9-11-13

Quantity of heat

sec 17.5

mgh = heat fig 17.5

mgh in Joules, heat in cals

$$1\,cal = 4.186\,J$$

$$\Delta Q = mc\Delta T$$

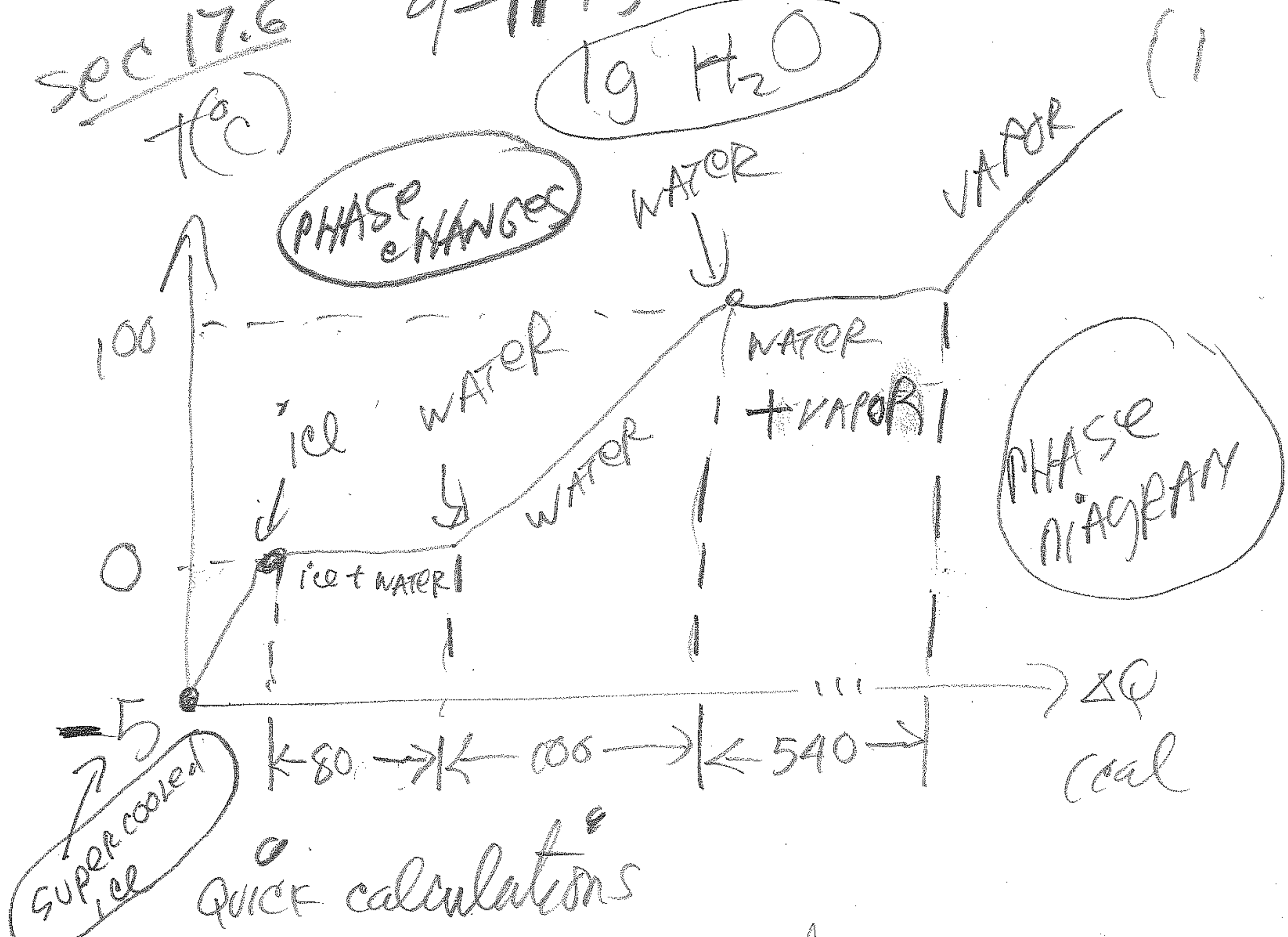
c = speufic heat

$$C_w = \frac{4190\,J}{kg\,°C} = \frac{1\,cal}{g\,°C}$$

Example: $\Delta T = ?$ if $\Delta Q = 3\,cal$ and $m = 1g$

$$\Delta T = \frac{2\,cal}{(1\,cal/g\,°C)\cdot(1g)} = 2°C$$

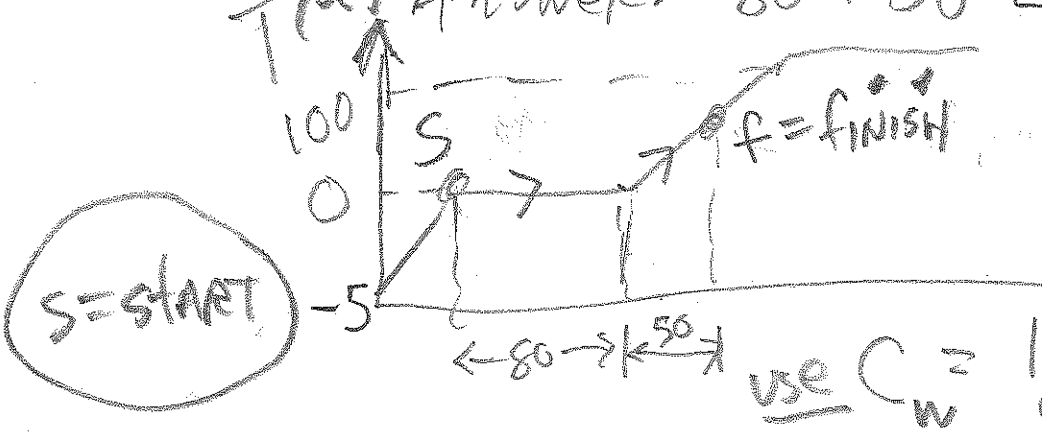
sec 17.6 9-11-13 (1g H_2O) (1



QUICK calculations

(1) How much ΔQ needed to turn 1 g of ice @ 0°C into 1 g of water at 50°C?

Answer: 80 + 50 = **130 cal**



use L_f = heat of fusion.

$L_f = 80 \frac{cal}{g}$.

use $C_w = \frac{1\ cal}{g\ °C}$ = specific heat.

MORE FORMAL calculation:

$$\Delta Q = m \cdot L_f + m \cdot C \cdot \Delta T$$

$$= (1g)\left(\frac{80\,cal}{g}\right) + (1g)\left(\frac{1\,cal}{g\,°C}\right)(50-0)°C$$

