1994 Paper 1 Question 5

Study the following ML function definitions and answer the questions below:

```
fun prefix   [ ]      [ ]   = [ ]
  | prefix (x::xs) (y::ys) = (x::y)::prefix xs ys;

fun sep [ ]            = [[ ], [ ]]
  | sep [x]            = [[x], [ ]]
  | sep (x::y::rest) = prefix [x,y] (sep rest);

fun merge[[ ],y]           = y : int list
  | merge[x,[ ]]        = x
  | merge[x::xs, y::ys)] =
     if x<y then x :: merge[   xs, y::ys]
            else y :: merge[x::xs,    ys];

fun s [ ] = [ ]
  | s [x] = [x]
  | s   x  = merge (map s (sep x));
```

Deduce the ML type of the function `prefix` and derive the result of the call:

```
 prefix [1, 2, 3] [[4], [5], [6]];
```

[2 marks]

Give a correctly-typed call to `prefix` that will generate an exception when evaluated. [2 marks]

What values do `sep[1,2,3,4,5,6,7,8]` and `sep[1,2,3,4,5,6,7]` yield?
[4 marks]

Deduce the ML type of `merge` and explain why the omission of '`: int list`' would lead to an error [2 marks]

Give an ML definition of the standard library function `map`. [2 marks]

Describe what the function `s` does and explain why it works. [8 marks]