Lab 1

(1) Identify propositions + truth values

Which of these sentences are propositions? What are the truth values of those that are propositions?

a) Riyadh is the capital of Saudi Arabia.
✓ Proposition — **True**

b) Dubai is the capital of the United Arab Emirates.
✓ Proposition — **False** (capital is Abu Dhabi)

c) 2 + 3 = 5.
✓ Proposition — **True**

d) x + 2 = 11.
✗ **Not a proposition** (depends on x)

e) What time is it?
✗ **Not a proposition** (question)

f) The moon is made of green cheese.
✓ Proposition — **False**

g) Answer this question.
✗ **Not a proposition** (command)

(2) Negation

What is the negation of each of these propositions?

a) Linda is younger than Sanjay.
Negation: **Linda is not younger than Sanjay.**

b) Janice has more Facebook friends than Juan.
Negation: **Janice does not have more Facebook friends than Juan.**

c) Mai has an MP3 player.
Negation: **Mai does not have an MP3 player.**

d) There is no pollution in New Jersey.
Negation: **There is pollution in New Jersey.**

e) 2 + 1 = 3.
Negation: **2 + 1 ≠ 3.**

f) The summer in Maine is hot and sunny.
Negation: **The summer in Maine is not hot or not sunny.**

(3) Truth values with Logical Connectives

Suppose the following information is given:

- Smartphone A: 256 MB RAM, 32 GB ROM, 8 MP camera
- Smartphone B: 288 MB RAM, 64 GB ROM, 4 MP camera

Determine the truth value of each proposition:

a) Smartphone B has more ROM or a higher resolution camera than Smartphone A.
ROM: True, Camera: False → True OR False = **True**

✓ **Answer: True**

b) Smartphone B has more RAM and more ROM than Smartphone A.
True AND True = **True**

✓ **Answer: True**

(4) Implication

Let the following propositions be given:

- **p:** It is raining.
- **q:** I stay at home.

a) Write the statement **p → q** as an English sentence.

b) Which of the following situations **violates** the statement **p → q**? Choose **one** answer.

A) It is raining and I stay at home.
B) It is raining and I do not stay at home.
C) It is not raining and I stay at home.
D) It is not raining and I do not stay at home.

a) p → q in English:

✓ **If it is raining, then I stay at home.**

b) Which situation violates p → q?

The implication is false only when p is true and q is false.

✓ **Answer: B) It is raining and I do not stay at home.**

(5) Express using another form

Write each of these statements in the form "if *p*, then *q*" in English.

a) It snows when the wind comes from the northeast.

✓ **If the wind comes from the northeast, then it snows.**

b) A student passes the exam if they study well.

✓ **If a student studies well, then the student passes the exam.**

c) Jan will go swimming unless the water is too cold.

✓ **If the water is not too cold, then Jan will go swimming.**

(6) Express using p if and only if q in English

Write each of these propositions in the form "*p* if and only if *q*" in English.

a) You buy an ice cream cone when it is hot outside, and only then.

✓ **You buy an ice cream cone if and only if it is hot outside.**

b) You get promoted only if you have connections, and you have connections only if you get promoted.

✓ **You get promoted if and only if you have connections.**

c) The light is on only when the switch is up.

✓ **The light is on if and only if the switch is up.**

(7) Logical equivalent

Use a truth table to determine whether the following propositions are logically equivalent:

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

p	q	r	pVq	(pVq)→r	¬r	¬p	¬q	¬r→¬p	¬r→¬q	$(\neg r \rightarrow \neg p) \wedge (\neg r \rightarrow \neg q)$
T	T	T	T	T	F	F	F	T	T	T
T	T	F	T	F	T	F	F	F	F	F
T	F	T	T	T	F	F	T	T	T	T
T	F	F	T	F	T	F	T	F	T	F
F	T	T	T	T	F	T	F	T	T	T
F	T	F	T	F	T	T	F	T	F	F
F	F	T	F	T	F	T	T	T	T	T
F	F	F	F	T	T	T	T	T	T	T

✓ **Conclusion: They are logically equivalent.**