



12.3 Lists in functional programming

Name: _____

Class: _____

Date: _____

Time: **21 minutes**

Marks: **15 marks**

Comments:

Q1.

In a functional programming language, four functions named `fw`, `fx`, `fy` and `fz` and a list named `sales` are defined as shown in the figure below.

```
fw [a,b] = a * b
fx c = map fw c
fy d = fold (+) 0 d
fz e = fy (fx e)

sales = [[10,2], [2,25], [4,8]]
```

The `sales` list represents all of the sales made in a shop in 1 day. It is composed of sublists.

The values in each sublist indicate the price of a product and the quantity of the product that was sold. For example, `[10,2]` indicates that 10 units of a product priced at £2 were sold.

- (a) Shade **one** lozenge to indicate how many of the four functions (`fw`, `fx`, `fy`, `fz`) in the figure above use a higher-order function.

1	<input type="radio"/>	2	<input type="radio"/>	3	<input type="radio"/>	4	<input type="radio"/>
---	-----------------------	---	-----------------------	---	-----------------------	---	-----------------------

(1)

- (b) Calculate the results of making the function calls listed in the table below, using the functions and lists in the figure above as appropriate.

Function call	Result
<code>fw [4,3]</code>	
<code>fx sales</code>	
<code>fz sales</code>	

(3)

- (c) In the context of the shop, explain what the result of the function call `fz sales` represents.

(1)

(Total 5 marks)

Q2.

In a functional programming language a function named `square` and three lists `a`, `b` and `c` are defined as follows.

```
square x = x * x

a = [1, 3, 5]
b = [1, 5, 10, 15]
```

`c = [9, 7, 2]`

- (a) What is the list or value that is the result of applying the functions `head(tail(tail b))`?

_____ (1)

- (b) Calculate the results of making the function calls listed in **Table 1** with the lists `a`, `b` and `c` above.

Table 1

Function Call	Result
<code>map square a</code>	
<code>filter (<10) b</code>	
<code>fold (+) 0 c</code>	

(3)

- (c) `map` is an example of a higher-order function.

Explain what a higher-order function is.

(1)

(Total 5 marks)

EXAM PAPERS PRACTICE

Q3.

In a functional programming language, a recursively defined function named `map` and a function named `double` are defined as follows:

```
map f []      = []
map f (x:xs)  = f x : map f xs

double x      = 2 * x
```

The function `map` has two parameters, a function `f`, and a list that is either empty (indicated as `[]`), or non-empty, in which case it is expressed as `(x:xs)` in which `x` is the head and `xs` is the tail, which is itself a list.

- (a) In **Table 1**, write the value(s) that are the head and tail of the list `[1, 2, 3, 4]`.

Table 1

Head	
------	--

Tail	
------	--

- (b) The result of making the function call `double 3` is 6.

(1)

Calculate the result of making the function call listed in **Table 2**.

Table 2

Function Call	Result
<code>map double [1, 2, 3, 4]</code>	

(1)

- (c) Explain how you arrived at your answer to part (b) and the recursive steps that you followed.

(3)

(Total 5 marks)

EXAM PAPERS PRACTICE