$$= (80 + 50)\,cal$$

$$= \boxed{130\,cal}$$

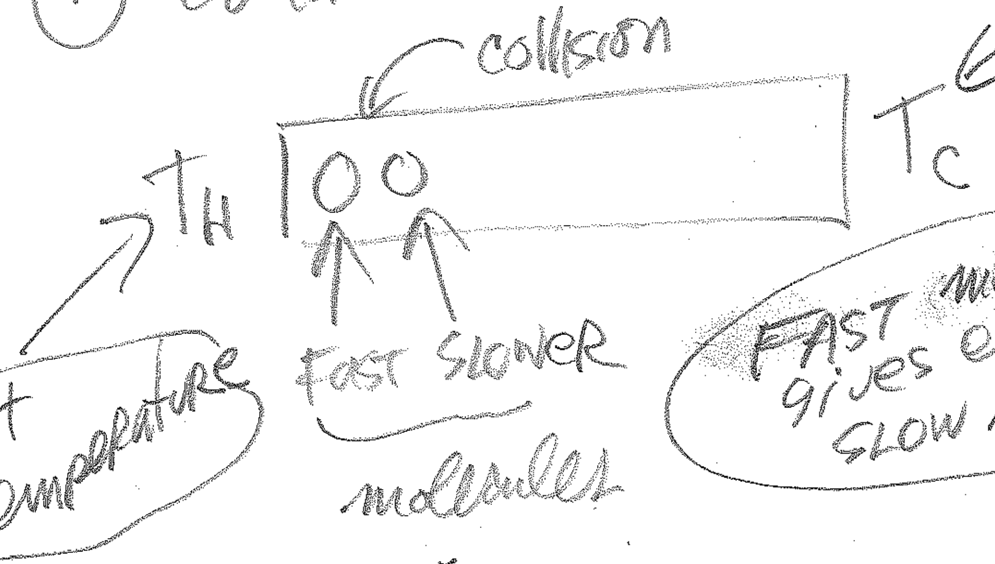
NOTE: L_v = heat of vaporization

$$L_v = 540\,\frac{cal}{g} \quad (H_2O)$$

NOTE: L_f, L_v and C are intrinsic properties independant of MASS.

Heat Transfer Mechanisms: (3)

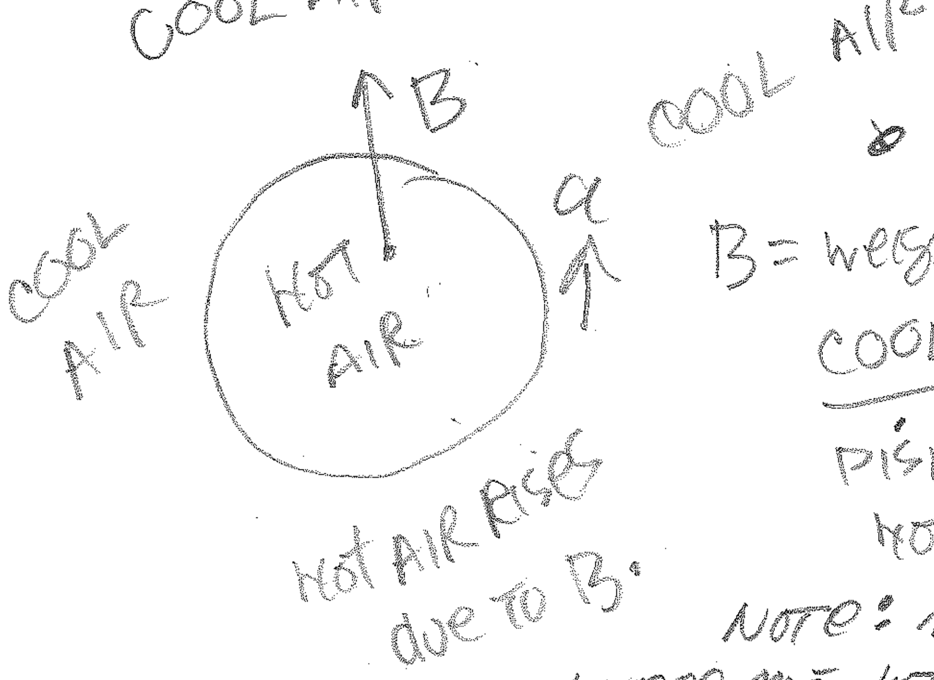
(1) conduction..



