1. **Claim**:
`(append (append xs ys) zs) = (append xs (append ys zs))`

Proof: We will prove this by induction on the set `xs`

Base Case: `xs = '()`

```
(append (append xs ys) zs)
= {Append-nil Law}
(append ys zs)
= {Append-nil Law, right to left}
(append '() (append ys zs))
= {Base case assumption}
(append xs (append ys zs))
```

Inductive Hypothesis: Assume the statement is true for some `xs'`:
`(append (append xs' ys) zs) = (append xs' (append ys zs))`

Now we prove that it is true for `xs = (cons x xs')`:

```
(append (append xs ys) zs)
= {Definition of xs}
(append (append (cons x xs') ys) zs)
= {append-cons law}
(append (cons x (append xs' ys)) zs)
={append-cons law}
(cons x (append (append xs' ys) zs))
={Inductive Hypothesis}
(cons x (append xs' (append ys zs)))
={append-cons law, right to left}
(append (cons x xs') (append ys zs))
={Definition of xs}
(append xs (append ys zs))
```

Thus, we have proven the statement is true for xs = (cons x xs'), so the claim is always true. QED