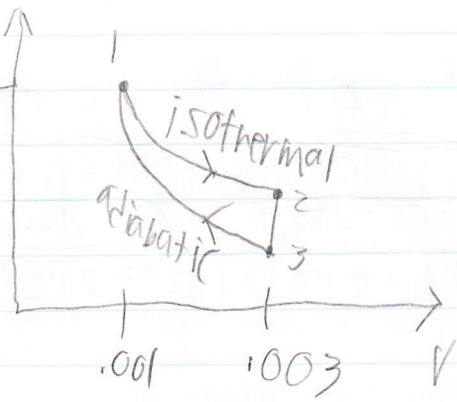
Exam 1

1

a)



$T_3 = 577K$

	P	V	T
1	300,000	.001	1200
2	100,000	.003	1200
3	48,075	.003	577

$\gamma = \frac{5}{3}$

$P_1 V_1 = P_2 V_2$

$P_2 = \frac{P_1 V_1}{V_2} = 100{,}000$

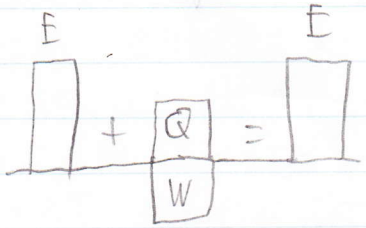
$T_1 V_1^{\gamma-1} = T_3 V_3^{\gamma-1}$

$T_1 = T_3 \left(\frac{V_3}{V_1}\right)^{\gamma-1}$

$T_1 = 1200$

$\frac{T_2}{P_2} = \frac{T_3}{P_3}$ $\quad P_3 = \frac{T_3}{T_2} P_2$

b) 12



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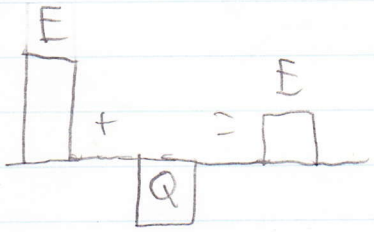

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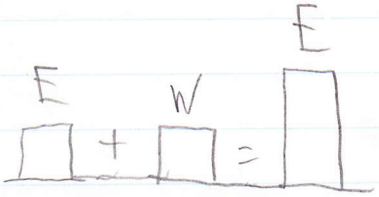


	ΔE	W	Q
12	0	-329.6	329.6
23	-233.7	0	-233.7
31	233.7	233.7	0

$$W_{12} = P_1 V_1 \ln\left(\frac{V_2}{V_1}\right) = 329.6$$

$$Q_{23} = n C_V \Delta T = \frac{3}{2} V_2 (P_3 - P_2)$$
$$-233.7$$

$$W_{31} = n C_V \Delta T = \frac{3}{2}(P_1 V_1 - P_3 V_3)$$

Exam

2

A) 

B) The amount of energy the soda has (relative to 0°C) minus the energy needed to melt the ice as well as the energy needed to heat the ice to 0°C. What is left is the energy the mixture has which can be used to work out temp.

