Java Assignment 1 for ES153

Problem
A program is needed to find the instantaneous voltage of a sinusoidal waveform from the peak voltage in volts, the frequency in kilohertz, and the time in milliseconds.

Theory

A simplified equation to give the instantaneous value of a waveform is given below:

$$v = V_{peak} \sin(2\pi ft)$$

Where:
v is the instantaneous voltage at any point in time t on the waveform, in volts
V_{peak} is the peak amplitude of the waveform, in volts.
π is the constant PI.
f is the frequency of the waveform, in Hz.
t is the time, in seconds, for v.

Outline
The process is outlined below:
- Get values for V_{peak} in volts, frequency in kHz, and Time in seconds.
- If input is incorrect terminate program with error message.
- Convert frequency from kHz to Hz: $f = 1000f$
- Calculate the instantaneous value using equation:
  $$v = V_{peak} \sin(2\pi ft)$$
- Print Calculated value with units

Program Ideas: JAVA
A try/catch structure can be used to 'catch' rather than 'throw' exceptions. It is used within a method as shown:

```
try {
    // Program
}
catch( an exception ) {
    // Code to excecute on exception
}
finally {
    // Code to excecute whatever result of try/catch
}
```

This can be used to prevent the user seeing the stack trace and can show more user-friendly information.

A reader object is needed in order to handle keyboard input. If the following code is used at (or towards) the start:

```
String value;
    InputStreamReader reader = new InputStreamReader(System.in);
    BufferedReader input = new BufferedReader(reader);
```

Then to read input the following line can be used

```
value = input.readLine();
```

The input is stored in the string 'value'

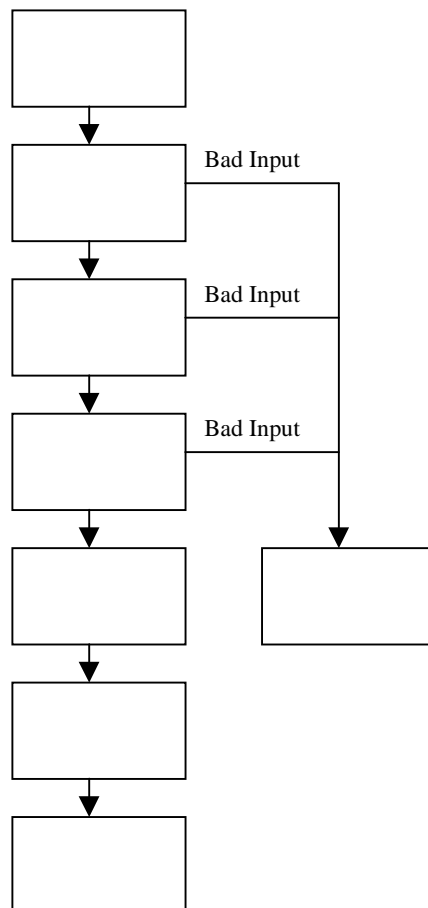If a string (eg number) contains a number in the double format, this can be read as shown:

```
num  = new Double(number).doubleValue();
```

This assumes that the num variable has already been initialised as a double value.

The maths functions 'Math.cos' and 'Math.PI' will be needed.

Pseudo Code/ Flow chart
- Print Program description "Calculate Instantaneous Value of a Sinusoidal Waveform"
- Declare variables
- If user input bad value, print error message and terminate program.
- Get user input for Vpeak (V) and store in variable vpeak
- Get user input for Frequency (kHz) and store in variable f
- Get user input for time (s) and store in variable t
- Convert frequency from kHz to Hz using: $f = 1000 f$
- Calculate instantaneous value of voltage according to equation: $v = V_{peak} \sin(2\pi f t)$
- Print out calculated instantaneous value of voltage with units.

Bad Input

Bad Input

Bad Input

<u>Program Development</u>
The program will be written in java.

First the nessecery libaries must be imported. We will be using I/O and maths functions:

```
// Import necessary librays

import java.lang.Math; // Maths Functions
import java.io.*;      // I/O Functions
```

We must then declare the main class and method:

```
public class WaveformValue
{ public static void main(String[] args) {
```

A try/catch construction will handle errors:

```
try {       // Traps Errors
```

An input reader is set up for use when reading user values:

```
    // Set up input reader and input string variable

    String number;  // Declare input string
    InputStreamReader reader = new InputStreamReader(System.in);
    BufferedReader input = new BufferedReader(reader);
```

The user variables are declared:

```
    // Declare user variables

    double f;               // Frequency (Hz)
    double t;               // Time (s)
    double v;               // Instantaneous Voltage (V)
    double vpeak;           // Peak Voltage (V)
```

Description of program function is printed:

```
    System.out.println("Calculate Instantaneous Value of a Sinusoidal Waveform\n");
```

