

PHY 117 HS2026

Week 6, Lecture 1

Oct. 20th, 2026

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TODAY:

thermodynamics

OLAT Quiz stats: 677 students

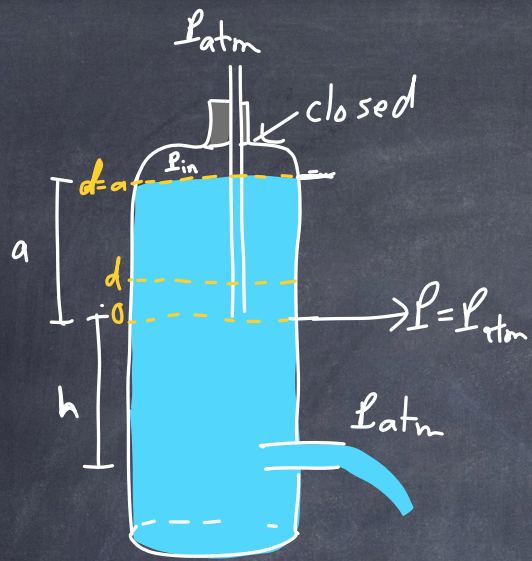
Quiz 1: 283

Quiz 2: 246

Quiz 3: 158

Quiz 4: 114

Quiz 5 + 6 come out this week.



Marriotte's bottle: constant velocity
water out of the hole.



From Marriotte's bottle (fluids)
to Marriotte's law (gas)



with this, we start our unit on:

Thermodynamics - study of temperature, heat, and the exchange of energy. (mechanical work)

Macroscopic scale: measurable properties:
volume, pressure, temperature.
 $\downarrow$
force/area

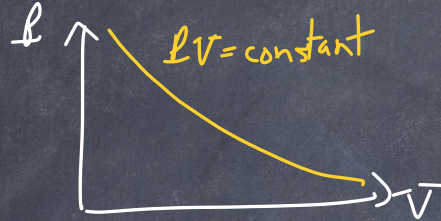
we will have 5 "k" variables
so I will write them differently:

K = Kelvin
 k = Boltzmann constant
 K = Kinetic energy

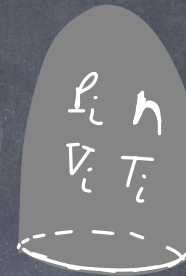
$k = \text{spring constant}$
 $\alpha = \text{coefficient of thermal conductivity}$

Ideal gases: randomly moving point particles
with no inter-particle interactions.

Boyle - Marriotte Law: $PV = \text{constant}$
for an ideal gas at
constant temperature



Why does our hot air balloon rise when air inside is heated?
 pressure decreases?
 density decreases?
 volume increases?



Visually:

