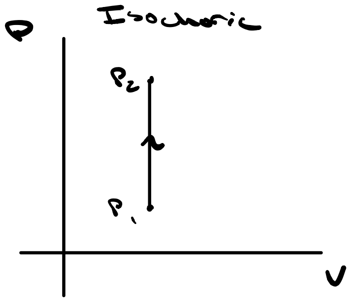
Stefano Fockesatto PHYS 212 2/21/21

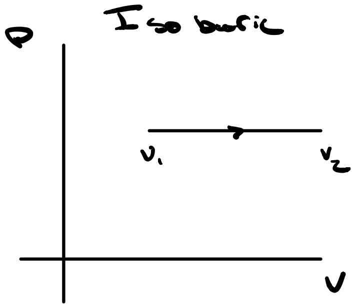
Part 1: Isothermal and Adiabatic processes.

1.) Isochoric



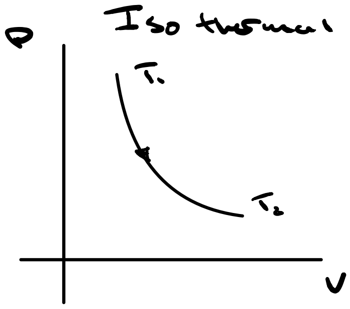
$P = \frac{nRT}{V}$, V is constant.

Isobaric



$V = \frac{nRT}{P}$, P is constant.

Isothermal



$P = \frac{nRT}{V}$, T is constant.

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

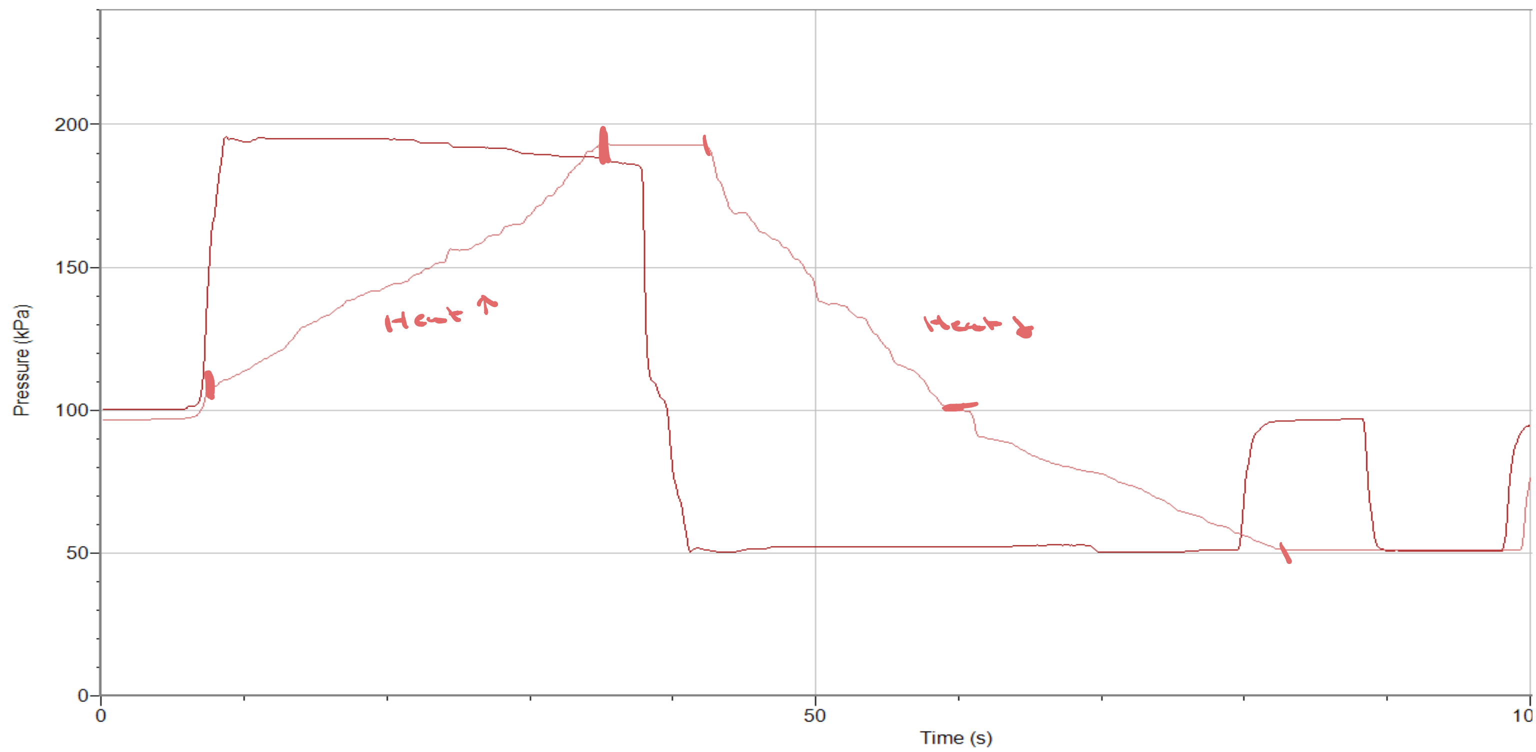
2.) Compressing the syringe will decrease the volume, and increase the pressure.

