General Instructions

Due Date:
Saturday, January 28 at 11pm (submit via blackboard)

Assignment Summary Instructions:
This assignment has four problems summarized below. You will use MATLAB as tool to solve the problems for the given test cases provided and that it is flexible for any additional test case that might be used to evaluate your code.

- Problem #1: Weight of rod (algorithm provided)
- Problem #2: Motor lift (algorithm provided)
- Problem #3: Stove-top efficiency
- Problem #4: Pressure Estimation

Submission Instructions:
You will submit a **.zip file** that will contain the following files:
1. **.m file – Matlab file (separate sections using %% for each problem)**. Your final script should be in the zipped folder and named as **MA#_USERNAME.m (for example, MA1_dwburles.m).**
2. .pdf file - scan of your algorithm sheet (use the template) for Problem #3
3. .pdf - scan of your algorithm sheet (use the template) for Problem #4

Submit your **.zip file** to blackboard using the Mastery Assignment 1 link. Your final submission should be a zipped folder named as **MA#_USERNAME.zip (for example, MA1_dwburles.zip).** The file must be completely submit before 11pm on January 28 for credit. **No late work is accepted and will result in a zero on the assignment**. It is your responsibility to make sure the file is completely submitted prior to the deadline. You are provided 2 upload opportunities in case your first upload is incomplete or a mistake.

Academic Honesty Reminder:

The work you submit for this assignment should be your work alone. You are encouraged to support one another through collaboration in brainstorming approaches to the problem and troubleshooting. **However, all support should be only verbal in nature**. Sharing files and showing other students your file is considered physical and visual help and is considered an academic honesty violation.

Some examples of academic misconduct in ENGI 1331 include but are not limited to the following actions:
1. Picking up and using or discarding another student's written or computer output;
2. Using the computer account of another student;
3. Representing as one's own the work of another on assignments, quizzes, and projects;
4. Giving another student a copy of one's work on an assignment before the due date.
5. Copying work from online resources (Chegg, google forums, etc.)
6. Posting work to online resources where other students can view your work

This assignment will be checked for similarity using a MATLAB code. The similarity code will check each submission for likeness between other student submissions, past student submissions, the solution manual, and online resources and postings. If your submission is flagged for a high level of similarity, it will be review by the ENGI 1331 faculty, and then it will be turned in for an academic honesty violation if deemed appropriate.

NOTE: Since this is an automated system for all sections, if any of your work is not your own, you will be caught. Changing variable names, adding comments, or spacing will not trick the similarity algorithm and will result in a violation.

Problem #1

Background: *A rod on the surface of Jupiter's moon Callisto has a volume measured in cubic meters. The specific gravity of the rod is 4.7 [-] and the gravitational acceleration on Callisto is 1.25 meters per second squared. The goal of this problem is to determine the weight of the rod when the user provides the volume. You can also assume the density of water is 1000 kg/m^3.*

Recommended Process (Algorithm):

1. Create a separate section for Problem 1 and the proper heading included the title, problem statement, and all variables defined with units.
2. Housekeeping Commands
3. Assign values for given variables and constants.
4. Ask the user to input the volume of the rod in cubic meters.
5. Calculate the rod density using specific gravity.
6. Calculate the weight of the rod in N.
7. Convert the weight from newtons to pounds-force
8. Produce a formatted output as shown below for the given test cases.

Test Case with Sample Output to Command Window:

```
Command Window
Enter volume of rod [cubic meters]: >> 0.3
The weight of the rod is 397 pounds-force.
```

Other Test Case:

Inputs (volume of rod [m^3])	Output (weight of rod [pound-force]
1.2	1586
3	3966

Problem #2

Background: *You are part of an engineering firm that is testing motors. The motor Is used to raise a load into the air. Your goal is to create a program that will determine how long it will take for a given motor to raise a load given the power and rated efficiency.*

Recommended Process (Algorithm):

1. Create a separate section for Problem 2 and the proper heading included the title, problem statement, and all variables defined with units.
2. Housekeeping Commands
3. Assign values to all given variables and constants.
4. Ask the user to enter the name of the motor being tested.
5. Ask the user to enter the power in watts of the motor being tested.
6. Ask the user to enter the rated efficiency in percent (0 to 100).
7. Ask the user to enter the load being lifted in kilograms.
8. Ask the user to enter the height the load is being raised in meters.
9. Calculate the potential energy.
10. Calculate the time in seconds
11. Produce a formatted output as shown below for the given test cases.