before heating

during heating

after heating



P_i : pressure inside

$P_i = P_{atm}$

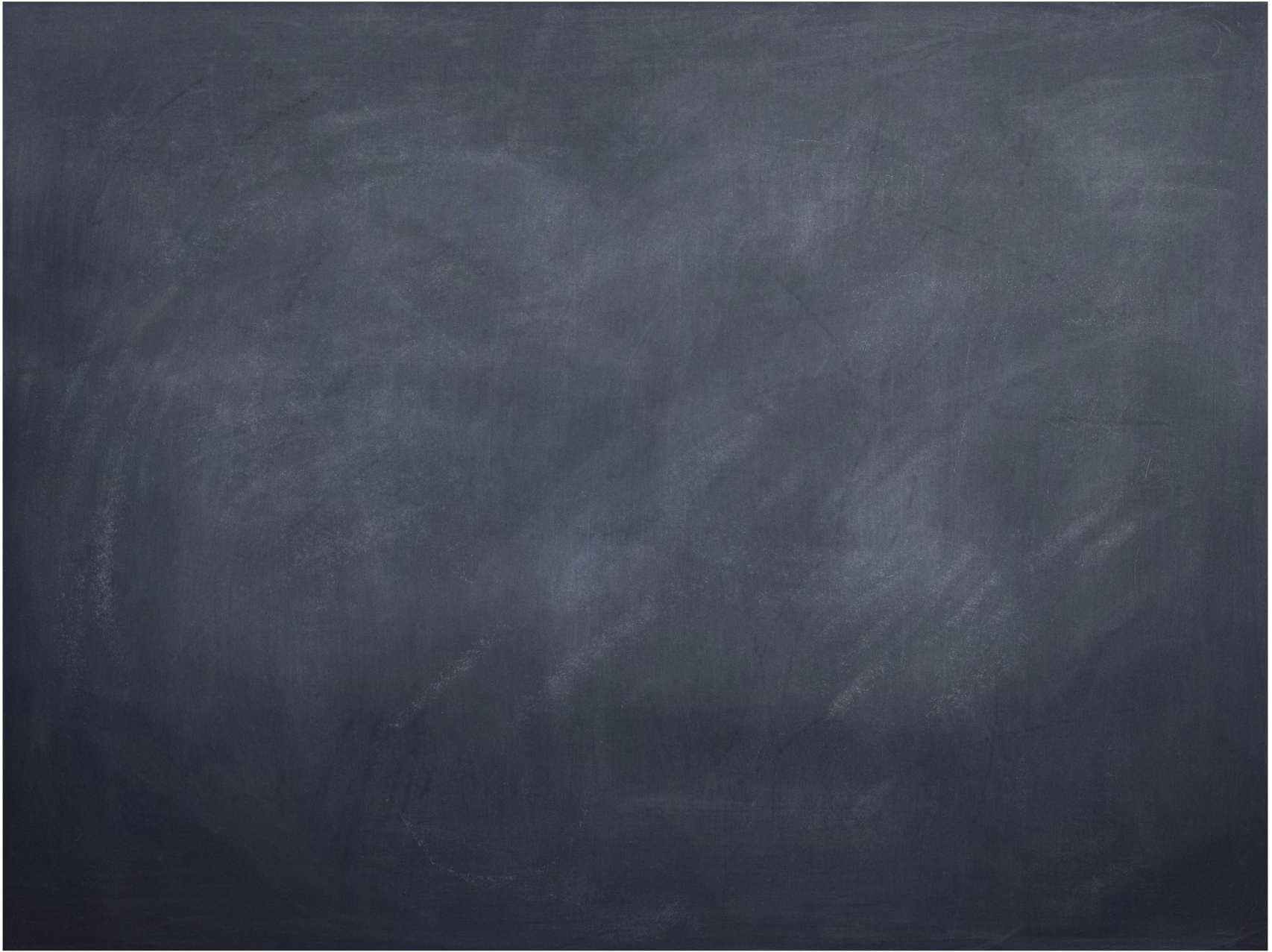
V_i = volume inside

n_i = # moles air inside

T_i = temp. inside

what is temperature?

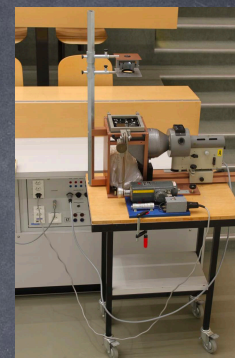
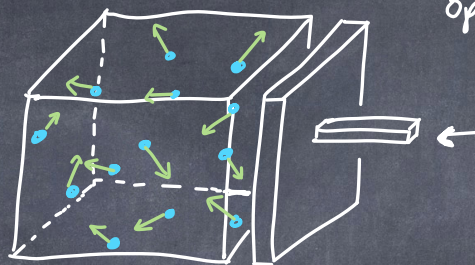




But what is
temperature really?
At the molecular
level?

box (5 closed sides)

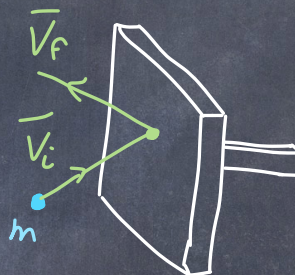
piston pushing 6th
open side



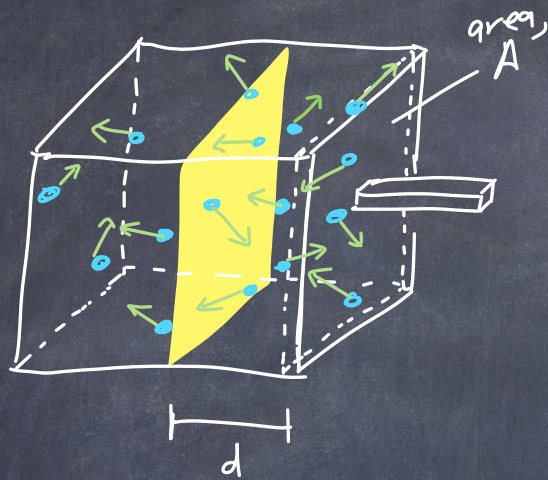
gas of molecules

we put molecules in the box, and close piston.