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}.$$

With temperature constant we will see the pressure increase.

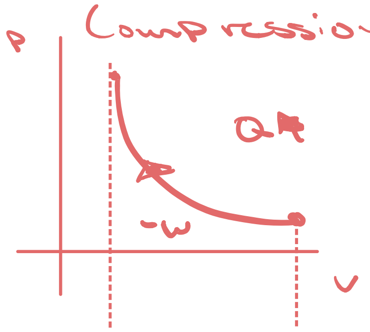
4/5/6) Results from testing the syringe

- Isothermal compression/expansion
- Adiabatic compression/expansion

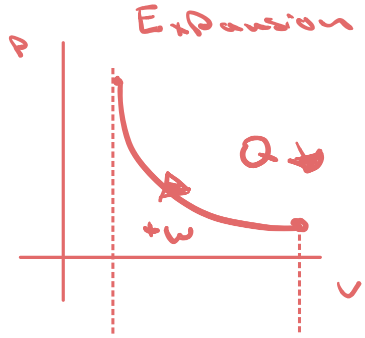


-No heat transfer is involved in an adiabatic process. However in an isothermal process we know that $Q = -W$.

Compression



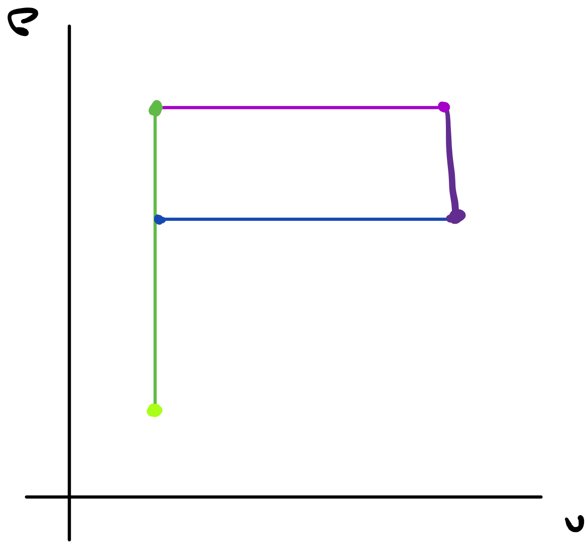
Expansion



Part 2:

From the described process this is my predicted pv-diagram

- Initial
- Isochoric Heating
- Isobaric Expansion
- Isochoric Cooling
- Isobaric Compression

