Lab 4

CAGloW (Cyclists Against Global Warming) is working with potential sponsors of legislation to require car owners to pay fees to offset the carbon dioxide production of their vehicles. These sponsors are concerned that CAGloW's original proposal, based on a fee calculated using miles driven and average fuel economy, will adversely affect low-income car owners (who tend to drive older and less fuel-efficient vehicles) and will generate fees that will be ignored by wealthy car owners. They want to explore options to make the carbon dioxide offset fee more progressive. Your job is to write a program that will let them explore different combinations of fee calculation.

Objectives:
1. Develop an outline (design) for the program and bring that with you to lab (you must have a hard copy of your outline when lab begins).
2. Convert the outline to your second original C program
3. Become familiar with use of programmer-defined functions and if-else statements.
4. Practice good style: commenting, indenting blocks appropriately, good identifier names, etc.
5. Enter your program into Visual Studio, compile and debug it.

Part 1: Design the Program
Program Description:
As in Lab 3, use the US Environmental Protection Agency estimate of 8,887 grams of carbon dioxide produced per gallon of gas used, and a tentative fee of $1.00 for each kilogram of carbon dioxide produced. Legislators want to adjust the fee to be paid based on the family income (FI) of the car owner: an owner with a FI below the Federal poverty level for a family of four ($23,850 in 2014, the most recent year for which full data are available) will pay no fee; an owner with a FI up to twice the Federal poverty level will pay 50% of the calculated fee; an owner with a FI greater than twice the poverty level but not greater than twice the median family income in California (which was $71,015 in 2014) will pay the calculated fee; an owner with a FI not greater than three times the median family income will pay 200% of the calculated fee; an owner with a FI not greater than four times the median family income will pay 300% of the calculated fee; and an owner with a FI greater than four times the median family income will pay 400% of the calculated fee.

Your solution **MUST** use a programmer-defined function to calculate and return the number of grams of carbon dioxide generated. Your program **MUST** use a different programmer-defined function to calculate and return the fee.

Write a program that:

1. Uses the printf ( ) C statement to prompt the user to enter the number of miles driven each year, the average gas mileage of the vehicle, and the owner's family income.

2. Uses the scanf ( ) C statement to read the values typed by the vehicle owner into your program into appropriately named variables.

3. Invokes the first function to calculate the fee (what parameters will this function need?).

4. Invokes the second function to calculate the fee to be paid (what parameters will this function need?).

5. Prints out the number of kilograms of carbon dioxide generated, and the fee.

Analyze and Design your program.

1. Analyze this program description.

2. Determine the variables and algorithms/equations needed to calculate the desired results.

3. Test your algorithm/equations on paper to validate your design.

4. Create an outline of your program structure, which you will include as a large comment at the beginning of your program.

Part 2. Implement the program you designed

Write your C program and test/debug it.

1. Open up VS and Create a new **Project**

2. This will be a **console program** in C

3. Type in your program using good style practices

4. Test and debug your program using a range of values for miles driven, fuel economy, and family income that will test all the calculations your program should perform. At a minimum, your test data must include these situations:

miles	mpg	family income
10,100	17.1	$21,346
13,001	33.4	$36,495
16,588	27.6	$106,932
14,105	24.7	$225,000
5,109	11.3	$500,000

5. Submit the source program files to Camino

Please start each Lab with a descriptive block that includes minimally the following information:

```
/* Name: <your name>
Date: <due date> (the day you have lab)
Title: Carbon dioxide fee calculation
File: Lab3
Description:
```

```
This program computes … <you should
complete an appropriate description here.>
*/
```

Part 3. Modify your program
The legislators feel the fee increases will not adequately incent higher income car owners. Change your program so owners with incomes in the 300% fee category will instead pay 450% of the calculated fee, and owners in the top category will pay 1000% of the calculated fee. Run your program again.

Extra credit
Electric vehicle owners heave heard of this plan and are vocally opposing having to pay for carbon dioxide offsets. However, some of the sources of electric power they use to charge their vehicle do generate carbon dioxide. Allow a vehicle owner to enter either 'G' for a gasoline-powered vehicle, 'D' for a diesel-powered vehicle, or 'E' for an electric vehicle. Electric vehicles will only pay 10% of the calculated fee. Run your program again with the second and fourth vehicles as electric vehicles.

Requirements to complete the lab
1. Give the TA a copy of your program design outline at the very beginning of lab.
2. You must show the TA correct execution of the program you wrote for Part 2.
3. You must show the TA correct execution of the modified program for Part 3.
4. If you did the extra credit, you must show the TA correct execution of the modified program for the extra credit portion.
5. Submit source code for both programs online through Camino.

Be sure to retain copies (machine and/or printed) of your program source code. You will want these for study purposes and to resolve any grading questions (should they arise).