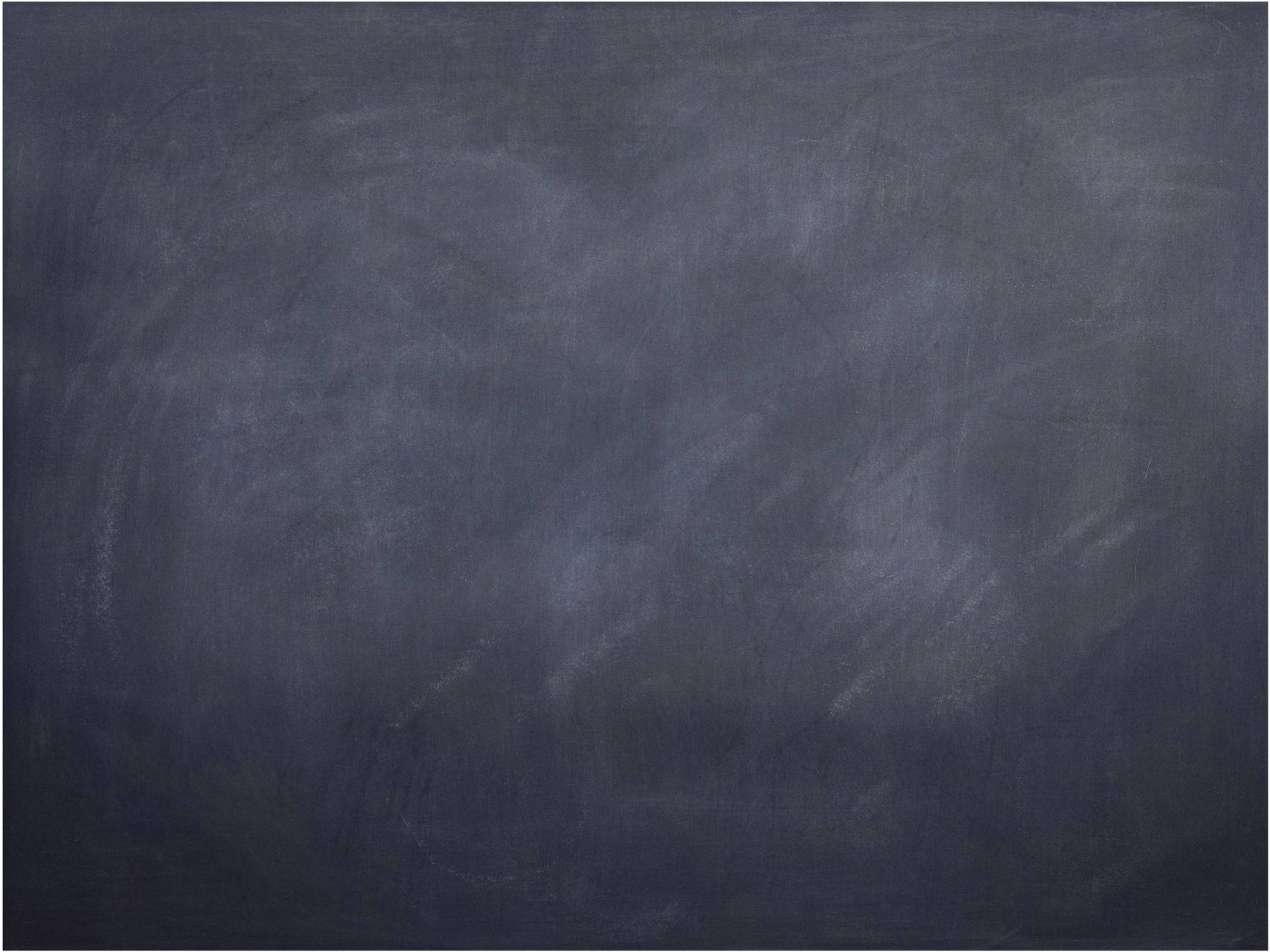
when one molecule
hits the piston,
its momentum
changes.