FAST molecules gives energy TO SLOW MOLECULES

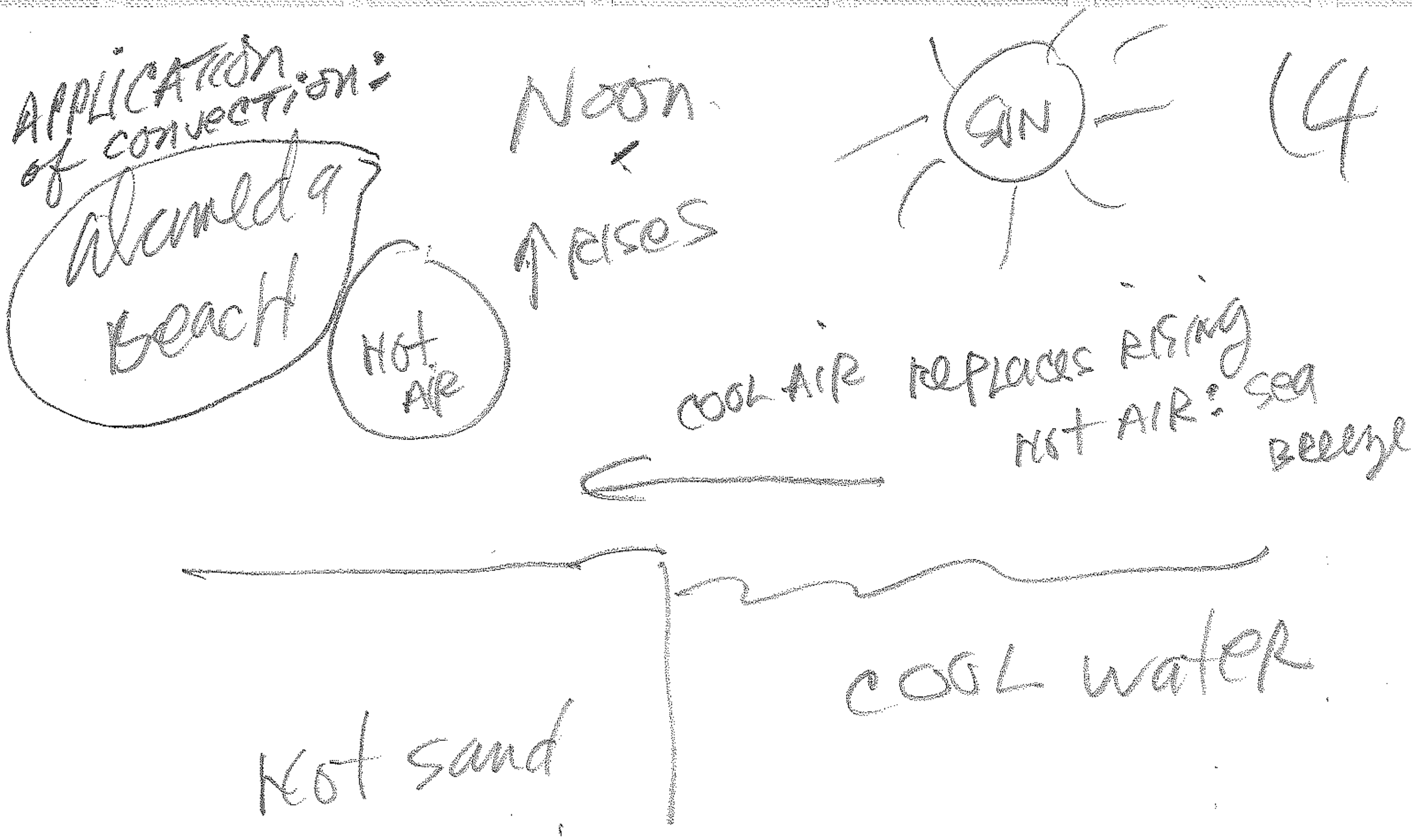
(2) CONVECTION

Hot Rocket of AIR SURROUNDED BY COOL AIR



B = weight of COOL AIR DISPLACED by HOT AIR

NOTE: $ma = B - mg$ WHERE m = HOT AIR MASS.



at noon sand hotter than H_2O since

$$C_{sand} < C_{water}.$$

OBJECTIVE---To measure pressure as a function of temperature and to extrapolate to absolute zero. REFERENCE---CHS. 17, 18. Check out the T intercept ! What do you see ? Why do the lines converge there ? SEE FIGURE 17.5

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 OR LOGGER PRO

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 T-intercept of the line P vs. T from the initial pressure and temperature and the final pressure and temperature. Note that P is the y-axis and T is the x-axis in this case. See figure 17.5 in the textbook. Calculate the T intercept in kelvin. Find the percent error from the theoretical value.**
9. **Plot the best-fit line of T vs. P in Excel OR LOGGER PRO 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.**

T_1 = Room temp	P_1 = P_1 ± offset
T_2 = 40	P_2 = P_2 ± offset
T_3 = 60	P_3 =
T_4 = 80	P_4 =
T_5 = 100	P_5 =

Questions.

