#1 (10 points) (a) Complete the truth table

<table>
<thead>
<tr>
<th>p</th>
<th>q</th>
<th>r</th>
<th>¬q</th>
<th>p ∨ q</th>
<th>(p ∧ ¬q) → r</th>
<th>p ∨ q</th>
<th>q → p</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
<td>T</td>
<td>F</td>
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<td>F</td>
<td>T</td>
</tr>
</tbody>
</table>

(b) In the table, above, mark the critical rows & decide whether the following argument is valid or invalid:

- p ∧ ¬q → r
- p ∨ q
- q → p

Therefore r.

Answer: INVALID → row 2 has a contradiction

#2 (3 points) Show all work & simplify completely, \((p ∧ (¬(p ∨ q))) ∨ (p ∧ q)\) = \(T\)

\[
\begin{align*}
(p ∧ (¬(p ∨ q))) ∨ (p ∧ q) &= \frac{p ∧ (¬(p ∨ q))}{\text{Distributive Property}} \\
&= \frac{(p ∧ ¬p) ∨ (p ∧ q)}{\text{Identity Property}} \\
&= \frac{0 ∨ (p ∧ q)}{\text{Absorption Property}} \\
&= \frac{(p ∧ q)}{\text{Identity Property}} \\
&= p ∧ q
\end{align*}
\]

\([p ∧ (¬(p ∨ q))] ∨ (p ∧ q) = p ∧ (T) = p

#3 (7 points) "If Tom is Ann's father, then Jim is her uncle."

(a) Write the statement in symbols, p, q etc.

Answer: \(p → q\)

(b) Write the negation of the statement in part (a).

Simplify your answer: \(p ∧ ¬q\)

(c) Write the negation of the original statement in words.

Tom is Ann's father and Jim is not her uncle.

#4 (2 points) Circle the form of argument that has been used in the following argument:

Modus Ponens  Modus Tollens  Disjunctive Syllogism

You can pay by credit card or cash.
You don't pay cash.
Therefore: You pay by credit card.

#5 (8 points) Convert the number \((124)_5\) to a binary number. Show all work.

\[

table
\]

\[
\begin{align*}
(124)_5 &= 1 \times 5^2 + 2 \times 5^1 + 4 \times 5^0 \\
&= 25 + 10 + 4 \\
&= 39
\end{align*}
\]

\([100111]_2

#6 (8 points) Consider the statement: "If P and Q, then ¬R."

(a) Write the statement using symbols \(¬(p ∧ q) → ¬R\).

(b) Write, using symbols, the contrapositive of (a).

(c) Write the converse of (a) in symbols.

(d) Write the inverse of (a) in symbols.