1. (Finite State Machine)

(a) (Verification) The annotated machine is shown below. The predicates to be proven are, one corresponding to each transition:

```
p(ε)
p(x) ⇒ q(x0)
p(x) ⇒ p(x1)
q(x) ⇒ ¬p(x0)
q(x) ⇒ p(x1)
¬p(x) ⇒ ¬p(x0)
¬p(x) ⇒ ¬p(x1)
```

(b) (Finite State Transducer)

(c) (Regular Expression)

\(ε, 0, 1, 00, 10, 11\).

2. (Recursion and Induction)

(a) \(\text{between } x \ y \ z = ((\min \ y \ z) < x) \& \& (x < (\max \ y \ z))\)

(b) \(\text{unequal } [x] = \text{False}\)

\(\text{unequal } (x: \ (y: \ xs)) = (x /= y) \ | \ | \ (\text{unequal } (y: \ xs))\)

(c) \(\text{zip } ([], []) = []\)

\(\text{zip } ((x:xs), (y: \ ys)) = (x,y): \text{zip } (xs,ys)\)

(d) \(\text{unzip } [] = ([], [])\)

\(\text{unzip } ((x,y): \ xyss) = ((x:xs), \ (y: \ ys))\)

\(\text{where } (xs, \ ys) = \text{unzip } xyss\)