ICS 6B F23 Take Home Exam 1

Due: October 6th, 2023 at 11:59PM

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(**alpha-numeric; NOT your student ID**)

- **Read** the instructions of each question carefully.
- **Show all of your work. For problems without work to show then you should provide a brief 1 to 2 sentence description of what you did.**
- An answer where thought process is unclear will be given a grade of Not Yet
- Your submission should follow the template exactly. Any insertion, removal, or reordering of pages from the original template may result in readers not grading certain problems. In such an event you will receive "Not Yet" and no feedback on the problems in question.
- Place your answers in the boxed regions. Writing outside of the boxes will not be considered as part of your answers.
- This exam will cover the Outcomes from the L Learning Objective
- Please keep in mind of the academic honesty guidelines. This take-home exam is to be **completed individually, with no outside help**. You may use any resources from our class (ZyBooks and resources from Canvas), but you may not use any other online resources.
- You may choose to print the exam or use a digital editor for completing the exam. It is required that you use this PDF to complete your work. If you have no access to a printer or digital tools to fulfill the exam, feel free to reach out to the staffs regarding your concern.
- If you have any questions, please post a private Ed or attend available Office Hours. Note that we are not allowed to provide specific help to answering the exam questions.
- Good luck!

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Problem 1.1 (L1)

Use the following propositions to translate the English sentences into logic

- A: Aditya is helping to develop a new app called Questify
- F: Questify is free to use
- B: The 6B team is testing Questify

A $\wedge$ F

Aditya is helping to develop Questify and it will be free to use.

$A \wedge F$

using conjunction to express A and F

$($ A $\wedge$ B $)$ $\vee$

Either both Aditya is helping to develop and the 6B team is helping to test Questify, or Questify cost money to download (or both).

$\neg$ F

$(A \wedge B) \vee \neg F$

using conjunction to express A and F, then using disjunction to express (A and F) or not F

A $\leftarrow$ B

As long as Aditya is helping to develop Questify the 6B team will help to test Questify

$B \rightarrow A$

B implies A, It is false to say if 6B team help testing then Aditya will not help developing Questify.

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Problem 1.2 (L1)

Use the following propositions to translate the logical statements into English

- L: Triss needs to mow her lawn
- D: Triss needs to get a dogsitter
- T: Triss is leaving town tomorrow

$L \vee D$

Triss needs to mow her lawn or she needs to get a dogsitter.

the symbol $\vee$ represents disjunction which translates to "or" in English

$T \implies (L \wedge D)$

If Triss is leaving town tomorrow then she needs to mow her lawn and get a dogsitter.

we can say T implies (L and D) which is If T, then L and D.

$L \wedge (\neg D \implies \neg T)$

Triss needs to mow her lawn and if she does not need to get a dogsitter then she is not leaving town tomorrow.

The symbol $\wedge$ represent conjunction and we can translate it to L and if not D then not T

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Problem 2 (L.2)

Prove using the laws of logic (show all steps) that the following two propositions are equivalent:

$(p \implies q) \implies r$

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

$(p \to q) \to r$	start	They are equivalent
$(\neg p \vee q) \to r$	conditional identity	
$\neg(\neg p \vee q) \vee r$	conditional identity	
$(\neg\neg p \wedge \neg q) \vee r$	de morgan's law	
$(p \wedge \neg q) \vee r$	double negation law	
$(p \vee r) \wedge (\neg q \vee r)$	distributive law	
$(\neg p \to r) \wedge (\neg q \vee r)$	conditional identity	
$(\neg p \to r) \wedge (q \to r)$	conditional identity	

Problem 3 (L.3)

Complete the truth table below for the following expression:

$(p \wedge q) \implies r$

$p \implies (q \vee r)$

row number	p	q	r	$p \wedge q$	$q \vee r$	(p $\wedge q) \implies r$	$p \implies (q \vee r)$
1	T	T	T	T	T	T	T
2	T	T	F	T	T	F	T
3	T	F	T	F	T	T	T
4	T	F	F	F	F	T	F
5	F	T	T	F	T	T	T
6	F	T	F	F	T	T	T
7	F	F	T	F	T	T	T
8	F	F	F	F	F	T	T

The above expressions are not equivalent. Give the row number that proves that these expressions are not equivalent. If there are more than one correct answer then only gave a single answer.

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Problem 4.1 (L.4)

Show whether $(((\neg l \vee k) \wedge k) \vee \neg k) \wedge (l \vee (\neg l \wedge k))$ is a tautology or not. Prove your answer within the box below.

☐ tautology

☑ not a tautology

l	k	$\neg l$	$\neg k$	$\neg l \vee k$	$(\neg l \vee k) \wedge k$	$((\neg l \vee k) \wedge k) \vee \neg k$	$\neg l \wedge k$	$l \vee (\neg l \wedge k)$
T	T	F	F	T	T	T	F	T
T	F	F	T	F	F	T	F	T
F	T	T	F	T	T	T	T	T
F	F	T	T	T	F	T	F	F

$(((\neg l \vee k) \wedge k) \vee \neg k) \wedge (l \vee (\neg l \wedge k)$
T
T
T
F

The truth table shows that not every truth value is true, therefore it is not a tautology

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Problem 4.2 (L.4)

For the following pairs of expressions, state whether or not the expressions are equivalent. Prove your answer within the boxes provided.

a) $(a \implies b) \vee (c \implies d)$, $(a \implies d) \vee (c \implies b)$

☑ equivalent

☐ not equivalent

$(a \to b) \vee (c \to d)$	start
$(\neg a \vee b) \vee (c \to d)$	conditional identity
$(\neg a \vee b) \vee (\neg c \vee d)$	conditional identity
$(\neg a \vee b) \vee (d \vee \neg c)$	commutative law
$\neg a \vee (b \vee d) \vee \neg c$	associative law
$\neg a \vee (d \vee b) \vee \neg c$	commutative law
$(\neg a \vee d) \vee (b \vee \neg c)$	associative law
$(\neg a \vee d) \vee (\neg c \vee b)$	commutative law
$(a \to d) \vee (\neg c \vee b)$	conditional identity
$(a \to d) \vee (c \to b)$	conditional identity

The two expression are equivalent.

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b) $(\neg x \vee y) \wedge z, \quad (x \implies y) \wedge (x \implies z)$

☐ equivalent

☑ not equivalent

	x	y	z	$\neg x$	$\neg x \vee y$	$(\neg x \vee y) \wedge z$	$x \rightarrow y$	$x \rightarrow z$	$(x \rightarrow y) \wedge (x \rightarrow z)$
1	T	T	T	F	T	T	T	T	T
2	T	T	F	F	T	F	T	F	F
3	T	F	T	F	F	F	F	T	F
4	T	F	F	F	F	F	F	F	F
5	F	T	T	T	T	T	T	T	T
6	F	T	F	T	T	F	T	T	T
7	F	F	T	T	T	T	T	T	T
8	F	F	F	T	T	F	T	T	T

The truth table shows that they are not equivalent. At row 6 and 8 show they are have different truth values.