B) $Q_P = .5 \cdot 20 \cdot 4,179$

$Q_P = 41790\ J$

$Q_I = -20 \cdot .1 \cdot 2,100$

$Q_I = 4,200 J$

$Q_F = 3,33 \cdot 10^5 \cdot .1 = 33,300$

$Q_{remaing} = 4290 J$

$4290 = 4,179 \cdot .6\ \Delta T$

$\Delta T = 1.71°C$

$T = 1.71°C$

Exam

3

a) $\frac{3}{2}PV = 227,981$ $\quad E = nC_V T$

b) $3.4108 \cdot 10^{-16} \cdot T$ Cant find T or N $\quad \frac{3}{2}PV$

c) need t for both

$V_{RMS} = .9444\sqrt{T}$

$k_{RMS} = 2.071 \cdot 10^{-23} T$

$\lambda = \frac{k_B T}{4\pi\sqrt{2} r^2 P} = 3.4108 \cdot 10^{-16} \cdot T$

$\lambda = \frac{1}{4\pi\sqrt{2} r^2 \frac{N}{V}}$

$v_{RMS} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3R}{M}}\sqrt{T}$

$f_{rms} = \frac{3}{2} k_B T$

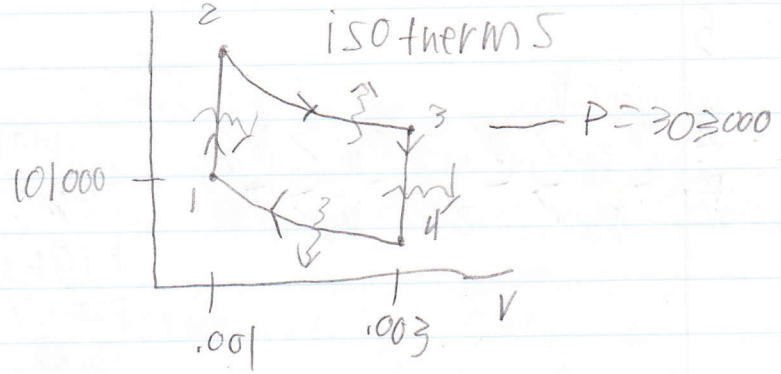
Exam

4

A $\eta_{carnot} = 88.9\%$

$\eta_{engine} = 25.9\%$

$1 - \frac{Q_C}{Q_H} = 1 - \frac{2535}{3423} = .259$



$Q_C = Q_{34} + Q_{41}$

$C_V = 3R$

$Q_{34} = n C_V \Delta T = 3 V_3 (P_4 - P_3)$

$T_H = T_3 = \frac{P_3 V_3}{nR}$

$P_1 V_1 = P_4 V_4$

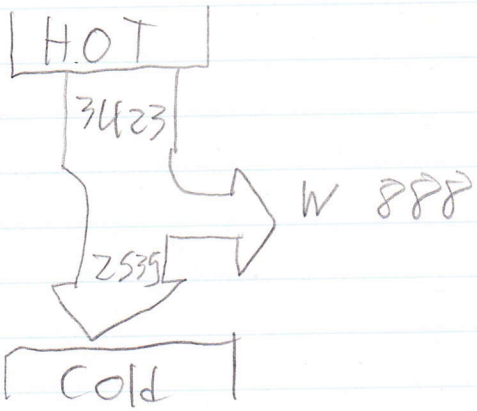
$T_C = T_1 = \frac{P_1 V_1}{nR}$

$P_4 = \frac{P_1 V_1}{V_4} = 33,667$

$\eta_{carnot} = 1 - \frac{P_1 V_1}{P_3 V_3} = .889$

$Q_{34} = -2424$

$Q_{41} = P_1 V_1 \ln\left(\frac{V_1}{V_4}\right) = 411$



$Q_C = 2535$

$Q_H = Q_{12} + Q_{23} = 3423$

$Q_{12} = 3V_1 (P_2 - P_1)$

$P_2 V_2 = P_3 V_3$

$P_2 = P_3 V_3 / V_2 = 90900$

$Q_{12} = 2424$

$Q_{23} = P_3 V_3 \ln\left(\frac{V_3}{V_2}\right) = 999$

Etam

5

A $W_3 > W_1 = W_4 > W_2$

B $T_3 > T_2 > T_4 > T_1$

work is the area of the shape
Teme increases as you go up and right. what ever the units = P·V. will be proportional to temp and will be comparable to the other values so sorting based off of the product of the two coordinates make sense

C $\eta_3 > \eta_1 > \eta_4 > \eta_2$

1: $1 - \frac{1.1}{2.4} = 87.5\%$

2: $1 - \frac{4.1}{4.4} = 75\%$

3: $1 - \frac{2.1}{5.4} = 90\%$

4: $1 - \frac{2.1}{5.2} = 80\%$

PV is proportional to temp so the ratio between two of these values will be the true ratio between the temps

Exam

6

A Keeping it at a high pressure allows you to cool the coolant through adiabatic cooling by reducing the pressure. such as by the radiator cap releasing coolant

B Heat is the transfer of thermal energy. Once a gas has that energy it will use that energy to vibrate an equal amount of energy to each type of vibration and energy is distributed among all the particles so, for a given amount of heat the change in temperature will be less the more ways to vibrate there are and the more particles there are $\Delta T = \Delta E / nC_V$

C Energy is not distributed evenly among all particles. some particles are moving particularly fast and have enough energy to break the hydrogen bonds keeping that particle part of the liquid.