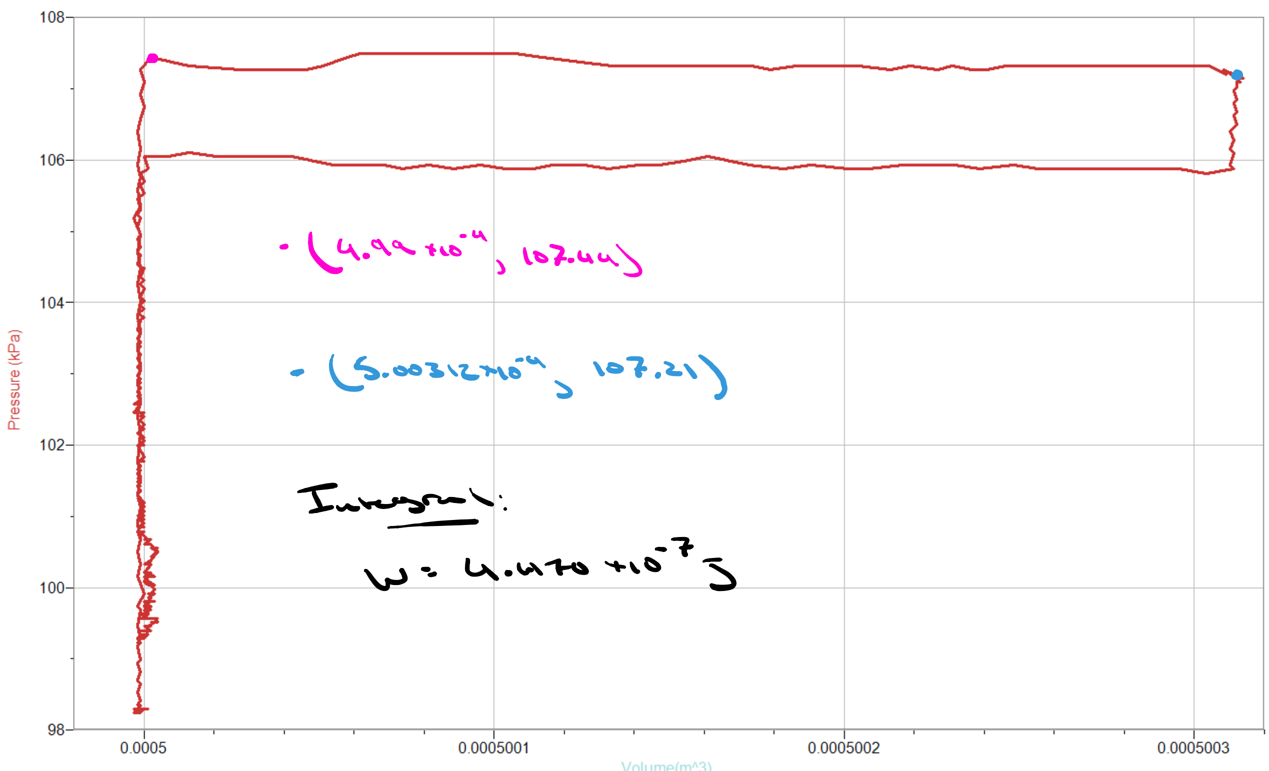


Results:

Mass of syringe = .3474 kg ± .001 kg.

Temps:	T_c	T_c
Trial 1	24.2°C	80.4°C
Trial 2	26.5°C	80.3°C
Trial 3	21.4°C	80.3°C

Trial 1:



Computing n:

