Subject 24.241 (Logic I) homework due in LEC #7.

1. Give sentences with the following truth tables:

(a)

A	B	C	
1	1	1	1
1	1	0	0
1	0	1	1
1	0	0	0
0	1	1	1
0	1	0	0
0	0	1	0
0	0	0	0

(b)

A	B	C	
1	1	1	0
1	1	0	0
1	0	1	1
1	0	0	1
0	1	1	0
0	1	0	0
0	0	1	0
0	0	0	0

(c)

A	B	C	
1	1	1	0
1	1	0	0
1	0	1	0
1	0	0	1
0	1	1	1
0	1	0	1
0	0	1	1
0	0	0	0

2. Give sentences in disjunctive normal form that are logically equivalent to each of the following
sentences:
(a) (P Ù (Q « R))
(b) ((P Ù Q) « R)
(c) ((P Ù Q) « (¬P Ú ¬Q)

3. A sentence is said to be in *conjunctive normal form* iff it is a conjunction of one or more sentences each of which is a disjunction of one or more atomic sentences and negated atomic sentences. Find a sentence in conjunctive normal form that is logically equivalent to "(P « (Q Ù R))." [Hint: First find a sentence in disjunctive normal form that is logically equivalent to the negation of the given sentence. Then apply de Morgan's laws repeatedly.]

4. Which of the following sets of connectives are expressively complete? Explain your answers:
(a) {"¬,""¬"}, where (φ ¬ ψ) is true iff φ is true or ψ is false
(b) {"¬,""®"}
(c) {"NAND"}, where (φ NAND ψ) is false iff φ and ψ are both true
(d) {"NOR"}, where (φ NOR ψ) is true iff neither φ nor ψ is true
(e) {"XOR"}, where (φ XOR ψ) is true iff φ is true or ψ is true but not both.

5. (a) Give a tautological substitution instance of "(P « (Q Ù R))."
(b) Give an inconsistent substitution instance of "(P « (Q Ù R))."
(c) Give an indeterminate substitution instance of "(P « (Q Ù R))."