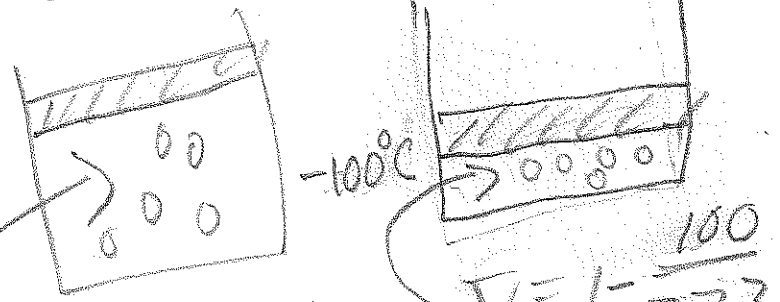
CHIC absolute zero:

Volume $= 1 + \frac{T}{273}$ = $V = 1 + \frac{T}{273}$ = volume formula.

T = temperature in °C.

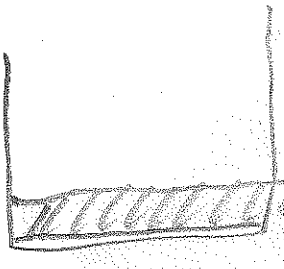
CONTAINER of gas



$V = 1 + \frac{100}{273}$

$V = 1 - \frac{100}{273}$

T = -273 °C = 0 KELVIN (K) = ABSOLUTE ZERO

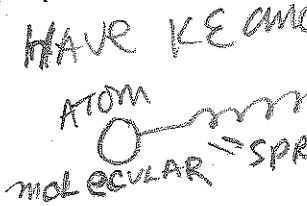


$V = 1 - \frac{273}{273} = 0$

V = 0

Internal Energy =

NOTE: DIATOMIC molecules HAVE KE and PE:

