1. **Exclusive Or**
   For each of the following, decide whether inclusive-or or exclusive-or is intended:
   
   (a) Experience with C or Java is required.

   **Solution:**
   Inclusive Or.

   (b) Lunch includes soup or salad.

   **Solution:**
   Exclusive Or.

   (c) Publish or perish

   **Solution:**
   Exclusive Or.

   (d) To enter the country you need a passport or Global Entry card.

   **Solution:**
   Inclusive Or.

2. **Translations**
   For each of the following, define propositional variables and translate the sentences into logical notation.

   (a) I will remember to send you the address only if you send me an e-mail message.

   **Solution:**
   
   \[ p : \text{I will remember to send you the address} \]
   \[ q : \text{You send me an e-mail message} \]

   \[ p \rightarrow q \]

   (b) If berries are ripe along the trail, hiking is safe if and only if grizzly bears have not been seen in the area.

   **Solution:**

   \[ p : \text{Berries are ripe along the trail} \]
   \[ q : \text{Hiking is safe} \]
   \[ r : \text{Grizzly bears have not been seen in the area} \]

   \[ p \rightarrow (q \leftrightarrow r) \]

   (c) Unless I am trying to type something, my cat is either eating or sleeping.
Solution:

\( p : \) My cat is eating
\( q : \) My cat is sleeping
\( r : \) I’m trying to type

\[ \neg r \to (p \oplus q) \]

3. Teatime
Consider the following sentence:

If I am drinking tea then I am eating a cookie, or, if I am eating a cookie then I am drinking tea.

(a) Define propositional variables and translate the sentence into an expression in logical notation.

Solution:

\( p : \) I am drinking tea
\( q : \) I am eating a cookie

\[ (p \to q) \lor (q \to p) \]

(b) Fill out a truth table for your expression.

Solution:

<table>
<thead>
<tr>
<th>( p )</th>
<th>( q )</th>
<th>( p \to q )</th>
<th>( q \to p )</th>
<th>( (p \to q) \lor (q \to p) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>T</td>
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<tr>
<td>T</td>
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</table>

(c) Based on your truth table, classify the original sentence as a contingency, tautology, or contradiction.

Solution:

Tautology
4. Truth Tables
Write a truth table for each of the following:

(a) \((p ⊕ q) ∨ (p ⊕ ¬q)\)

Solution:

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

(b) \((p ∨ q) → (p ⊕ q)\)

Solution:

<table>
<thead>
<tr>
<th>(p)</th>
<th>(q)</th>
<th>(p ∨ q)</th>
<th>(p ⊕ q)</th>
<th>((p ∨ q) → (p ⊕ q))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(T)</td>
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</tr>
</tbody>
</table>

(c) \(p ↔ ¬p\)

Solution:

<table>
<thead>
<tr>
<th>(p)</th>
<th>(¬p)</th>
<th>(p ↔ ¬p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(T)</td>
<td>(F)</td>
<td>(F)</td>
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<tr>
<td>(F)</td>
<td>(T)</td>
<td>(F)</td>
</tr>
</tbody>
</table>

5. Non-equivalence
Prove that the following pairs of propositional formulae are not equivalent by finding inputs they differ on.

(a) \(p → q\) \quad q → p

Solution:
When \(p = T\) and \(q = F\), then \(p → q \equiv F\), but \(q → p \equiv T\).

(b) \(p → (q ∧ r)\) \quad (p → q) ∧ r

Solution:
When \(p = F\) and \(r = F\), then \(p → (q ∧ r) \equiv T\), but \((p → q) ∧ r \equiv F\).
6. Circuitous
Translate the following circuit into a logical expression.

Solution:
\[ \neg (\neg p \lor (p \land \neg q)) \]