Each user value is read:

```
    // Get User Input

    // Get Vpeak
    System.out.println("Enter peak voltage in volts: ");     // Prompt User
    number = input.readLine();                               // Read Voltage
    vpeak  = new Double(number).doubleValue();               // Write input to vpeak
    System.out.println(" Peak Voltage = " + vpeak + " V\n"); // Print Value

    // Get Frequency
    System.out.println("Enter frequency in kHz: ");          // Prompt User
    number = input.readLine();                               // Read Frequency
    f  = new Double(number).doubleValue();                   // Write input to f
    System.out.println(" Frequency = " + f + " kHz\n");      // Print Value

    // Get time
    System.out.println("Enter time in seconds: ");           // Prompt User
    number = input.readLine();                               // Read Time
    t  = new Double(number).doubleValue();                   // Write input to t
    System.out.println(" Time = " + t + " s\n");             // Print Value
```

Value is calculated. F is converted into Hz from kHz:

```
    // Calculate Values

    f = f * 1000; // Convert f in kHz to Hz

    v = vpeak * Math.sin( 2 * Math.PI * f * t ); // Calculate Instantaneous Voltage
```

Results are displayed:

```
System.out.println("Instantaneous Voltage = " + v + " V");
```

Try closed and the code to execute on error is encased in the catch braces:

```
    }
```

```
catch ( Exception e) {      // Catches Errors and Alerts User
      System.err.println("Error: Bad Input. Try Again.");

    }
```

Main method and class closed:

```
  }
}
```

Full Program Listing:

```
// Calculating Instantaneous value of a Sinusoidal Waveform
// Copyright Thomas Kennaugh 2000
// Version 1.2b

/*
STUDENT DECLARATION
1. I confirm that I am aware of the University's Regulation governing Cheating in a
University Test (Regulation 12) and of the guidance issued by the School of
Engineering concerning plagiarism and proper academic practice, and that the assessed
work now submitted is in accordance with this regulation and guidance.
2. I understand that, unless already agreed with the School of Engineering, assessed
work may not be submitted that has previously been submitted, either in whole or in
part, for any qualification other than the one for which I am currently registered, at
this or any other institution.
3. I recognise that should evidence emerge that my work fails to comply with either of
the above declarations, then I may be liable to proceedings under Regulation 12.
Student name: Thomas Kennaugh        Date:  08/12/00
*/


// Import necessary librays

import java.lang.Math; // Maths Functions
import java.io.*;      // I/O Functions

public class WaveformValue
{ public static void main(String[] args) {

try {        // Traps Errors

    // Set up input reader and input string variable

    String number;  // Declare input string
    InputStreamReader reader = new InputStreamReader(System.in);
    BufferedReader input = new BufferedReader(reader);

    // Declare user variables

    double f;                // Frequency (Hz)
    double t;                // Time (s)
    double v;                // Instantaneous Voltage (V)
    double vpeak;            // Peak Voltage (V)

    // Print Description

    System.out.println("Calculate Instantaneous Value of a Sinusoidal Waveform\n");
```

```java
        // Get User Input

        // Get Vpeak
        System.out.println("Enter peak voltage in volts: ");      // Prompt User
        number = input.readLine();                                // Read Voltage
        vpeak  = new Double(number).doubleValue();                // Write input to vpeak
        System.out.println(" Peak Voltage = " + vpeak + " V\n"); // Print Value

        // Get Frequency
        System.out.println("Enter frequency in kHz: ");           // Prompt User
        number = input.readLine();                                // Read Frequency
        f  = new Double(number).doubleValue();                    // Write input to f
        System.out.println(" Frequency = " + f + " kHz\n");       // Print Value

        // Get time
        System.out.println("Enter time in seconds: ");            // Prompt User
        number = input.readLine();                                // Read Time
        t  = new Double(number).doubleValue();                    // Write input to t
        System.out.println(" Time = " + t + " s\n");              // Print Value

        // Calculate Values

        f = f * 1000; // Convert f in kHz to Hz

        v = vpeak * Math.sin( 2 * Math.PI * f * t ); // Calculate Instantaneous Voltage

        // Print Result

        System.out.println("Instantaneous Voltage = " + v + " V");

    }

catch ( Exception e) {     // Catches Errors and Alerts User
    System.err.println("Error: Bad Input. Try Again.");

    }

  }
}
```

Compiling
The code can be compiled as shown (using jdk 1.3 available from
http://java.sun.com/):

```
javac WaveformValue.java
```