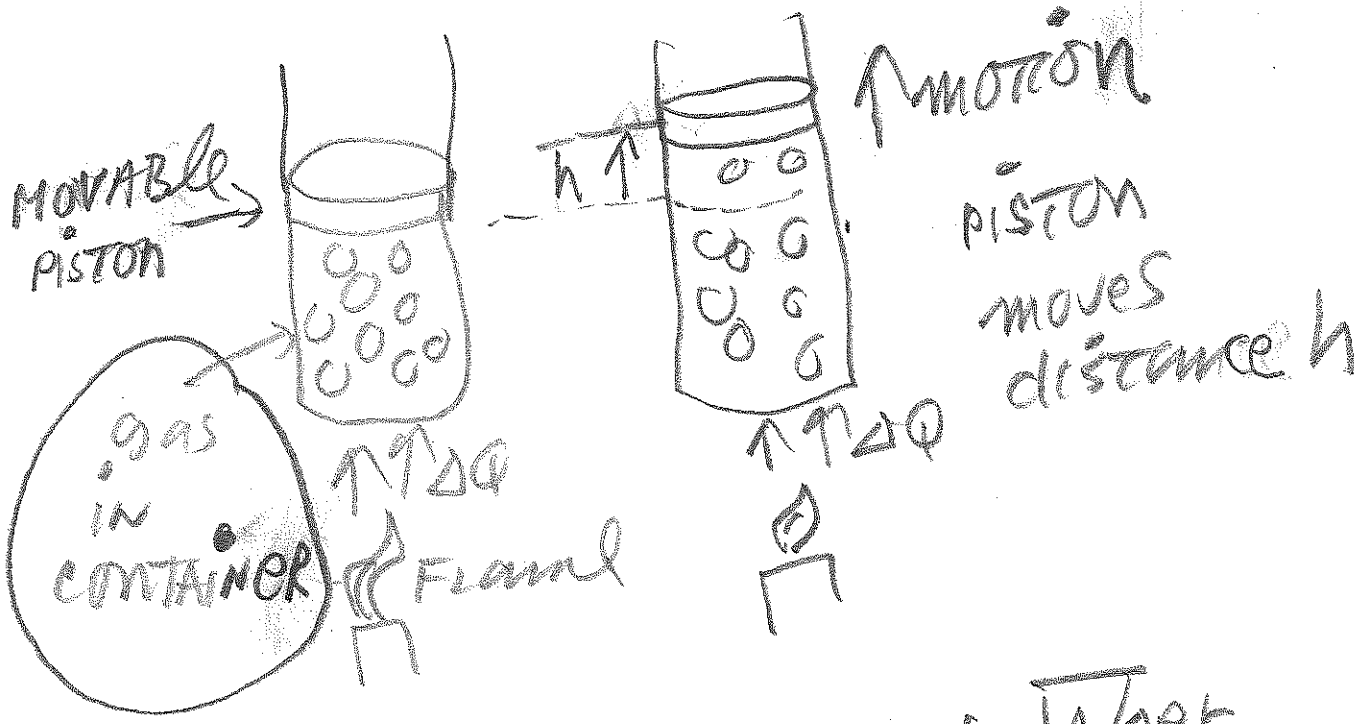


= KE + PE of molecules

↑ kinetic energy ↑ potential energy

CH 18

1ST LAW of Thermodynamics



input heat = ΔE_{int} + Work

ΔQ = [change in internal energy] + Work

WORK = WORK BY gas ON PISTON in moving it upward.

Adiabatic process:

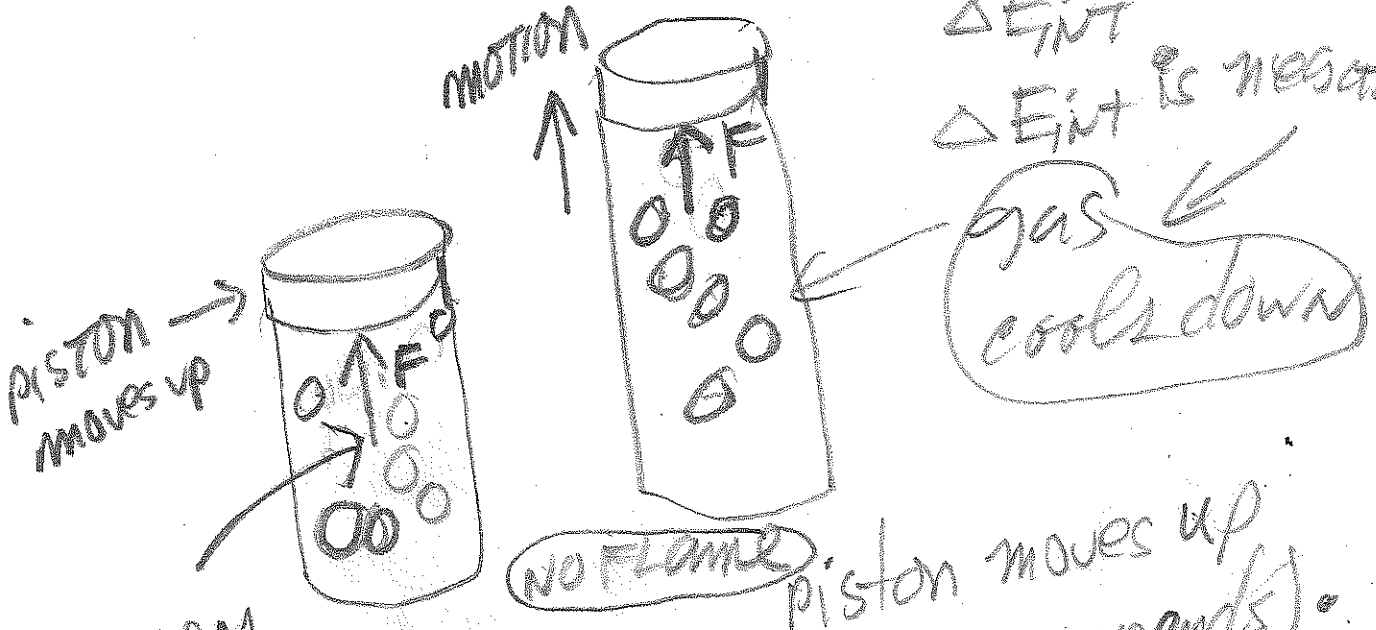
input heat = 0 = ΔQ

gas expands and cools down.

