1) Given the function

\[ X = A + \overline{B} \cdot C \]

Build a circuit out of switches:

That connects 1 to X, whenever X is true, and 0 to X, whenever X is false.
2) Prove that:
\[ A + \overline{B} \cdot C = (A + C) \cdot (A + \overline{B}) \]
   a) using a truth table
   b) using Venn diagrams.

3a) Prove that:
\[ (A \oplus B) \oplus C = A \oplus (B \oplus C) \]
   b) Generalize to:
\[ (A \oplus B \oplus C) \oplus D = A \oplus (B \oplus C \oplus D) \]
   c) Find the Karnaugh map
   at \[ A \oplus B \oplus C \oplus D \]
4) Given the following circuit:

![Circuit Diagram]

a) Find the truth table governing this circuit.

b) Find minimal realizations for Sum and Cout using and, or, not-gates.

c) Convert to an all-nand realization.

da) Convert to an all-nor realization.
5) Given the following truth table:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>X</td>
</tr>
</tbody>
</table>

← all other combinations →  X ← don't care

Find a minimal realization for the output variable F.