Program Execution
Using jdk the compiled bytecode in the CLASS file can be executed using the
command: `java WaveformValue`
Three examples of sample input and output are shown below:

```
H:\JDK>java WaveformValue
Calculate Instantaneous Value of a Sinusoidal Waveform

Enter peak voltage in volts:
120
 Peak Voltage = 120.0 V

Enter frequency in kHz:
.1
 Frequency = 0.1 kHz

Enter time in seconds:
.0025
 Time = 0.0025 s

Instantaneous Voltage = 120.0 V

H:\JDK>java WaveformValue
Calculate Instantaneous Value of a Sinusoidal Waveform

Enter peak voltage in volts:
240
```
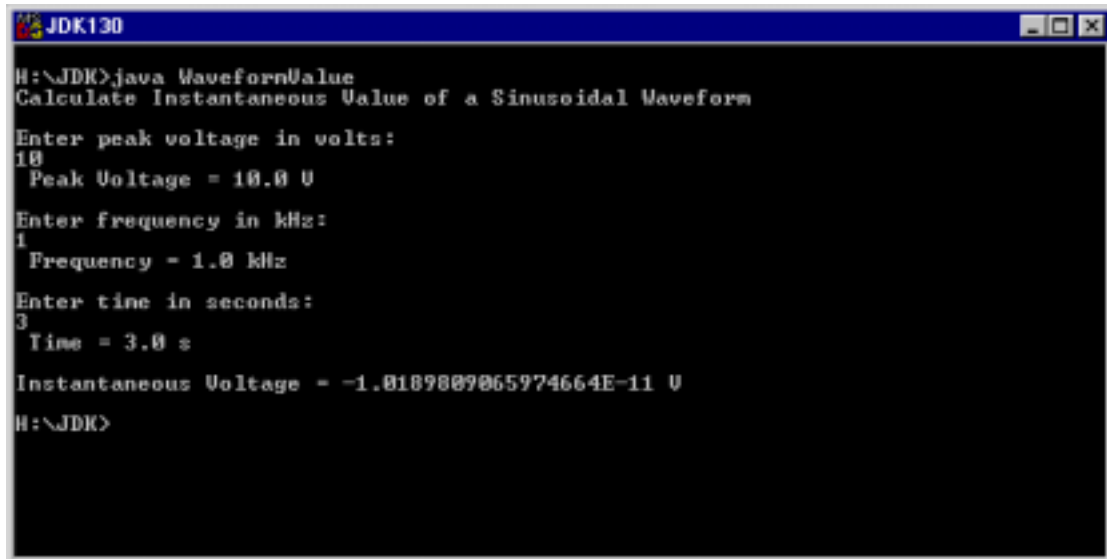
```
 Peak Voltage = 240.0 V

Enter frequency in kHz:
.05
 Frequency = 0.05 kHz

Enter time in seconds:
.015
 Time = 0.015 s

Instantaneous Voltage = -240.0 V
```
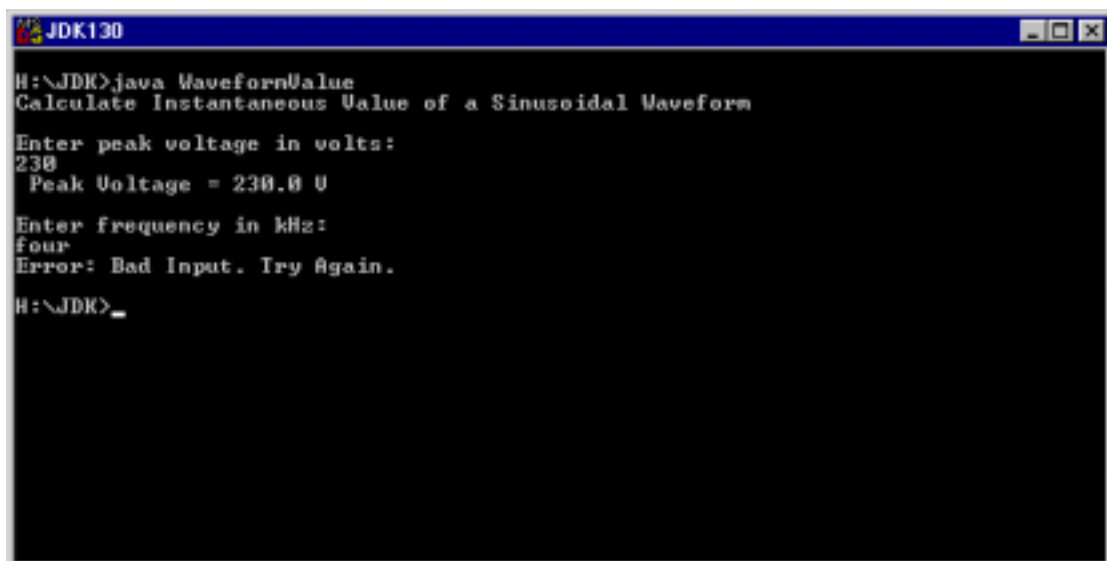

Note the output accuracy when the double data type is used. This prevents inaccurate data and allows a large range of values to be used.

The above results can be confirmed using a calculator. eg:

240sin(2*3.141592*.05*0.15) = -240 V

An example of bad input is shown below:

CLASS File

The final JAVA application (class file) can be accessed here (right click, edit and then save contents from ITS computers):

WaveformValue.class

This may be run using JDK on Win32 machines.

Bibliography

Stephen J. Chapman, *"Java for Engineers and Scientists"*, Prentice Hall, 1999
Hubbard, *"Programming in Java"*, McGraw-Hill, 1999