Computer Science 121
Midterm 1 Solutions

1. A truth table for the statement:

p	q	$p \rightarrow q$	~p	$(p \rightarrow q) \wedge \sim p$	~q	whole statement
F	F	T	T	T	T	T
F	T	T	T	T	F	F
T	F	F	F	F	T	T
T	T	T	F	F	F	T

Therefore the statement is neither a tautology nor a contradiction.

2.

a. $\sim(\sim w \vee g) \rightarrow (d \wedge t)$ OR $(w \wedge \sim g) \rightarrow (d \wedge t)$

If we interpret "but we will be late" as "in any case we will be late":

$(\sim(\sim w \vee g) \rightarrow d) \wedge t$ OR $((w \wedge \sim g) \rightarrow d) \wedge t$

b. $\sim g \rightarrow (w \rightarrow (d \wedge t))$
OR
$(\sim g \wedge w) \rightarrow (d \wedge t)$

3.

Expression:

$(\sim p \wedge \sim q) \vee (q \wedge r)$

OR

$\sim((q \wedge \sim r) \vee (p \wedge \sim q))$

4.

Proof:

$(p \wedge \sim q) \rightarrow \sim p$	given
$\equiv \sim(p \wedge \sim q) \vee \sim p$	definition of $\rightarrow$
$\equiv (\sim p \vee \sim\sim q) \vee \sim p$	DeMorgan
$\equiv (\sim p \vee q) \vee \sim p$	double negation (may skip)
$\equiv \sim p \vee (\sim p \vee q)$	commutative (may skip)
$\equiv (\sim p \vee \sim p) \vee q$	associative
$\equiv \sim p \vee q$	idempotence
$\equiv p \rightarrow q$	definition of $\rightarrow$

5.

a. $\sim[\ \sim p \wedge \sim((\ p \wedge q) \vee r)]$

b.

$\sim[\ \sim p \wedge \sim((\ p \wedge q) \vee r)]$

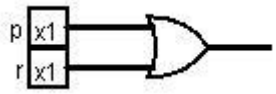
$\equiv\ \sim\sim p \vee \sim\sim((\ p \wedge q) \vee r)$ DM

$\equiv\ p \vee ((\ p \wedge q) \vee r)$ DNEG (twice)

$\equiv\ (p\ \vee\ (\ p\ \wedge q))\ \vee r$ ASS

$\equiv\ p\ \vee\ r$ ABS

c. The circuit can be implemented with a single OR gate:



6.

a. 0 1111000

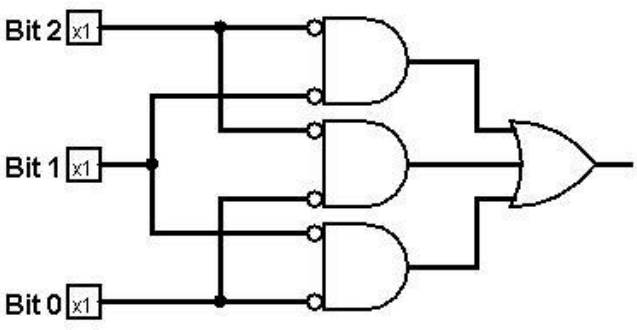
b. 54

c. -10

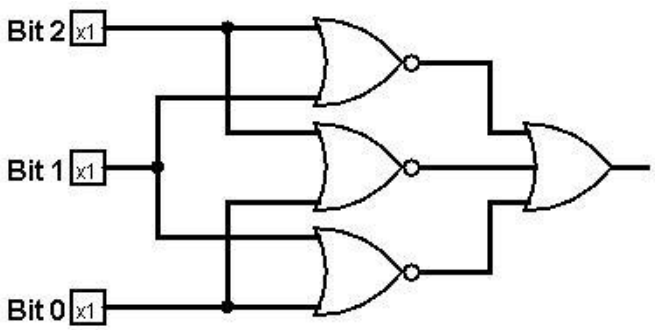
d.

	01000000	64
	10111111	
+1	00000001	
	11000000	-64

7.



OR



8.

1.	$p \vee q$	premise
2.	$q \rightarrow r$	premise
3.	$p \wedge u \rightarrow t$	premise
4.	$\sim q \rightarrow (w \wedge u)$	premise
5.	$\sim r$	premise
6.	$\sim q$	2, 5, modus tollens
7.	p	1, 6, elimination
8.	$w \wedge u$	4, 6, modus ponens
9.	u	8, specialization
10.	$p \wedge u$	7, 9, conjunction
11.	t	3, 10, modus ponens

9. a)

i. $\forall p \in PM,\ L(p) \vee C(p)$

OR

$\forall p \in PM,\ L(p) \oplus C(p)$

ii. $\forall p \in PM,\ W(p) \rightarrow C(p)$

b)

i. No prime minister of Canada is/was a member of the Liberal and the Conservative Party

ii. Every prime minister of Canada who is not /was not a woman and is/was a member of the Liberal Party, does not like fishing

OR (assuming that not female means male):

Every male prime minister of Canada who is not /was a member of the Liberal Party, does not like fishing