Test Case with Sample Output to Command Window:

Command Window

```
Name of the motor: >> Beta Motor
Power of the motor [w]: 100
Rated efficiency of the motor [%]: 60
Load being lifted [kg]: 100
Height to be raised [m]: 5

For the Beta Motor motor, it will take 81.67 seconds to raise a 100 kg load 5.0 m.
```

Other Test Case:

Inputs					Result
Name	Power [W]	Rated Efficiency [%]	Load [kg]	Height [m]	Time [s]
Alpha Motor	80	70	100	5	87.50
Prime Motor	200	80	500	7.5	229.69

Problem #3

Background: *You are part of an engineering firm on contract by the U.S. department of Energy's Energy Efficiency and Renewable Energy task force to develop a program to help consumers measure the efficiency of their home appliances.*

Before using your program, the consumer will place a pan of room temperature water on their stove with 1 gallon of water, record the initial room temperature in units of degrees Fahrenheit, turn on the burner, and wait or it to boil. When the water begins to boil, they will record the time in units of minutes it takes for the water to boil. Finally, they will look up the power for the burner provided by the manufacturer.

The goal of this program is to measure the efficiency of stove-top burners using the recorded information by the consumer. You will need to use proper conversions as defined in the textbook.

NOTE: Use previous chapters in the textbook and equation/conversion sheets to determine the necessary equation to use.

Algorithm Requirements:

- Fill in the algorithm template provided on blackboard. It can be typed or by hand.
- Save or scan the file to a .pdf file and include in your final .zip submission

Coding Requirements:

- Include required documentation and header for the problem.
- The following values should be user inputs:
  - Initial room temperature of water [degrees Fahrenheit]
  - Time it takes water to boil [min]
  - Brand name and model of the stove
  - Power of the stove top burner [watts]
  - Absolute temperature
- The output of your program should like the test case displayed below with the same spacing, indentations, and number of significant digits.

Test Case with Sample Output to Command Window:

```
Command Window
Household Appliance Efficiency Calculator: Stove

Type the initial room temperature of the water [deg F]: >> 68
Type the time it takes the water to boil [min]: 21
Type the brand name and model of your stove: Krispy 32-z
Type the power of the stove-top burner [W]: 1200

Energy required:              1267909 J
Power used by burner:         1006 W

Burner efficiency for a Krispy 32-z stove: 83.9%
```

Other Test Case:

Inputs				Outputs		
Stove Model	Room Temp [deg F]	Time to Boil [min]	Rated Burner Power [W]	Energy Required [J]	Power used by burner [W]	Burner Efficiency [%]
Charbake 5	69	18	1,350	1259104	1166	86.4%
SmoldefChef 20F	71	25	1,300	1241494	828	63.7%

Problem #4:

Background: *The ideal gas law provides one way to estimate pressure exerted by a gas in a container. The law is*

$$P = \frac{nRT}{V}$$

More accurate estimates can be made with the van der Waals equation

$$P = \frac{nRT}{V - nb} - \frac{an^2}{V^2}$$

where the term *nb* is a correction for the volume of the molecules and the term an^2/V^2 is a correction for molecular attraction. The values of *a* [-] and *b* [-] depend on the type of gas. The gas constant is R given as 0.08206 [-], the absolute temperature is *T* [kelvin], the gas volume is *V* [L], and the number of gas molecules is indicated by *n* [mol].

The goal of this program is to compare the pressure estimates given by the ideal gas law and the van der Waals equation.

Algorithm Requirements:

- Fill in the algorithm template provided on blackboard. It can be typed or by hand.
- Save or scan the file to a .pdf file and include in your final .zip submission

Coding Requirements:

- Include required documentation and header for the problem.
- The following values should be user inputs:
    - Name of the gas
    - Value of a [-]
    - Value of b [-]
    - Gas Volume [L]
    - Absolute temperature [kelvin]
- Output Statement showing the pressure calculated by each method and the difference as shown in the test cases below

Test Case with Sample Output to Command Window:

```
Command Window
Name of the gas: >> Chlorine
Volume of gas [L]: 22.41
Absolute Temperature [kelvin]: 273.2
Value of a [-]: 6.49
Value of b [-]: 0.0562

The estimated pressure using ideal gas law is 1.0004 atm.
The estimated pressure using van der Waals equation is 0.9900 atm.
fx The difference between these two estimations is 0.0104 atm.>>
```

Other Test Case:

Inputs					Outputs		
Gas	Volume [L]	Temp [K]	a [-]	b [-]	P (from ideal gas law) [atm]	P (from van der Waals equation) [atm]	Difference [atm]
Oxygen	25	290	1.36	0.0318	1.0619	1.0607	0.0012
Carbon Dioxide	10	300	3.59	0.0427	1.0985	1.0935	0.0051