1. What would happen (classically, not quantum mechanically i.e., IGNORE THE UNCERTAINTY PRINCIPLE) 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 ? Research and cite your source. Explain the experiment you cite using language appropriate to a 4C student audience in a paragraph or 2 as needed.

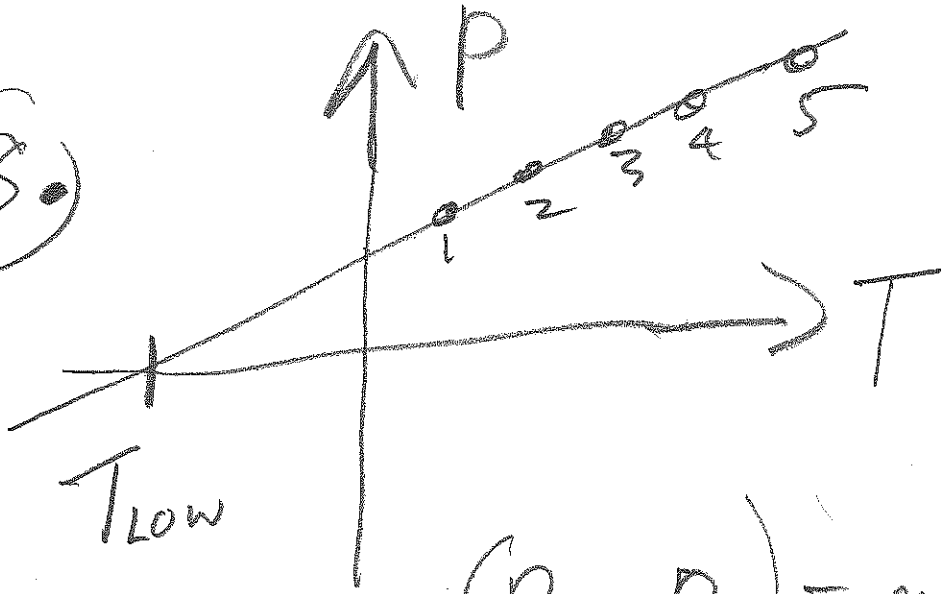
3. Compute the product of the numerical answer to the last question and the temperature of the interior of the sun? (i.e. What answer do you get when you multiply them together?)

4. What happens at the triple point of water ? and what is the approximate value of the triple point temperature in ^{0}C to the nearest hundredth place?

5. REFERENCE CH. 18: 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 . EXPLAIN YOUR CHOICE IN A FEW SENTENCES or more.

R

(8.)



