Negations

<table>
<thead>
<tr>
<th>All</th>
<th>At least one does not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some do</td>
<td>None</td>
</tr>
<tr>
<td>Some do not</td>
<td>All</td>
</tr>
<tr>
<td>None</td>
<td>Some do</td>
</tr>
</tbody>
</table>

ex. p: Some people eat pancakes.

\[\sim p:\]

ex. p: \( \exists \text{ person } x, \; x \text{ eats pancakes.} \)

\[\sim p:\]

ex. q: \(3x - 7y \geq 21\)

\[\sim q:\]
ex. r: \( \forall x \in R, \text{ if } x > 2, \text{ then } x^2 > 4. \)

\( \sim r \) : 

Do: Write the negations of the following statements.
D = \{ -8, -6, -4, -2, 0, 1, 2, 3, 4 \}

1. \( \forall x \in D, \text{ if } x < 0, x \text{ is even.} \)

2. \( 3x = 7 \) \hspace{1cm} (Write using quantifiers.)

3. \( \sin^2 x + \cos^2 x = 1 \) \hspace{1cm} (Write using quantifiers.)
Vacuous Truth of Universal Statements

A statement of the form $\forall x \in D, \text{ if } P(x), \text{ then } Q(x)$ is called vacuously true if and only if $P(x)$ is false for every $x \in D$. (Remember that $F \rightarrow T$ or $F$ is true.)

ex. Suppose there are no balls in a bowl. The statement “All the balls in the bowl are blue” is vacuously true. You can also check that its negation is false. “There exists at least one ball in the bowl that is not blue.”
Conditional: $\forall x \in A, \text{ if } p, \text{ then } q$

Converse, inverse and contrapositive the same as previously defined.

ex. If $x + 3 = 7$, then $2x = 8$.

Contrapositive:

Negation:

ex. Having a password is a necessary condition for logging onto the server.

ex. I will remember to send you the address only if you send me an e-mail message.
Do. Write the negation.

1. Listening intently in class is a sufficient condition for being able to do the homework.

2. x divides 8 if y divides 6.