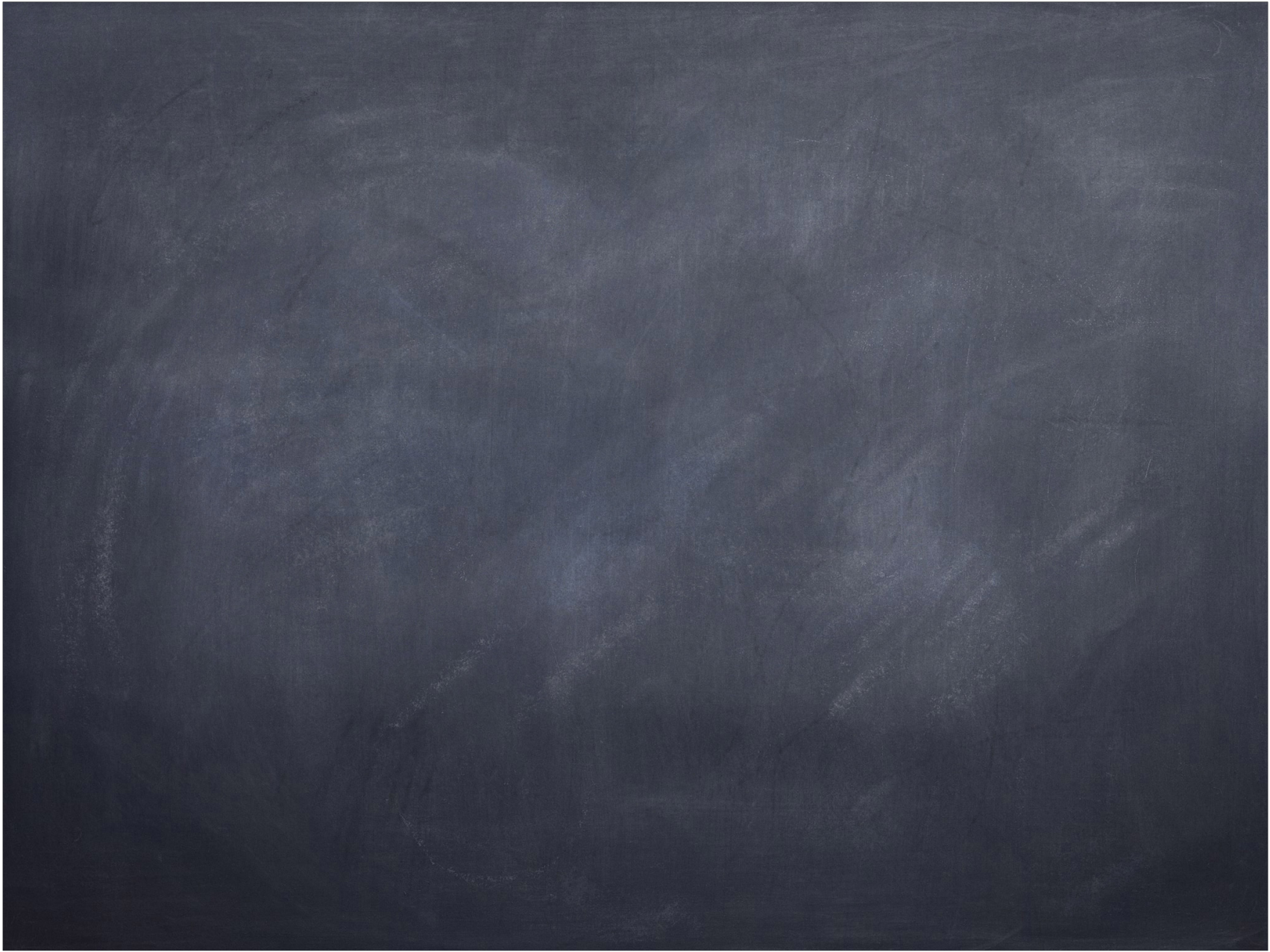