$$(P - P_1) = m(T - T_1)$$

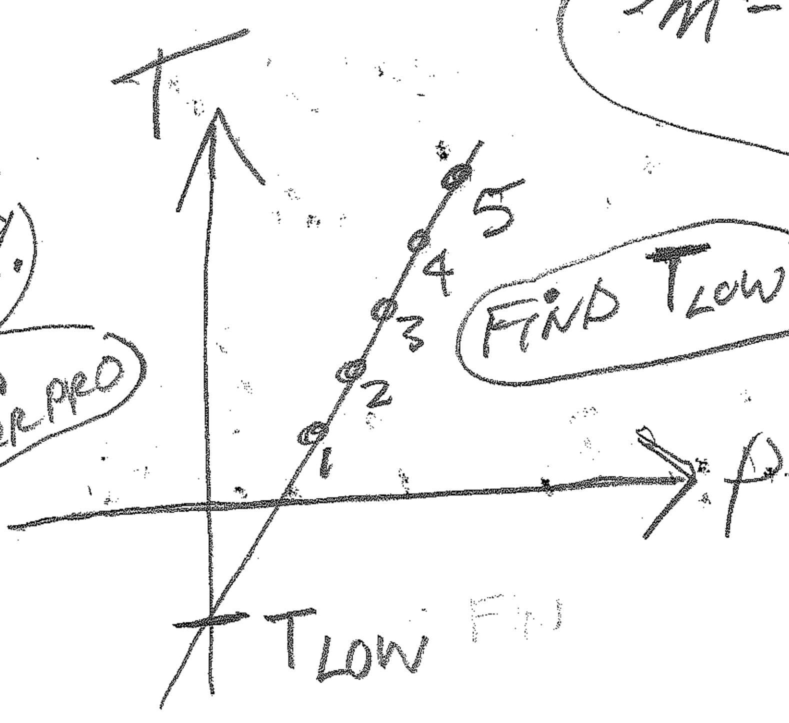
set $P = 0$
and FIND $T = T_{LOW}$

$$0 - P_1 = m(T_{LOW} - T_1)$$

$$m = \frac{P_5 - P_1}{T_5 - T_1}$$

(9.)

Excel; LoggerPro

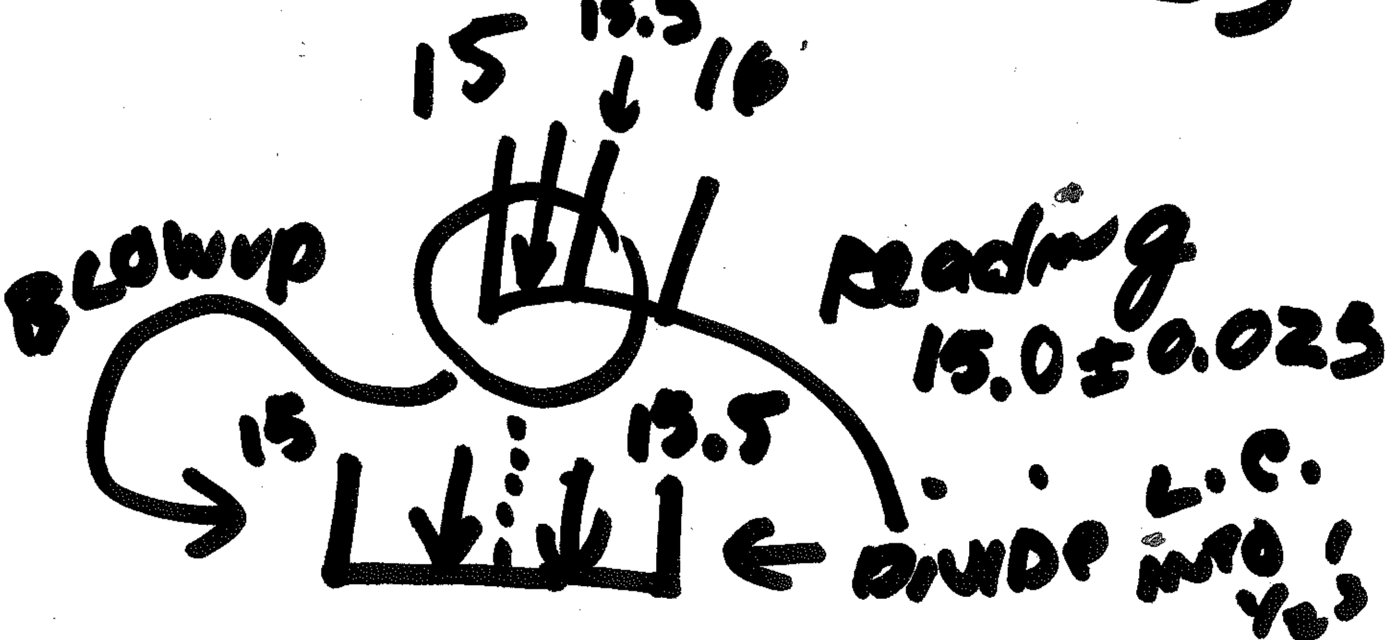


FIND T_{LOW}

L.C. = LEAST count of the METER is

0.5 psi

error = ± 0.025



C4

15.00 ± 0.025

15.00 ± 0.03

OR POSSIBLY

15.50 ± 0.03