
1	1	0	0	0	0	1	1

$\boxed{\text{Yes}}$

For the questions on this page: if you are using the Laws of Logic, remember to use one law of logic per line, and be sure to state the name of the law you are using!

7. (5 points) Prove the following using the laws of logic. If you're stuck, try using a truth table for part marks.

$$A+\overline{B}(B+\overline{B}) = \overline{A}\,\overline{B} + \overline{\overline{A}\,B}$$

method #1:

$A + \overline{B}(1) =$ " complement

$A + \overline{B} =$ " identity

$\therefore = \overline{A}\,\overline{B} + A + \overline{B}$ De Morgan's

$= \overline{B} + A + \overline{B}$ absorption

$= A + \overline{B}$ idempotent

method #2

$A + \overline{B}(B + \overline{B}) = \overline{A}\,\overline{B} + \overline{\overline{A}\,B}$

(same steps as above for left hand side)

$= \overline{A}\,\overline{B} + A + \overline{B}$ DeMorgan's

$= A + \overline{B}$ absorption

8. (2 points) Simplify the following. This is the nasty question I promised you and credit will only be awarded if the laws of logic are used to simplify the expression.

$$\overline{\overline{A}\,\overline{B}}\;\overline{\overline{B}\,A} + \overline{\overline{A}\,B}\;\overline{\overline{B}\,\overline{A}}$$

method #1:

$(A+B)(B+\overline{A}) + (A+\overline{B})(B+A)$ De Morgan's

$B + A\overline{A} + A + \overline{B}B$ distributive

$B + 0 + A + 0$ complement

$B + A$ identity

method #2:

$\overline{\overline{A}\,\overline{B} + \overline{B}A} + \overline{\overline{A}B + \overline{B}\,\overline{A}}$ De Morgan's

$\overline{\overline{B}(\overline{A}+A)} + \overline{\overline{A}(B+\overline{B})}$ distributive

$\overline{\overline{B}\cdot 1} + \overline{\overline{A}\cdot 1}$ complement

$\overline{\overline{B}} + \overline{\overline{A}}$ identity

$B + A$ complement