UNSW
SYDNEY

CANDIDATE

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TEST

Quiz 7

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Question	Status	Marks	Question type
1.1	Correct	1/1	Multiple Choice
1.2	Correct	1/1	Multiple Response
1.3	Correct	1/1	Multiple Response
1.4	Correct	1/1	True / False
1.5	Correct	1/1	Multiple Response
2.1	Correct	1/1	Multiple Response
2.2	Correct	1/1	Numeric Entry
2.3	Correct	1/1	Multiple Response
2.4	Correct	1/1	Multiple Response
2.5	Correct	1/1	Multiple Response

1.1 What is the value of
$(!x) \,||\, (y \,\&\&\, (x \,||\, z))$
when x=1, y=1 and z=0?

- None of these options
- 1 ✓
- 0

1.2 Assume {p,q} ⊆ Prop. Which of the following are well-formed formulas under the strictest definition given in lectures (i.e. no conventional omissions)?

Select all that apply:

- [x] ¬(p ∧ q) ✓
- [x] ((p ↔ q) ∨ (q ∧ ⊥)) ✓
- [x] ¬¬¬⊥ ✓
- [ ] (⊥ ∨ (¬⊤))
- [ ] p → ¬⊤

1.3 Which of the following propositional formulas are tautologies?

Select all that apply:

- [x] (¬p ↔ (p→⊥)) ✓
- [x] (¬p ∨ (⊤→p)) ✓
- [x] ((p ∧ q) → (p → q)) ✓
- [ ] (((p→q) ∧ (q→r)) ↔ (p→r))
- [ ] ((p → q) → (p ∧ q))

1.4 True or false:
$(p \wedge r), (q \rightarrow \neg p) \models (r \vee q)$
Select one alternative:

- (●) True ✓
- ( ) False

1.5 Which of the following are logically equivalent to: $(((a \rightarrow \bot) \wedge (b \rightarrow \bot)) \rightarrow \bot)$?
Select all that apply:

- [ ] $(a \leftrightarrow b)$
- [ ] $(a \rightarrow b)$
- [ ] None of the other options
- [ ] $(a \wedge b)$
- [x] $(a \vee b)$ ✓

2.1 Let $f:\{0,1\}^2 \rightarrow \{0,1\}$ be the following binary boolean function:

x	y	f(x,y)
0	0	1
0	1	0
1	0	0
1	1	0

Which of the following binary boolean functions are the same as g(x,y) = (x && y)?
Select all that apply:

- [ ] None of these options
- [ ] f(f(x,y), f(x,y))
- [x] f(f(x,x), f(y,y)) ✓
- [x] f(f(y,y), f(x,x)) ✓
- [ ] f(f(x,y), f(y,x))

2.2 The *minority function*, **minority**(x,y,z), is a 3-ary Boolean function that returns 1 if and only if at most one of x,y,z is 1.

How many minterms are there in the canonical DNF for minority? 4 ✓ .

How many clauses are there in an optimal DNF for **minority** (i.e. what is the minimum number of covering rectangles in a Karnaugh map for minority)? 3 ✓

2.3 Which of the following sets, operations and constants can be used to define a Boolean algebra?
Select all that apply:

- [ ] T = {n : n>0 and n|8}
  Meet: x∧y := gcd(x,y)
  Join: x∨y := lcm(x,y)
  Complement: x' := 8/x
  Zero: 1
  One: 8

- [x] T = {n : n>0 and n|30}
  Meet: x∧y := gcd(x,y)
  Join: x∨y := lcm(x,y)
  Complement: x' := 30/x
  Zero: 1
  One: 30

- [x] T = {X⊆ℕ : X is finite} ∪ {X⊆ℕ : ℕ\X is finite}
  Meet: x∧y := x∩y
  Join: x∨y := x∪y
  Complement: x' := ℕ\x
  Zero: ∅
  One: ℕ

- [x] T = Pow({a,b,c})
  Meet: x∧y := x∪y
  Join: x∨y := x∩y
  Complement: x' := {a,b,c}\x
  Zero: {a,b,c}
  One: ∅

- [ ] T = {0,1}
  Meet: x∧y := (xy)%2
  Join: x∨y := (x+y)%2
  Complement: x' := 1-x
  Zero: 0
  One: 1

- [ ] T = [0,7] ∩ ℕ
  Meet: x∧y := min(x,y)
  Join: x∨y := max(x,y)
  Complement: x' := 7-x
  Zero: 0
  One: 7

2.4 Let F represent the set of all well-formed formulas. Define the relation $R \subseteq F \times F$ as follows:

$(\varphi,\psi) \in R$ if and only if $\varphi \vDash \psi$

Which of the following properties does R satisfy?
Select all that apply:

- [ ] Anti-symmetric
- [x] Transitive ✓
- [ ] Symmetric
- [x] Reflexive ✓
- [ ] Anti-reflexive

2.5 Suppose $\theta,\psi \vDash \neg\varphi$.

Which of the following hold:
Select all that apply:

- [x] $\psi \vDash (\varphi \rightarrow \neg\theta)$ ✓
- [ ] $\vDash \varphi \rightarrow (\theta \rightarrow \psi)$
- [x] $\varphi \vDash \neg(\theta \wedge \psi)$ ✓
- [x] $(\theta \wedge \varphi) \vDash \neg\psi$ ✓
- [ ] $\vDash ((\neg\varphi \vee \theta) \vee \neg\psi)$