

Name & Directory ID: _____

Circle Your Section!			
0101 (10am: 3120, Ladan)	0102 (11am: 3120, Ladan)	0103 (Noon: 3120, Peter)	
0201 (2pm: 3120, Yi)	0202 (10am: 1121, Vikas)	0203 (11am: 1121, Vikas)	0204 (9am: 2117, Karthik)
0301 (9am: 3120, Huijing)	0302 (8am: 3120, Huijing)	0303 (1pm: 3120, Yi)	250H (10am: 2117, Peter)

1. (40 points) Consider the following propositions:

p : Unicorns exist.

q : I am a student at University of Maryland.

r : Robot monkeys are eating my brains!

s : Gene Simmons is *not* my instructor.

Write each sentence below as a compound proposition using $\{p, q, r, s\}$ and the logical connectives $\{\vee, \wedge, \neg, \rightarrow, \leftrightarrow\}$. Decide whether each sentence is true or false in the context of the current world we live in. Show your work.

- (a) Either unicorns exists, or I am a student at University of Maryland, or both.

Solution: $p \vee q, \quad F \vee T \equiv T$

- (b) I am a student at University of Maryland if and only if Gene Simmons is not my instructor.

Solution: $q \leftrightarrow s, \quad T \leftrightarrow T \equiv T$

- (c) If I am a student at University of Maryland, then Gene Simmons is not my instructor.

Solution: $q \rightarrow s, \quad T \rightarrow T \equiv T$

- (d) Gene Simmons is not my instructor if robot monkeys are eating my brains!

Solution: $r \rightarrow s, \quad F \rightarrow T \equiv T$

- (e) Gene Simmons is not my instructor only if robot monkeys are eating my brains!

Solution: $s \rightarrow r, \quad T \rightarrow F \equiv F$

- (f) If unicorns exist, then robot monkeys are eating my brains!

Solution: $p \rightarrow r, \quad F \rightarrow F \equiv T$

- (g) If Gene Simmons *is* my instructor and robot monkeys *don't* eat my brains, then neither do unicorns exist nor am I a student at University of Maryland.

Solution: $\neg s \wedge \neg r \rightarrow \neg p \wedge \neg q, \quad \neg T \wedge \neg F \rightarrow \neg F \wedge \neg T \equiv F \wedge T \rightarrow F \wedge F \equiv F \rightarrow F \equiv T$

2. (60 points) A proposition is a *tautology* if it is always true, and it is a *contradiction* if it is always false. Label the following as a tautology, a contradiction, or neither. Justify each answer using a truth table.

(a) $A \vee \neg A$

Solution:

A	$\neg A$	$A \vee \neg A$
T	F	T
F	T	T

Since the last column is all T, the statement is a **tautology**.

(b) $B \rightarrow (\neg A \wedge B)$

Solution:

A	B	$\neg A$	$\neg A \wedge B$	$B \rightarrow (\neg A \wedge B)$
T	T	F	F	F
T	F	F	F	T
F	T	T	T	T
F	F	T	F	T

Since the last column has both T and F, the statement is **neither**.

(c) $(\neg A \wedge B) \rightarrow B$

Solution:

A	B	$\neg A$	$\neg A \wedge B$	$(\neg A \wedge B) \rightarrow B$
T	T	F	F	T
T	F	F	F	T
F	T	T	T	T
F	F	T	F	T

Since the last column is all T, the statement is a **tautology**.

(d) $((A \rightarrow B) \wedge (B \rightarrow C)) \rightarrow (A \rightarrow C)$

Solution: Table OMITTED. tautology

(e) $((A \rightarrow B) \wedge (B \rightarrow C)) \wedge \neg(A \rightarrow C)$

Solution: Table OMITTED. contradiction