

# CPSC 120 LOGIC EXERCISES (SOME SOLUTIONS)

(2)

P	q	$\neg p \wedge q$	$(\neg p \wedge q) \vee \neg q$ (b)	$\neg(\neg p \wedge q)$	$\neg q \vee q$	$\neg(\neg p \wedge q) \vee (\neg q \vee q)$ (c)
T	T	F	F	T	T	T
T	F	F	T	T	T	T
F	T	T	T	F	T	T
F	F	F	T	T	T	T

Tautology

(e)

P	q	r	$(p \wedge \neg r)$	$\neg q \vee r$	$(p \wedge \neg r) \wedge (\neg q \vee r)$
T	T	T	F	T	F
T	T	F	T	F	F
T	F	T	F	T	F
T	F	F	T	T	T
F	T	T	F	T	F
F	T	F	F	F	F
F	F	T	F	T	F
F	F	F	F	T	F

(4) (b)

P	q	$\neg p \wedge \neg q$	$\neg(\neg p \wedge \neg q)$	$p \vee q$
T	T	F	T	T
T	F	F	T	T
F	T	F	T	T
F	F	T	F	F

$\neg(\neg p \wedge \neg q) \equiv p \vee q$  because they have the same truth values for every case in the truth table.

ALSO  $\neg(\neg p \wedge \neg q) \equiv \neg(\neg p) \vee \neg(\neg q) \equiv p \vee q$  (By De Morgan's law)

4(e)

P	q	$P \wedge q$	$\neg(P \wedge q)$	$\neg(P \wedge q) \vee P$	$\neg(\neg(P \wedge q) \vee P)$
T	T	T	F	T	F
T	F	F	T	T	F
F	T	F	T	T	F
F	F	F	T	T	F

$\equiv \text{False}$  (always false - a contradiction)

6(e)  $\neg(\neg(P \wedge q) \vee P) \equiv (P \wedge q) \wedge \neg P$  (DeM.)  
 $\equiv (q \wedge P) \wedge \neg P$  Commutative Law  
 $\equiv q \wedge (P \wedge \neg P)$  Associative  
 $\equiv q \wedge \text{False} \equiv \text{False}$  (Negation and Identity)

(7) (a)  $\text{age} \geq 18 \ \&\& \ \text{age} \leq 21$

(b)  $\text{age} < 18 \ \&\& \ \text{age} > 10$

(d) ! answer.equals("Yes") && ! answer.equals("No")  
 OR ! ( answer.equals("Yes") || answer.equals("No") )

(f)  $\text{age} > 21 \ \&\& \ ( \text{discountCard} \ || \ \text{answer.equals("No")} )$

(8) (a)  $\text{age} < 18 \ \ || \ \ \text{age} > 21$

(b)  $\text{age} \geq 18 \ \ || \ \ \text{age} \leq 10$

(d)  $\text{answer.equals("Yes")} \ || \ \ \text{answer.equals("No")}$

(f)  $\text{age} \leq 21 \ \ || \ \ ( \ ! \ \text{discountCard} \ \&\& \ ! \ \text{answer.equals("No")} \ )$

(5) (b)  $P \vee (\neg P \wedge q) \equiv (P \vee \neg P) \wedge (P \vee q)$  (Distributive)  
 $\equiv \text{True} \wedge (P \vee q)$  (P or  $\neg P$  is always true)  
 $\equiv P \vee q$  (Identity)

(c)  $(P \wedge q \wedge \neg r) \vee (P \wedge q \wedge r) \equiv (P \wedge q) \wedge (\neg r \vee r)$  Distributive "Factor out P & q"  
 $\equiv (P \wedge q) \wedge \text{True} \equiv P \wedge q$