Homework 4

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a) Simplification
b) Disjunctive syllogism
c) Modus ponens
d) Addition
e) Hypothetical syllogism

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a) Statement is invalid. a = -1 serves as a counterexample.
b) Valid by modus ponens

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There is an error at step 3. It is not possible to use the simplification rule since you would need $P(c) \land Q(c)$ not $P(c) \lor Q(c)$. A similar error is made on step 5. Another error exists on step 7. Using the conjunction rule would result in $\forall x(P(x) \land Q(x))$ not $\forall x(P(x) \lor Q(x))$.