$T_o = T_c = 24.2\,°C = 297.35\,K$

$P_o = 98.24\ kPa$

$V_o = .0005\ m^3$ $\Rightarrow$ $n = \frac{PV}{RT} = .019868\ mol$

<u>Top left:</u>

$n = .019868\ mols$

$P_L = 107.44\ kPa$

$P_V = 4.99 \times 10^{-4}\ m$

$T_L = \frac{PV}{nR} = 325.19\,K$

<u>Top Right:</u>

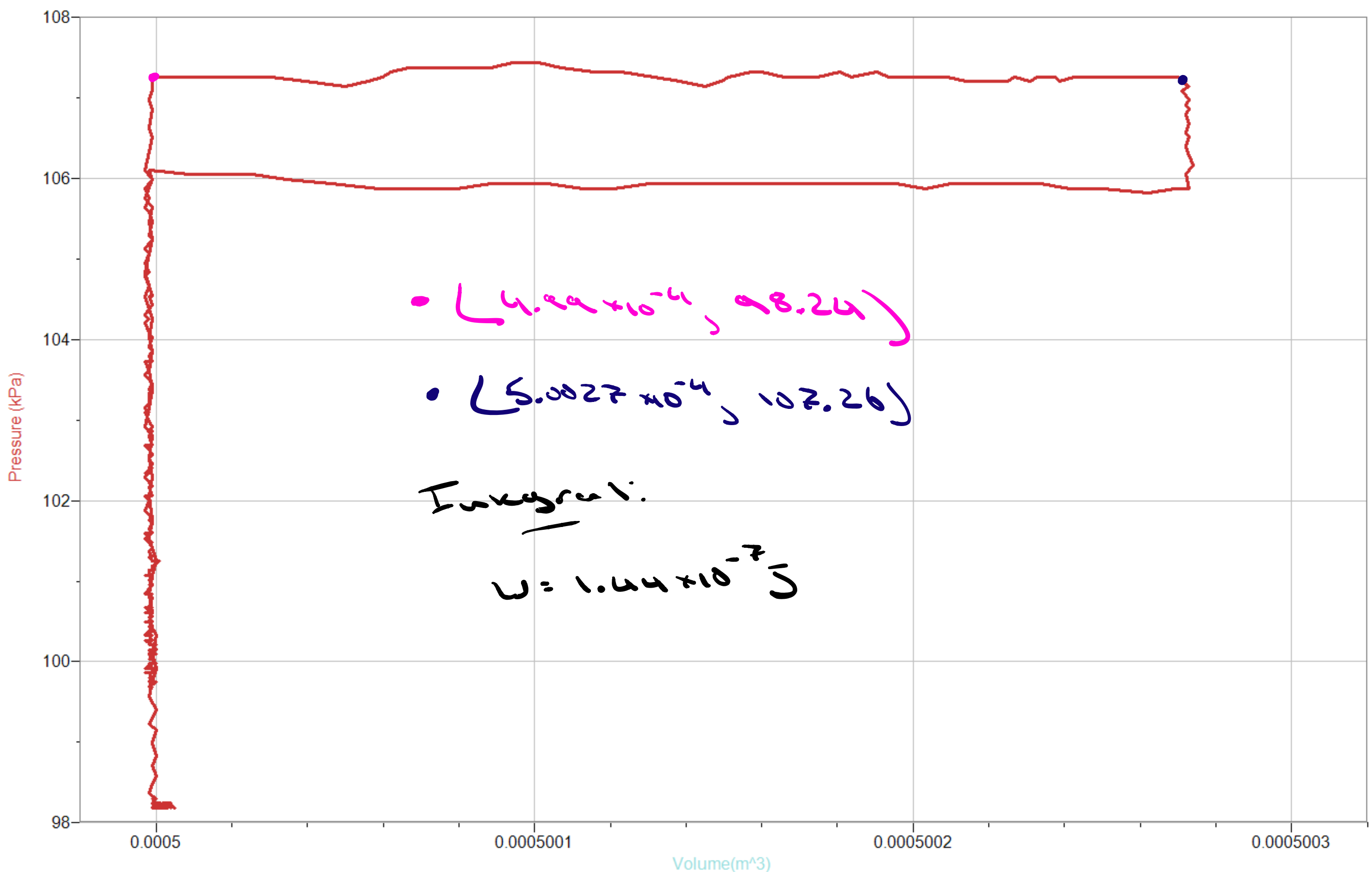
$n = .019868\ mols$

$P_R = 107.21$

$V_r = 5.00312 \times 10^{-4}\ m^3$

$\Rightarrow T_R = \frac{PV}{nR} = 324.69\,K$

<u>Trial 2:</u>



Computing n:

$T_0 = T_c = 26.5^\circ C = 299.65\,K$

$P_0 = 98.24\ kPa$

$V_0 = 5\times10^{-4}\ m^3$

$\Rightarrow n = \frac{PV}{RT} = .0197161\ mol$

Top Left:

$n = .0197161\ mol$

$P_L = 98.24$

$V_L = 4.99\times10^{-4}\ m^3$

$\Rightarrow T_L = \frac{PV}{nR} = 299.64$

Top Right:

