Proof by induction over \( n \).

Base case: \( n = 0 \). Left and right hand sides are both 0, so equation holds.

Induction case. Suppose as induction hypothesis (IH) that the equation is true for some \( n \), i.e.
\[
\sum_{i=0}^{n} i(i+1) = \frac{n(n+1)(n+2)}{3}.
\]

We must show that \( \sum_{i=0}^{n+1} i(i+1) = \frac{(n+1)(n+2)(n+3)}{3} \).

We have
\[
\sum_{i=0}^{n+1} i(i+1) = \text{(splitting off last term)}
\]
\[
\sum_{i=0}^{n} i(i+1) + (n + 1)(n + 2) = \text{(by IH)}
\]
\[
\frac{n(n+1)(n+2)}{3} + (n + 1)(n + 2) = \text{(forming common denominator)}
\]
\[
\frac{n(n+1)(n+2) + 3(n+1)(n+2)}{3} = \text{(regrouping)}
\]
\[
\frac{(n+3)(n+1)(n+2)}{3} = \text{(reordering)}
\]
\[
\frac{(n+1)(n+2)(n+3)}{3}
\]
as desired.

2. We need to make (implicit or explicit) use of the definition of \( \subseteq \), namely that if \( T \subseteq U \), then \( x \in T \implies x \in U \).

The three defining properties of a partial order follow easily.

- Reflexivity. For any set, it is immediate that \( T \subseteq T \).
- Transitivity. If \( T \subseteq U \) and \( U \subseteq V \), then any element of \( T \) must be in \( U \) and hence also in \( V \), so \( T \subseteq V \).
- Antisymmetry. If \( T \subseteq U \) and \( U \subseteq T \), then every element of \( T \) must be in \( U \) and vice-versa, so indeed \( T = U \).

3. Here’s an OCaml solution:

```ocaml
type exp =
  | True
  | False
  | And of exp * exp
  | Or of exp * exp
  | Not of exp

let rec eval e = match e with
  | True -> true
  | False -> false
  | And(e1,e2) -> eval e1 && eval e2
  | Or(e1,e2) -> eval e1 || eval e2
  | Not e -> not (eval e)
```