In [84]:
```
### from thermostate import State, Q_, units
from math import pi
print('Jason Secula')
print('Homework 3.3')
print('           ')
substance = 'air'
R_Cnst = Q_(8.3145498*(10**3),'(kJ)/(K*kmole)')
R_Bar = Q_(28970, '(kg)/(kmole)') #Had to Convert from Joules, ThermoStat
R = (R_Cnst/R_Bar) #R=(8.31(kJ)/(kmol-K))/(28.97kg/kmol)
#^^^R  = 0.2870055160510874 kilogram kelvin

T_1 = Q_(27.0, 'degC')
p_1 = Q_(101.0, 'kPa')
V_1 = Q_(566.0, 'cm**3')
r = Q_(8.0, 'dimensionless')
T_4 = Q_(1726.0, 'degC')
#^_^Given-^-^-^-^-^-^-^-^-^-^-^-^-^
#State 1
st_1 = State(substance, T=T_1, p=p_1)
#State 2
V_2 = (V_1/r)
v_2 = ((V_1/V_2)*st_1.v)
st_2 = State(substance, s=st_1.s, v=v_2)
#State 3
st_3 = State(substance, T=T_1, v=v_2)
#State 4
st_4 = State(substance, T=T_4, s=st_3.s)

denominator = (p_1*V_1).to('kJ') #Dimensionality issue, had to convert fi
m = (denominator/(R*T_1)) #Mass
print ('The mass was found to be  = {}'.format(m))
Wnet = (((st_3.u -st_4.u)-(st_2.u-st_1.u)))
print('1) The Net Work Output  = {}'.format(Wnet)) #W_net in kJ/kg
eta = (1-((st_4.u-st_1.u)/(st_3.u-st_4.u)))
print(('2) The Thermal Efficiency is  = {}').format(eta))
MEP = (Wnet/(V_2-V_1)) #.to('bar') #V_d = V_btc-V_tdc
print('3) The MEP is  = {}'.format(MEP))

#ColdAirStandardAnalysis
print('           ')
print('4) The cold air is as followed')
cv = ((st_3.u-st_2.u)/(st_3.T-st_2.T)) #DeltaU=cv*DeltaT >> Cv = DeltaU/D
#^_^_^CV  = 715.8716134760114 joule / kelvin / kilogram^_^_^_^_^
cp = (cv+R)
#^_^_^CP  = 1002.8771295270988 joule / kelvin / kilogram^_^_^_^_^
#k=(cp/cv)
k = (1+(cv/R))
#k  = 3.4942782401038777 dimensionless
#One
v_1ca = ((R*T_1)/p_1) #ca = Cold Air
#Two
T_2ca = (T_1*(r**(k-1)))
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```python
p_2ca = (p_1*(r**k))
v_2ca = (v_1ca*r)
#Three
v_3ca = v_2ca
p_3ca = (p_2ca*((v_2ca/v_3ca)**k)).to('kg/(m*s**2)') #Page 512 in Text Bo
T_3ca = (T_2ca*(p_3ca/p_2ca))
#Four
p_4ca = p_3ca.to('kg/(m*s**2)')
v_4ca =  (r*v_3ca)    #Original: (p_4ca/(R*T_4)) :Demensionality Error...
#^^ r = (v_4/v_3) for an otto system.

W_12 = (m*(cv*(T_1-T_2ca))).to('kJ')
W_34 = (m*(p_3ca*(v_4ca-v_4ca))).to('kJ')
Q_in = (m*(cv*(T_3ca-T_2ca))).to('kJ') #Originally used this for Eta, but
Wnet_ca = (W_12 - W_34)
print(' 1.b) The Net Work Output  = {}'.format(Wnet_ca)) #W_net in kJ/kg
eta_ca = (1-(1/(r**(k-1))))
print(' 2.b) The Thermal Efficiency is  = {}'.format(eta_ca))
MEP_ca = (((Wnet_ca/(v_1ca-v_2ca)))*m)
print(' 3.b) The MEP is  = {}'.format(MEP_ca))
```

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Jason Secula
Homework 3.3

The mass was found to be  = 0.0006636043338180686 kilogram
1) The Net Work Output  = -1340853.8127436675 joule / kilogram
2) The Thermal Efficiency is  = 2.0001209117904235 dimensionless
3) The MEP is  = 2707.428193323912 joule / centimeter ** 3 / kilogram

4) The cold air is as followed
 1.b) The Net Work Output  = -25.363297626730944 kilojoule
 2.b) The Thermal Efficiency is  = 0.9944096075523767 dimensionless
 3.b) The MEP is  = 0.0028190947579642568 kilogram ** 2 * kilopascal
```