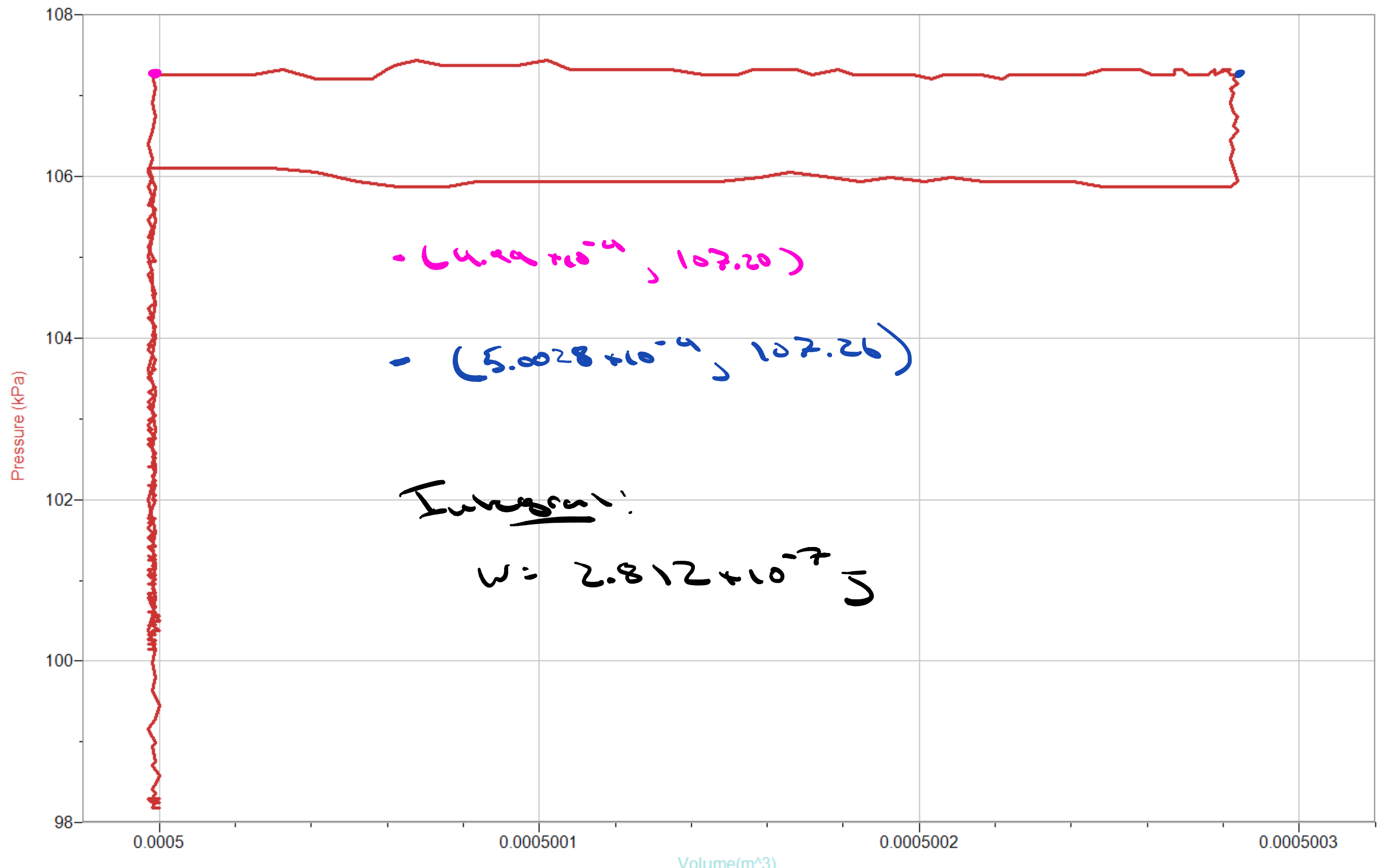
$n = .0197161\ mol$

$P_R = 107.26\ kPa$

$V_R = 5.0027\times10^{-4}\ m^3$

$\Rightarrow T_R = \frac{PV}{nR} = 327.34\,K$

Trial 3:



Computing n:

$T_0 = T_c = 21.4°C = 294.55K$

$P_0 = 98.18\ KPa$

$V_0 = 4.99 \times 10^{-4}\ m^3$

$n = \frac{PV}{RT} = .0236596\ mol$

Top left:

