Task: Design a simple Rankine cycle using only a single pump, Boiler, turbine and condenser, subject to the limitations given in the datasheets below.

Objective: Create a system that will pay off its initial investment over a 5 year period. Special acknowledgement will be given to the **lowest cost system** that has a positive return within 5 years, and the system with the **greatest 5 year profit**.

Parameters: Fuel for the boiler costs $0.007/MJ. The energy produced is worth $0.10/kWh. Make sure that your design meets **all the requirements** for the individual components you chose.

Results to Hand In:

1. A 1 paragraph description of the calculation steps necessary to analyze the cycle
2. A brief summary of what variables you thought played the biggest role in determining the cycle performance, and which variables didn't seem to matter
3. A summary of the following parameters of your cycle
    a. System parts chosen
    b. Low and high operating pressures
    c. Max cycle temperature
    d. Turbine outlet quality
    e. Mass flow rate
    f. Cycle efficiency
    g. Net power produced
    h. Total system cost
    i. Total annual energy produced
    j. Payback time

Datasheets for the Cycle Components:

Pumps

Name	Cost	Isentropic Efficiency	Min Inlet P	Max Outlet P	Max Flow Rate
A	$250,000	0.85	100 kPa	9 MPa	5.0 kg/s
B	$300,000	0.75	50 kPa	9 MPa	10.0 kg/s
C	$400,000	0.88	100 kPa	10 MPa	7.5 kg/s
D	$400,000	0.80	40 kPa	12 MPa	10.0 kg/s
E	$500,000	0.88	50 kPa	15 MPa	7.5 kg/s

Turbines

Name	Cost	Isentropic Efficiency	Max inlet T	Min outlet quality	Max Flow Rate
A	$250,000	0.85	450°C	0.8	5.0 kg/s
B	$350,000	0.80	475°C	0.85	7.5 kg/s
C	$400,000	0.80	550°C	0.85	10.0 kg/s
D	$400,000	0.95	475°C	0.90	7.5kg/s
E	$500,000	0.90	500°C	0.90	10.0 kg/s

Boiler

Name	Cost	Heat Xfer Efficiency	Max outlet T	Max pressure	Max Flow Rate
A	$250,000	0.85	475°C	8 MPa	7.5 kg/s
B	$350,000	0.90	500°C	8 MPa	10.0 kg/s
C	$400,000	0.88	500°C	10 MPa	7.5 kg/s
D	$400,000	0.85	525°C	9 MPa	5.0 kg/s
E	$500,000	0.90	550°C	12 MPa	10.0 kg/s

Condenser

Name	Cost	Max Flow Rate
A	$250,000	5.0 kg/s
B	$300,000	7.5 kg/s
C	$350,000	10 kg/s

Installation Instructions:

1. Download and install Python 3.6 for your platform: https://www.python.org/downloads/
2. Open a command prompt. From the Windows 10 search bar, this may be found by typing cmd in the search bar.
3. In your command prompt type each of the following commands to download required libraries
   - `pip install numpy`
   - `pip install matplotlib`
   - `pip install pyromat`