Discuss these with your partner(s)

1. Rewrite the following statements formally as a predicate with a quantifier. Be certain to define the domain. Then write formal and informal negations.
   (a) There is a professor at Wheaton who went to graduate school at Northwestern.
   (b) All customers must wear shoes.

2. Consider the statement: $\forall\, x \in \mathbb{R},$ if $x^2 > 9$ then $x > 3$ or $x < -3$
   Write the negation,
   the converse,
   the inverse, and
   the contrapositive.
   Indicate which are true and which are false.

3. Determine the truth of each of the following.
   (a) $\forall\, x \in \mathbb{R}, \forall\, y \in \mathbb{R}, x + y = y + x$
   (b) $\exists\, x \in \mathbb{N}, \exists\, y \in \mathbb{N}$ such that $x + y = 5$
   (c) $\forall\, x \in \mathbb{R}, \forall\, y \in \mathbb{R}, x + y = 5$
   (d) $\forall\, x \in \mathbb{Z}, \exists\, y \in \mathbb{Z}$ such that $x + y = 5$
   (e) $\exists\, x \in \mathbb{Z}$ such that $\forall\, y \in \mathbb{Z}, x + y = y$

   From Rachelle DeCoste

4. For each of the following, rewrite the statement in English without $\forall$ or $\exists$ or variables, as simply as possible. Then write the negation.
   (a) $\exists$ a book b such that $\forall$ people p, p has read b
   (b) $\forall\, x \in \mathbb{N}, \exists\, y \in \mathbb{Q}$ such that $x \cdot y = 1$

   Epp, Exercise 3.3.14