1. Check the (single) box that best characterizes each item. [6 points]

\[ \forall x \in \mathbb{R}, (|x+5| \leq 5) \rightarrow (|x| \leq 100). \]

- true [✓] false undefined

\[ \neg (p \land \neg q) \equiv \neg p \land q \]

- true undefined false [✓]

\[ \neg (\forall x \ P(x) \rightarrow Q(x)) \equiv \exists x \ \neg (P(x) \land Q(x)) \]

- true undefined false [✓]

2. Predicates [12 points]

Suppose three predicates, \( C, D \) and \( O \) (standing for being a cat, a dog, or the name of an operating system) are defined over the universe \{Lion, Wolf, Fox, Puma, Jaguar\}, as follows (\( T \) denotes True and \( F \) denotes False).

<table>
<thead>
<tr>
<th>x</th>
<th>C(x)</th>
<th>D(x)</th>
<th>O(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lion</td>
<td>T</td>
<td>F</td>
<td>T</td>
</tr>
<tr>
<td>Wolf</td>
<td>F</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>Fox</td>
<td>F</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>Puma</td>
<td>T</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Jaguar</td>
<td>T</td>
<td>F</td>
<td>T</td>
</tr>
</tbody>
</table>

Select all the statements below that are true. (No justification is needed.)

- [✓] A. \( \forall x \ O(x) \rightarrow C(x) \).
- □ B. \( \exists x \ \neg (O(x) \rightarrow C(x)) \).
- [✓] C. \( \exists x \ D(x) \rightarrow O(x) \).
- [✓] D. \( \forall x \ \neg (C(x) \land D(x)) \).

Since \( C(\text{Lion}) \) and \( C(\text{Jaguar}) \).

This is the negation of A.

Consider \( x \) s.t. \( \neg D(x) \): say \( x = \text{Lion} \).

\( C \) and \( D \) are never simultaneously true.

3. Which of the following propositions is equivalent to the proposition \( p \)? [2 points]

- [✓] A. \( \neg p \rightarrow F \) (where \( F \) stands for false)
- □ B. \( p \rightarrow \neg p \)
- □ C. \( p \rightarrow F \)
1. Check the (single) box that best characterizes each item. [6 points]

\[ \exists x \in \mathbb{R}, (|x + 5| \leq 5) \land (|x| > 15). \]

- true □
- false ✓
- undefined □

\[ \neg(p \land \neg q) \equiv \neg p \land q \]

- true □
- false ✓

\[ \neg(\forall x P(x) \rightarrow Q(x)) \equiv \exists x P(x) \land \neg Q(x) \]

- true ✓
- false □

2. Predicates [12 points]

Suppose three predicates, \( C, D \) and \( O \) (standing for being a cat, a dog, or the name of an operating system) are defined over the universe \{Lion, Wolf, Fox, Puma, Jaguar\}, as follows (\( T \) denotes True and \( F \) denotes False).

<table>
<thead>
<tr>
<th></th>
<th>( C(x) )</th>
<th>( D(x) )</th>
<th>( O(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lion</td>
<td>( T )</td>
<td>( F )</td>
<td>( T )</td>
</tr>
<tr>
<td>Wolf</td>
<td>( F )</td>
<td>( T )</td>
<td>( F )</td>
</tr>
<tr>
<td>Fox</td>
<td>( F )</td>
<td>( T )</td>
<td>( F )</td>
</tr>
<tr>
<td>Puma</td>
<td>( T )</td>
<td>( F )</td>
<td>( F )</td>
</tr>
<tr>
<td>Jaguar</td>
<td>( T )</td>
<td>( F )</td>
<td>( T )</td>
</tr>
</tbody>
</table>

Select all the statements below that are true. (No justification is needed.)

- A. \( \exists x D(x) \rightarrow O(x) \). Consider \( x \) s.t. \( \neg D(x) \): say \( x = \) Lion.

- B. \( \forall x O(x) \rightarrow C(x) \). Since \( C(\text{Lion}) \) and \( C(\text{Jaguar}) \).

- D. \( \forall x \neg(C(x) \land D(x)) \). \( C \) and \( D \) are never simultaneously true.

- C. \( \exists x \neg(O(x) \rightarrow C(x)) \). This is the negation of A.

3. Which of the following propositions is equivalent to the proposition \( p \)? [2 points]

- A. \( p \rightarrow F \) (where \( F \) stands for false)

- B. \( p \rightarrow \neg p \)

- C. \( \neg p \rightarrow p \)