Please show your work or describe your reasoning. Do not simply mark an answer without explanation.

NOTE: there are problems on the back of this sheet!

Problem 1: Linear models

A linear model is an equation designed to explain experimental data, having the form

$$\hat{y} = a_1 f_1(x) + a_2 f_2(x) + a_3 f_3(x) + \cdots$$

For n data points (x, y), the equation above can be written as a matrix equation with n rows for the model predictions $\hat{y}_i$ as $X\vec{a} = \hat{y}$. The "best-fit" coefficients $a_1, a_2, \ldots$ are found by solving the matrix equation:

$$X^T X \vec{a} = X^T y$$

where y are the observed values and $\hat{y}$ are the predicted values from the model.

(a) Consider a linear model of the form $\hat{y} = a_1 x + a_2 \sin\left(\frac{\pi x}{2}\right)$. For the following experimental data, find the matrix X.

x	y
0	0.1
1	1.5
2	1.5
3	1.25

(b) Setup, **but do not solve**, the system of equations $X^T X a = X^T y$ (i.e. calculate the matrix $X^T X$ and the vector $X^T y$.

Problem 2: for and while loops

Assume that the Workspace has been cleared. Write a program using a for loop which produces the same output.

Original MATLAB Code:	Your MATLAB code:

``matlab
n = 2;
 	
while n < 5
 	
    n = n + 1;
 	
    disp(n)
 	
end
 	
disp(n)
``	

Problem 3: while loops

Assume that the workspace and command window have been cleared. What is the output from the following script? **Remember, only the lines highlighted in grey will produce output.**

MATLAB Code	Output

``matlab
d = 1;
f = 120;
 	
while f > 1
    f = f / d
    d = d + 1;
end
 	
f
d
``	

List one concept that confuses you, or one question you would like me to answer