Assignment on Propositional Logic

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Section A: Multiple Choice Questions (MCQs) (2 Marks each)

(Choose the correct answer)

1. Which of the following is a tautology?
   a) $P \wedge \neg P$
   b) $P \vee \neg P$
   c) $P \wedge Q$
   d) $\neg(P \vee Q)$
2. What is the negation of $P \wedge Q$?
   a) $\neg P \vee \neg Q$
   b) $\neg P \wedge \neg Q$
   c) $\neg P \vee Q$
   d) $P \vee \neg Q$
3. Which of the following is not a well-formed formula?
   a) $P \wedge (Q \vee R)$
   b) $\neg(P \vee Q)$
   c) $\vee P \wedge Q$
   d) $(P \vee Q) \wedge R$
4. If $P \rightarrow Q$ and $\neg Q$ are true, which of the following must also be true?
   a) $\neg P$
   b) $P \wedge Q$
   c) $\neg Q \rightarrow \neg P$
   d) $P \vee Q$

[Total for Section A: 8 Marks]

Section B: Short Answer Questions (4 Marks each)

5. Write the truth table for the following expression:
   $(P \vee Q) \wedge (\neg P \vee Q)$.
6. Determine whether the following statement is a tautology, contradiction, or contingency:
   $(P \rightarrow Q) \leftrightarrow (\neg Q \rightarrow \neg P)$.
7. Rewrite the following formula in its equivalent conjunctive normal form (CNF):
   $\neg(P \rightarrow Q)$.

[Total for Section B: 12 Marks]

Section C: Long Answer Question (10 Marks)

8. Prove that the following proposition is a tautology by logically analyzing its components:
   $[(P \rightarrow Q) \wedge (\neg Q \rightarrow R)] \rightarrow (P \rightarrow R)$. **[Total for Section C: 10 Marks]**