Thermodynamic Variables List ALL of the thermodynamic variables and constants that you can think of. Include their name, the letter that represents them, their units, and their value (if applicable).

Table 1: The thermodynamic variables we've covered so far. I only included SI units. (there are other valid units- but these are the ones you want to work with)

Name	**Letter**	**Units**	**Value** (if applicable)
Pressure	P	Pa	
Volume	V	m^3	
Temperature	T	K	
Thermal Energy	E_{th}	J	
Work	W	J	
Heat	Q	J	
Entropy	S	$\frac{J}{K}$	
Moles	n	mol	
Molecules/Particles/Atoms	N	molecules	
Ideal Gas Constant	R	$\frac{J}{mol \cdot K}$	$8.31 \frac{J}{mol \cdot K}$
Boltzmann Constant	k_b	$\frac{J}{K}$	$1.38 \times 10^{-23} \frac{J}{K}$
Specific Heat	c	$\frac{J}{g^\circ C}$	

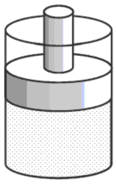
Write a Question As a group, write up a question and a solution for one of the thermodynamic topics covered so far in PH 202. Be sure to include all of the information necessary to solve the problem. Be sure your solution has not only the correct answer but all of the relevant equations and steps for solving for it.

[0]Select problems may be modified from Walsh, Harrison, or the Internet.

Heat Transfer A system does $1.80 \times 10^8 J$ of work while $7.50 \times 10^8 J$ of heat transfer occurs to the environment. What is the change in internal energy of the system assuming no other changes (such as in temperature or by the addition of fuel)?

$$Q = -7.5 \times 10^8 J \quad (1)$$
$$W = -1.8 \times 10^8 J \quad (2)$$
$$\Delta \mathrm{E} = \mathrm{Q} + \mathrm{W} \quad (3)$$
$$\Delta \mathrm{E} = -1.8 \times 10^8 J - 7.5 \times 10^8 J \quad (4)$$
$$= -9.30 \times 10^8 J \quad (5)$$

Gas on the Counter This container of an ideal gas is sitting on the recitation table when you come in. You notice over the course of class time that the volume triples in size. What else do you know must have *changed* about this gas? By how much did it change?



$$P = \frac{F}{A} \quad (6)$$
$$= \frac{m \cdot g}{A} \quad (7)$$
$$\implies P_1 = P_2 \quad (8)$$
$$(9)$$
$$P_1 V_1 = n_1 R T_1 \quad (10)$$
$$P_1 = P_2 \quad (11)$$
$$3V_1 = V_2 \quad (12)$$
$$n_1 = n_2 \quad (13)$$
$$\implies P_1(3V_1) = n_1 R T_2 \quad (14)$$
$$\implies 3T_1 = T_2 \quad (15)$$

How many moles? If I have $72L$ of an ideal gas held at a pressure of $3.4atm$ and a temperature of $225K$, how many moles of gas do I have?
How would you solve this if I asked for molecules instead?
What is the conversion between moles and molecules?

$$P = 3.4\text{atm} = 344505\text{Pa} \tag{16}$$
$$V = 72\text{L} = 0.072\text{m}^3 \tag{17}$$
$$T = 225\text{K} \tag{18}$$
$$R = 8.31\frac{\text{J}}{\text{mol}\cdot\text{K}} \tag{19}$$
$$k_b = 1.38\times 10^{-23}\frac{\text{J}}{\text{K}} \tag{20}$$
$$\tag{21}$$
$$\text{PV} = \text{nRT} \tag{22}$$
$$(344505Pa)(0.072\text{m}^3) = n(8.31\frac{\text{J}}{\text{mol}\cdot\text{K}})(225\text{K}) \tag{23}$$
$$\implies n = 13.3\text{moles} \tag{24}$$
$$\text{PV} = \text{Nk}_\text{b}\text{T} \tag{25}$$
$$(344505Pa)(0.072\text{m}^3) = n(1.38\times 10^{-23}\frac{\text{J}}{\text{K}})(225\text{K}) \tag{26}$$
$$\implies N = 8.009448195000001\times 10^{24}\text{molecules} \tag{27}$$
$$\tag{28}$$
$$1\text{mole} = 6.0221415\times 10^{23}\text{molecules} \tag{29}$$