University of Leeds **School of Computing**
Procedural Programming COMP1711
Semester 1, 2017-2018

Individual Mini-Project 1

(Covers Assignments 1, 2, and 3)

20 Marks
To be submitted before 5pm 27/10/2017

The Brief

You will write a program for a water company. The program calculates and prints water bills for different customers. It also computes and prints summary reports about the company's business.

The Details

The Problem

To encourage customers to save water without penalizing low consumers, a water company has introduced an incremental tariff system. In this system, the price (tariff) of one cubic meter of water increases with increased consumption. To compute water charges, the overall quarterly consumption of a customer is divided into bands, with consumption at higher bands charged a higher unit price than consumption at lower bands, as shown in the following table:

Band No.	Water Consumption Range (m^3)	Unit Price (£/m^3)
1	1 – 5	0.20
2	6 – 12	0.35
3	13 - 25	0.5
4	26 - 40	0.75
5	Above 40	2.5

Examples:

1. A customer consumed $3m^3$ in one quarter.
The total consumption of this customer is in band 1, hence they pay:
water charge = 3 * 0.2 = £0.6

2. A customer consumed $14m^3$ in one quarter.
This customer has reached band 3, hence they pay £0.2 for each of the 5 cubic meters in band 1, £0.35 for each of the 7 cubic meters in band 2, and £0.35 for each of the 2 cubic meters they consumed in band 3:
water charge = 5 * 0.2 + 7 * 0.35 + 2 * 0.5 = £4.45

3. A customer consumed 41 m^3 in one quarter.
water charge=5*0.2 + (12-5)*0.35 + (25-12)*0.5 + (40-25)*0.75 + (41-40)*2.5= £23.7

In addition to the cost of fresh water, a customer is also charged for processing waste water that returns to the sewerage system. The company estimates the amount of water that returns to public sewer at 95% of the total fresh water consumption. The charge for waste water is £0.25/m^3.

Also, customers have to pay a fixed fee of £10 per quarter for processing surface water (e.g. rain water) that drains to the public sewer from their property. Finally, each customer is charged a fixed daily (standing) charge of £0.10 per day.

In addition to domestic customers, the company also serves commercial customers. These customers pay the maximum tariff (of band 5) on all of their consumption. Commercial customers also pay waste water charges at £2/m^3, a surface water charge of £50 per quarter, and a standing charge of £1.30 per day.

Commercial customers have to pay value added tax (VAT) at a rate of 20% on the total amount of the bill, but domestic customers are exempt from VAT.

For simplicity, assume that there are exactly 91 days in one quarter.

Note: The above rates are hypothetical, so please do not use them to compare with your water provider!

The Task

Write a C program that can be used by the above company to:
1) Compute and print the bill for any customer.
2) Compute the following quarterly sums and statistics:
   A. The total amount of fresh water consumed by all customers.
   B. The total amount of fresh water consumed by domestic customers.
   C. The total amount of revenue from all the bills (this should not include collected VAT since this must be forwarded to the government).
   D. The total cost of providing water to customers. Assume that one cubic meter of water costs the company an average of £1 (this covers everything including fresh and waste water processing, pumping, maintenance, wages, advertising, …etc.).
   E. The profit (or loss!) of the company (profit = revenue – cost)
   F. The income tax the company has to pay to the government assuming an income tax rate of 25%.
   G. The average domestic consumer bill.
   H. The maximum domestic consumer bill.

The program should be menu driven, i.e. when you run the program a menu similar to this one should appear:

```
1. Compute and Print the Bill for a Customer
2. Show Sums and Statistics
3. Quit the program

Please enter your choice (1, 2, or 3):
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The program waits for the user to enter the number of an option. If the user enters 1, the program

prompts the user to enter the total amount of quarterly water consumption of a customer, and the type of this customer (domestic or commercial). The program then computes the bill and display its details on the screen. The bill details should include the following:

- Type of customer (domestic or commercial)
- Amount of fresh water consumption
- Fresh water charges
- Waste water charges
- Surface water charges
- Standing charges
- Amount of VAT (if applicable)
- Total amount to pay

After 'printing' the bill the program, displays the menu again and wait for the user to enter a choice. If the user selects choice number 2, the program displays the sums and statistics mentioned above, and redisplays the menu. Finally to quit the program the user enters 3.

General Guidelines

- In this program you will be using the following C statements only:
  - Variable declaration statements
  - The printf and scanf functions
  - Assignment statements
  - Conditional 'if else' statements
  - Loops
- Please do **NOT** use arrays, structs, functions, or pointers even if you are already familiar with them.
- Write the program in standard C. If you write your code in any other language, it will NOT be assessed and you will get a zero mark.
- This is an individual project, and you are not supposed to work in groups or pairs with other students.
- Be aware that plagiarism in your code will earn you a zero mark and will have very serious consequences. It is much better to submit your own partially finished work, than to fall into the trap of plagiarism.

To simplify program development, you can write your code in iterations. In the first iteration you simply write the code that displays the menu, prompts the user to enter a choice then process the user input. In this iteration, the program could simple display the message "This option is not yet implemented" when the user chooses options 1 or 2.
Once you are satisfied that the menu system is working properly, you can add the code for option 1. This code reads input data (customer type and water consumption) then computes and displays the bill. You should test this code with some input data, and compare the program output with manual calculations.
In the third and final iteration, you will add the code to compute the various sums. It might be easier to add the code for each type of sum and check the results before implementing the next one. Notice that the sums are actually updated every time a new bill is generated, but they are only displayed when the user chooses option 2.

<u>You will be provided with a set of input data and the corresponding program output so that you can test your program with confidence.</u>

Marking Scheme

The program displays the menu and process user options correctly (1 mark)
The program computes domestic bills correctly (5 marks)
The program computes commercial bills correctly (1 mark)
The program computes the following values correctly: (8 marks, 1 mark each)

- The total amount of fresh water consumed by all customers.
- The total amount of fresh water consumed by domestic customers.
- The total amount of revenue from all bills.
- The total cost of providing water to customers.
- The profit (or loss!) of the company.
- The income tax the company has to pay to the government.
- The average domestic consumer bill.
- The maximum domestic consumer bill.

The program is well structured, clear, and efficient (2 marks)
The program uses comments properly (1 marks)
2 marks for students who add useful and creative extra functionality to the above (e.g. more useful sums or statistics).