$\Delta Q = 0 = \Delta E_{INT} + Work$

$\Delta E_{INT} = -Work$

ΔE_{INT} is negative.



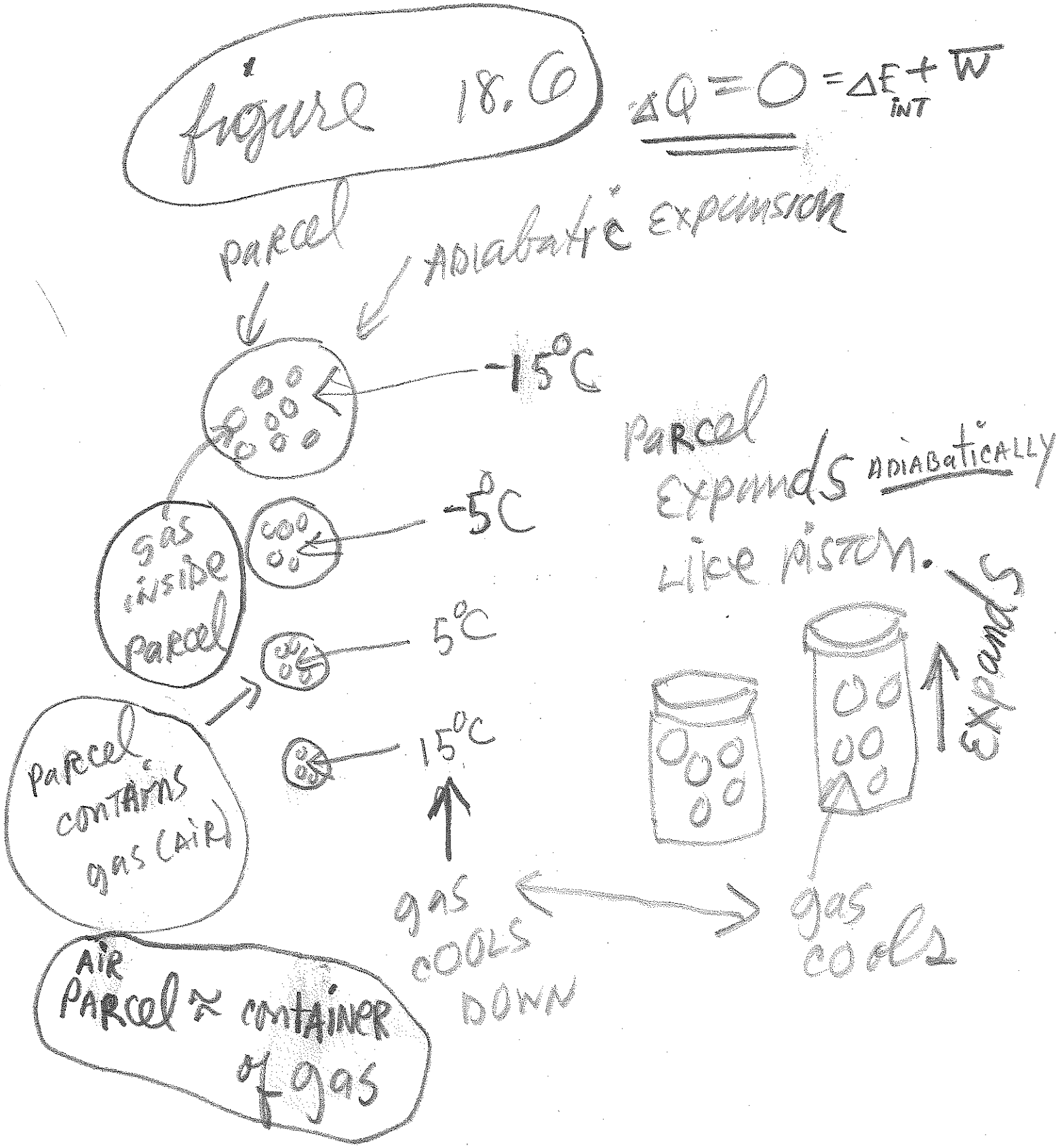
WARM gas pushes on piston with FORCE F.

piston moves up (gas expands). gas cools down. gas loses energy to work it does to move piston up.

