CMPS205: In-class Exercise (1)

1. Write the negation of the following propositions:
   - Ahmed's PC runs Linux _____
   - Sami has a laptop _____
2. Write the English equivalent of the conjunction and the disjunction of the following propositions:

   p="Khalid's PC has more than 16 GB free hard disk space" and q = "The processor in Khalid's PC runs faster than 1 GHz."

3. Let p be the statement "Maria learns discrete mathematics" and q the statement "Maria will find a good job." Express the statement $p \rightarrow q$ as a statement in English.

4. What are the contrapositive, the converse, and the inverse of the conditional statement "If it is raining, then the home team wins".

   Contrapositive: _____

   Converse: _____

   Inverse: _____

5. Let p and q be the propositions

   p : It is below freezing.

   q : It is snowing.

   Write these propositions using p and q and logical connectives (including negations).

   a) It is below freezing and snowing. _____
   b) It is below freezing but not snowing. _____
   c) It is not below freezing and it is not snowing. _____
   d) It is either snowing or below freezing (or both). _____
   e) If it is below freezing, it is also snowing. _____

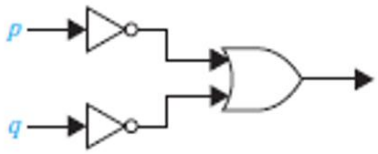
6. For each of these sentences, determine whether an inclusive or, or an exclusive or, is intended. Explain your answer.

   a) Experience with C++ or Java is required.
   b) Lunch includes soup or salad.
   c) To enter the country you need a passport or a voter registration card.

7. Determine whether these biconditionals are true or false.

   a) $2 + 2 = 4$ if and only if $1 + 1 = 2$. _____
   b) $1 + 1 = 2$ if and only if $2 + 3 = 4$. _____
   c) $1 + 1 = 3$ if and only if monkeys can fly. _____

8. Find the output of each of these combinatorial circuits.

a) 

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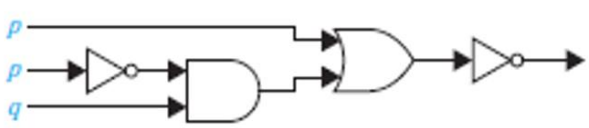
b) 

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9. Construct a combinatorial circuit using inverters, OR gates, and AND gates that produces the output $(p \wedge \neg r) \vee (\neg q \wedge r)$ from input bits p, q, and r.

10. Use De Morgan's laws to find the negation of each of the following statements.

a) Jan is rich and happy. _____

b) Carlos will bicycle or run tomorrow. _____

11. Show that each of these conditional statements is a tautology by using truth tables.

a) $[\neg p \wedge (p \vee q)] \rightarrow q$

b) $[(p \rightarrow q) \wedge (q \rightarrow r)] \rightarrow (p \rightarrow r)$

p	q	

p	q	r	

12. Show that $(p \wedge q) \rightarrow (p \vee q)$ is a tautology.