$n = .0236596\ mol$

$P_L = 107.2\ KPa$ $T_L = 272.63\ K$

$V_L = 4.99 \times 10^{-4}\ m^3$

Top Right:

$n = .0236596\ mol$

$P_R = 107.26\ KPa$ $\Rightarrow T_R = 272.79K$

$V_R = 5.0028 \times 10^{-4}\ m^3$

Questions:

part 1:

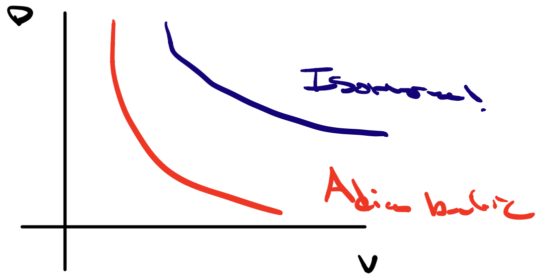
15) The pressure likely was changing because of inefficiencies in the syringe vacuum seal. Increased pressure puts pressure on the seal and gas escapes,

$PV = nRT,$

$\downarrow P = \downarrow n.$

16) In an adiabatic process both temp and pressure have an inverse relationship with volume, so the temp + pressure $\downarrow$

17)



The adiabatic process has a deeper slope than the isothermal process in order to create an isothermal process we need to match $|\Delta P| = |\Delta V|$ giving a slower increase.

Part 2:

18) The negative sign is used to transform the distance from the motion detector.

19)

	ΔQ	Reason
• Initial	0	Initial
• Isochoric Heating	+	$\Delta Q = \Delta U$
• Isobaric Expansion	+	$\Delta Q = \Delta U + \Delta W$
• Isochoric Cooling	−	$\Delta Q = \Delta U$
• Isobaric compression	−	$\Delta Q = \Delta U + \Delta W$

20)

Trial 1:

Isobaric process : $Q = \frac{7}{2}(.019868)(324.69 - 325.19)(8.3145)$
$= -.2890\ J$

Isochoric process : $Q = \frac{5}{2}(.019868)(325.19 - 297.35)(8.3145)$
$= 11.497$

$Q_{in} = 11.208\ J$

Trial 2:

Isobaric process: $Q = \frac{7}{2}(.0197161)(327.34 - 299.64)(8.3145)$
$= 15.893\ J$

Isochoric Process: $Q = \frac{5}{2}(.0197161)(299.64 - 299.65)(8.3145)$
$= -.004\ J$

$Q_{in} = 15.889\ J$

Trial 3:

Isobaric process: $Q = \frac{7}{2}(.0236596)(272.79 - 272.63)(8.3145)$
$= .1101\ J$

Isochoric process: $Q = \frac{5}{2}(.0236596)(272.63 - 294.55)(8.3145)$

$= -10.780\ J$

21) The only trial with even remotely believable temperatures is trial 1 and maybe trial 2. Trial 3 temps give us that heat was leaving the system when it was put in the hot water. The temperature should be increasing throughout and through the Isochoric process it should increase the majority because $\Delta P > \Delta V$.

22.) $W = F \cdot d$.

Mass of Syringe = .3474 kg

$F = .3474(9.81) = 3.4079$ N.

Trial 1:

$d = .0544$ m, $W = .1858$ J

Trial 2:

$d = .047677$ m, $W = .1624$ J

Trial 3:

$d = .049563$ m, $W = .1689$ J

I Don't think this is right :(

23) The values from the integral and calculated above are several orders of magnitude off. I feel like I must have done some calculation wrong.

24) Calculating efficiency.

Trial 1: $\frac{.1858}{11.208} = .0165$

Trial 2: $\frac{.1624}{15.889} = .01022$

Trial 3: ommited, calculations would result in - effeciency

25) Ideal efficiency.

$$\eta_I = 1 - \frac{T_c}{T_h}$$

Trial 1:

$$\eta_I = 1 - \frac{297.35}{353.55} = .15845$$

Trial 2:

$$\eta_I = 1 - \frac{299.65}{353.45} = .1522$$

Trial 3:

$$\eta_I = 1 - \frac{294.55}{353.45} = .1666$$