2005 Paper 9 Question 10

Types

Give a polymorphic lambda calculus (PLC) type $list_\alpha$ that contains a single free type variable α and which corresponds to the ML datatype of polymorphic lists:

```
datatype 'a list = Nil | Cons of 'a * ('a list)
```

[2 marks]

Give PLC expressions *Nil*, *Cons* and *iter* of appropriate types that encode the ML constructors `Nil` and `Cons` and the ML function `iter` given by

```
fun iter x f Nil = x
  | iter x f (Cons(h, t)) = f h (iter x f t)
```

You should prove the PLC typings you claim for these expressions.   [13 marks]

Show that *iter* has β-conversion properties corresponding to the above declaration of the ML function `iter`.   [5 marks]