

INSTRUCTIONS

Before your workshop Revise the material from Week 1 (Logic). Make a summary and learn the vocabulary. Then make your best attempt at Problems 1, 3 and 5 on the worksheet. Write your attempts neatly, on the worksheet or a separate piece of paper, and bring them to the workshop. At this stage, the correctness of your solution is not important. What is important is that you try your best, and write what you do know so that it is evident that you tried your best. You must take your attempts at Problems 1, 3 and 5 to the workshop. You may take along any summaries or other notes you have made about the material too. You should expect to spend about two hours revising material and making your attempts at Problems 1, 3 and 5.

During your workshop At the start of the workshop, your demonstrator will ask to see your attempts at Problems 1, 3 and 5. While your demonstrator looks these over, you will work collaboratively with your classmates on problems 2, 4 and 6. Your demonstrator will guide you through the workshop, and help you if you are stuck. The demonstrator and class members may comment and correct your work during the workshop. Your goal is to leave the workshop feeling like you understand how to solve as much of the worksheet as possible. The aim is for a collaborative mathematical experience.

You may take notes during a workshop for later reference. Some of you will prefer to take photos, rather than write notes. We need some rules for this. You may take photos of work written on the board, but only after the author of the work has given their explicit permission. You may not take photos of people during the workshops.

For MATH1005 students only, workshop participation is worth 10% of your overall grade. For a maximum participation mark you will need to bring satisfactory attempts at problems 1, 3 and 5 to class (where satisfactory does not have to mean correct) and participate productively throughout the workshop. If illness or other circumstances prevent you attending one or two workshops, don't worry because we will only use the best eight out of ten workshop participation scores.

After your workshop At 8pm after your workshop your assignment document will become available on Wattle. This will contain several questions closely related to the questions on this worksheet. When you have worked out answers write up the solutions neatly and carefully in the spaces provided in the assignment document, using good English spelling and grammar and, most importantly, showing all necessary steps of calculations and reasoning (except on multiple choice questions). You have 6 days to submit your assignment (online). Your demonstrator will then grade it and you will be able to see marks and possible comments online. These assignments will contribute 10% to your overall grade.

Assignments will vary from one day to another, so you must download your own assignment, not rely on someone else who may have a workshop on a different day. Also note that late submissions will not be accepted, and the assignment document itself will disappear from Wattle after the submission deadline.

MY NAME IS:

MY u NUMBER IS:

Question 1 Define the logical variables a , d and f as follows: a = “The ASX is at least 4000” d = “The Dow is at least 1200” f = “The FTSE is at least 5000”

Express each of the following in symbols, as succinctly as you can.

- (a) The ASX is at least 4000, and either the Dow is at least 1200 or the FTSE is at least 5000, but not both.
- (b) When the FTSE is below 5000 the Dow is below 1200.
- (c) Either the ASX is at least 4000 and the Dow is at least 1200, or the ASX is below 4000 and the Dow is below 1200. [*Try to express this with just one logical connective.*]

Question 2 Negate each of the statements below.

Use as natural sounding English as you can manage, and try to avoid using the word ‘not’. Do not use symbols.

- (a) She will win silver or gold.
- (b) She will win silver if she fails to win gold.
- (c) She will win gold in the 100m event and in the 200m event.

Question 3 When solving the equation $2x - 6 = 0$ we might write out the solution method in ‘shorthand’ something like this:

$$2x - 6 = 0 \quad \Rightarrow \quad 2x = 6 \quad \Rightarrow \quad x = 3.$$

In our model of logic this appears to have the form $p \Rightarrow q \Rightarrow r$. However this statement form is ambiguous because the \Rightarrow connective is not associative; *i.e.* $(p \Rightarrow q) \Rightarrow r$ and $p \Rightarrow (q \Rightarrow r)$ mean different things.

- (a) Use truth table(s) to show that $[(p \Rightarrow q) \Rightarrow r] \not\equiv [p \Rightarrow (q \Rightarrow r)]$.
- (b) Is the shorthand solution scheme notation $p \Rightarrow q \Rightarrow r$ correctly represented by either $(p \Rightarrow q) \Rightarrow r$ or $p \Rightarrow (q \Rightarrow r)$? If so, which one; if not, what should it be?

Question 4 Let $p =$ “If the new drug succeeds, diabetes rates will fall”.

- (a) Write out the converse of p . Is this equivalent to p ?
- (b) Write out the contrapositive of p . Is this equivalent to p ?
- (c) Express p using the phrase “necessary condition”.

Question 5 For each of the following sentences, say whether the sentence is a true statement, a false statement or a predicate. Also give the negation of each sentence.

- (a) If $x^2 > 0$ then $x > 0$.
- (b) $\forall x \in \mathbb{N} \exists y \in \mathbb{N} \ x = y^2$.
- (c) $\exists! x \in \mathbb{N} \ 3x - x^2 = 2$. [*This one is tricky!*]

Question 6

- (a) Construct a circuit diagram corresponding to the input-output (truth) table at right. Do this by employing the standard method of first writing out a logically equivalent expression that is in disjunctive normal form, and then converting this to a circuit using only AND, NOT and OR gates.

inputs		output
X	Y	
1	1	0
1	0	1
0	1	1
0	0	0

- (b) (*Challenge*) Construct a circuit diagram corresponding to the same input-output table but this time using only NAND gates. Try to use the least number of gates you can.
- (c) (*Challenge*) Consider the following statement.

“The functional completeness of NAND allows logic gate manufacturers to exploit an economy of scale.”

What do you think the statement means? Do you think it is true or false?