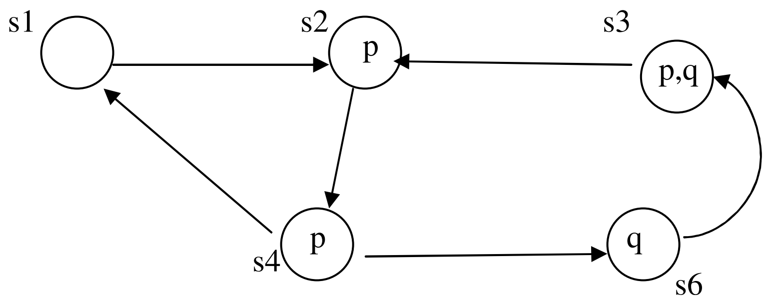
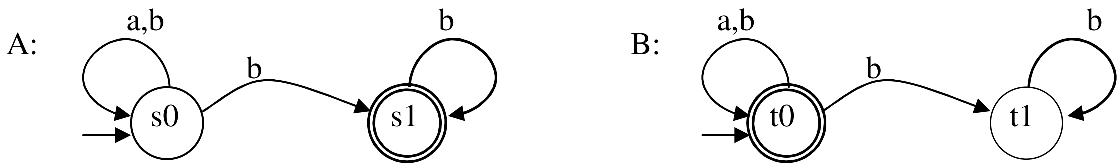
1. **[2 points]** Use the *labelling algorithm* to find the states of the following transition system that satisfy the CTL formula AXE[p U q]:



2. **[2,5 points]** Consider the following two Büchi automata:



   a) What infinite language is recognized by the leftmost automaton A?
   b) Construct a Büchi automaton recognizing the $L_\omega(A) \cap L_\omega(B)$. Is this language empty?

3. **[1 point]** For each of the following pairs of CTL formulae exhibit a model in which one formula is true but not the other:
   a) $AF(p \wedge q)$ and $AFp \wedge AFq$
   b) A[p U q] and A[p W q]

4. **[1 point]** Let σ be a state such that with σ (x) = 0 and σ(y) = 1. Give a derivation to determine the final state σ' of the command `x:=y+1; y:=x+1` when starting from the initial state σ.

5. **[1 point]** For each of the following cases, give an example of a command C that satisfies the Hoare triple for total correctness, or argue why such an example does not exist:
   a) {true } C {true}
   b) {true} C {false}
   c) {false} C {true}
   d) {false} C {false}

6. **[2,5 points]** Consider the following Hoare triple of a command computing the absolute value of the difference of two positive integers n and m:

```
{true}
 z := 0;
 if (m > n) then
      while (m – z ≠ n) do z := z + 1 od
 else
      while (m + z  ≠ n) do z := z + 1 od
 fi
{z = |m – n|}
```

   a) Give a proof outline for *partial* correctness.
   b) Give a proof outline for *total* correctness.

The final score is given by the sum of the points obtained.