Answer two questions from section A, and four questions from section B. Questions from section A carry 25 marks each, while questions in section B carry $12\frac{1}{2}$ marks each. Students are allowed to use course notes, books and calculators.
Section B: Functional Programming

4. Consider the following type class:

   class QueueInt a where
     enqueue :: Int -> a -> a
     -- add an integer to the end of the queue
     dequeue :: a -> (Int, a)
     -- remove the integer at the front of a queue

Show your understanding by making [Integer] an instance of QueueInt.

5. Consider the following datatypes:

   data Unit = Kg | G | L | Ml
               -- kilograms, grams, litres, millilitres

   data Amount = Amount Float Unit

   data Ingredient = Sugar | Milk | Water | ...

   data Recipe =
                 PutIn Ingredient Amount
                | Mix Recipe Recipe

Write a function which, given a recipe, returns the same recipe but with only grams and millilitres used as units.

6. Consider the following type synonyms:

   type Line = String
   type Text = [Line]

A piece of text is represented as a list of lines, each of which is a string.
Define a function nextTo, which given two pieces of text, returns a new piece of text where the $i$th line is the catenation of the $i$th line of the first text and the $i$th line of the second text. For example:
abcd
ef
g

The above text can be placed next to:

hij
k

to give:

abcdhij
efk
g

7. Give the type and explain the value of \texttt{mystery} defined as:

\texttt{mystery} = 1: \texttt{map (2*) mystery}

8. Give the type of the following functions:

\texttt{typewriter1} \hspace{1em} x \hspace{1em} y = x ++ \texttt{concat} \hspace{1em} ys

\texttt{typewriter2} \hspace{1em} [] \hspace{1em} y = [y]
\texttt{typewriter2} \hspace{1em} (x:xs) \hspace{1em} y = \texttt{show} \hspace{1em} x: \texttt{typewriter2} \hspace{1em} xs \hspace{1em} y