Atmospheric behavior and adiabatic process.

figure 18.6

$\Delta Q = 0 = \Delta E_{INT} + W$



LAB NOTES BELOW

OBJECTIVE---To measure pressure as a function of temperature and to extrapolate to absolute zero.

REFERENCE---CH. 14 TO 18, ESPECIALLY, CHS. 14 AND 18: See figures 14.3, 18.1 and 18.3 in the textbook.

COMPUTATIONS---You should be able to find the slope and the x or y intercept of a line from two data points. You should also be able to make a simple chart in Excel.

EQUIPMENT:

Bucket
Pressure gauge
Thermometer
Electric range
Table clamp
Long and short rod
Rod clamps

PROCEDURE:

Fill the bucket with water so that the bulb of the pressure gauge can be completely submerged.

1. **Place the bucket on the electric range and submerge the bulb under the water; secure the pressure gauge with rods and clamps as in the demonstration set-up.**
2. **Submerge the thermometer probe under the water. The probe should not be in direct contact with the bottom of the bucket. You may have to tape the thermometer to the gauge rod.**
3. **Measure the temperature.**
4. **Measure the pressure. Note that the pressure may be offset from the true value at the initial temperature of the water.**
5. **Turn on the electric range to high. Observe the rise in the temperature of the water.**
6. **Record the pressure at the intermediate points of about 40 ^{0}C , 60 ^{0}C, and 80 ^{0}C. Record the exact values of the pressure and temperature.**
7. **Record the pressure at the maximum water temperature which should be about 100 ^{0}C.**
8. **Calculate the slope and <u>T-intercept of the line P vs. T</u> from the <u>initial</u> pressure and temperature and the <u>final</u> pressure and temperature. Note that P is the y-axis and T is the x-axis in this case. SEE LECTURE NOTES. Calculate the T intercept in kelvin. Find the percent error from the theoretical value. REVIEW YOUR HIGH SCHOOL ALGEBRA**
9. **Plot the best-fit line of <u>T vs. P</u> in Excel using the data points. Note that T is the y-axis and P is the x-axis in this case. (Be careful !)Calculate the percent error between the T-intercept and the theoretical value. REVIEW EXCEL.**

FOCUS HERE

T_1 =	P_1 =
T_2 =	P_2 =
T_3 =	P_3 =
T_4 =	P_4 =
T_5 =	P_5 =

Questions . Short answers.

1. What would happen (classically) to the kinetic energy of the molecules of a gas if its temperature could reach 0 K?
2. What is the lowest achieved temperature in Kelvin ? Cite source w/ short summary
3. Compute the product of the numerical answer to the last question and the temperature of the interior of the sun? (i.e. What answer do you get when you multiply them together?)
4. What happens at the triple point of water ?
5. What is the approximate value of the triple point temperature in ^{0}C to the nearest hundredth place?
6. What is the letter of the correct answer? The temperature of 1 cup of water is 25 ^{0}C. The temperature of 30 gallons of water is 25 ^{0}C. The average kinetic energy of the molecules in the cup is (a) less than those in the 30 gallons container (b) more than those in the 30 gallon container (c) the same

ANSWER QUESTIONS

(8), (9.)

$$\left| \frac{T_{ex} - T_{acc}}{T_{acc}} \right| \times 100\%$$

T_{ex} from excel (9.)
and algebra (8.)

$t_{acc} = -273\,°C$