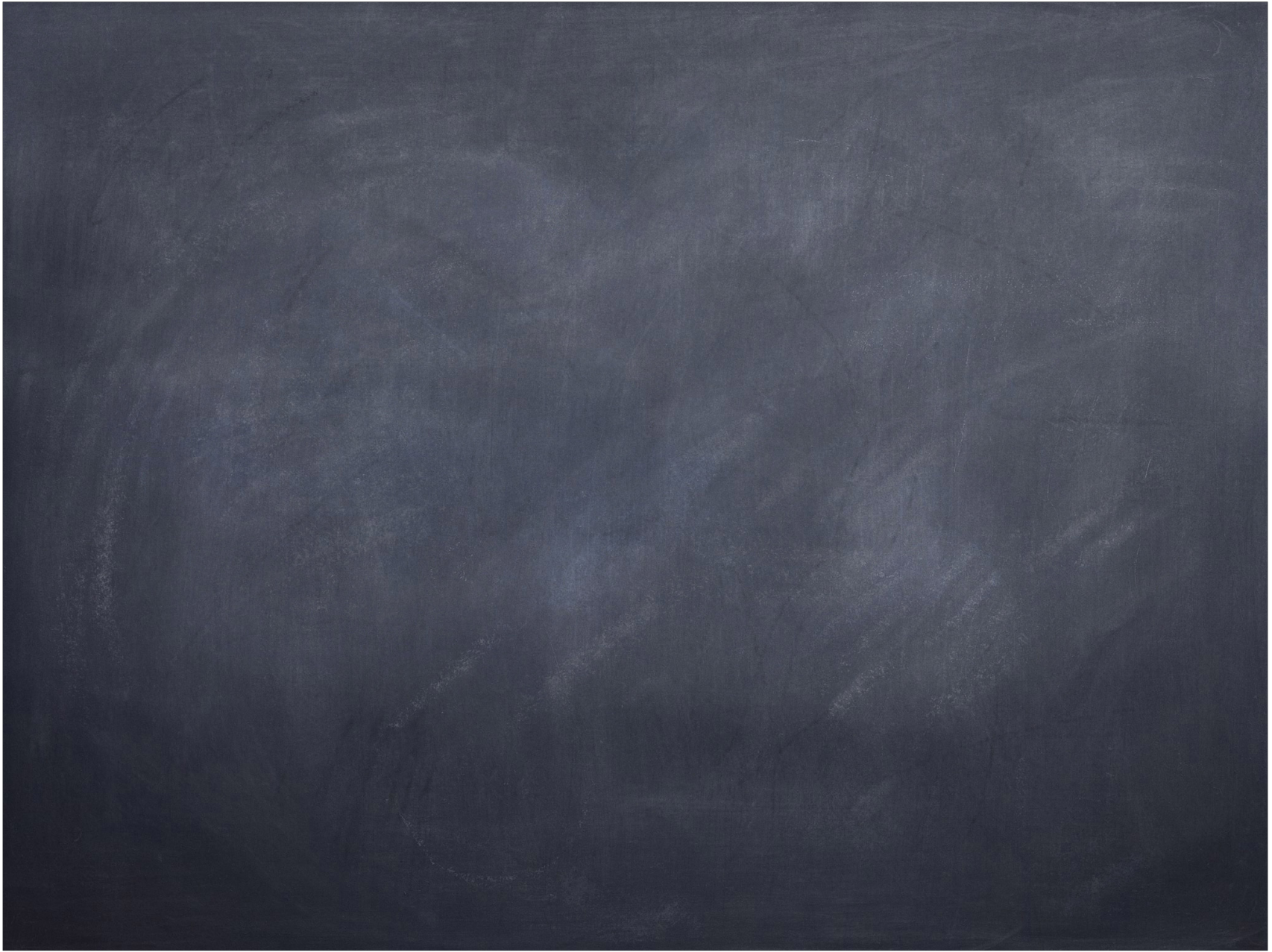
The total volume of box is V

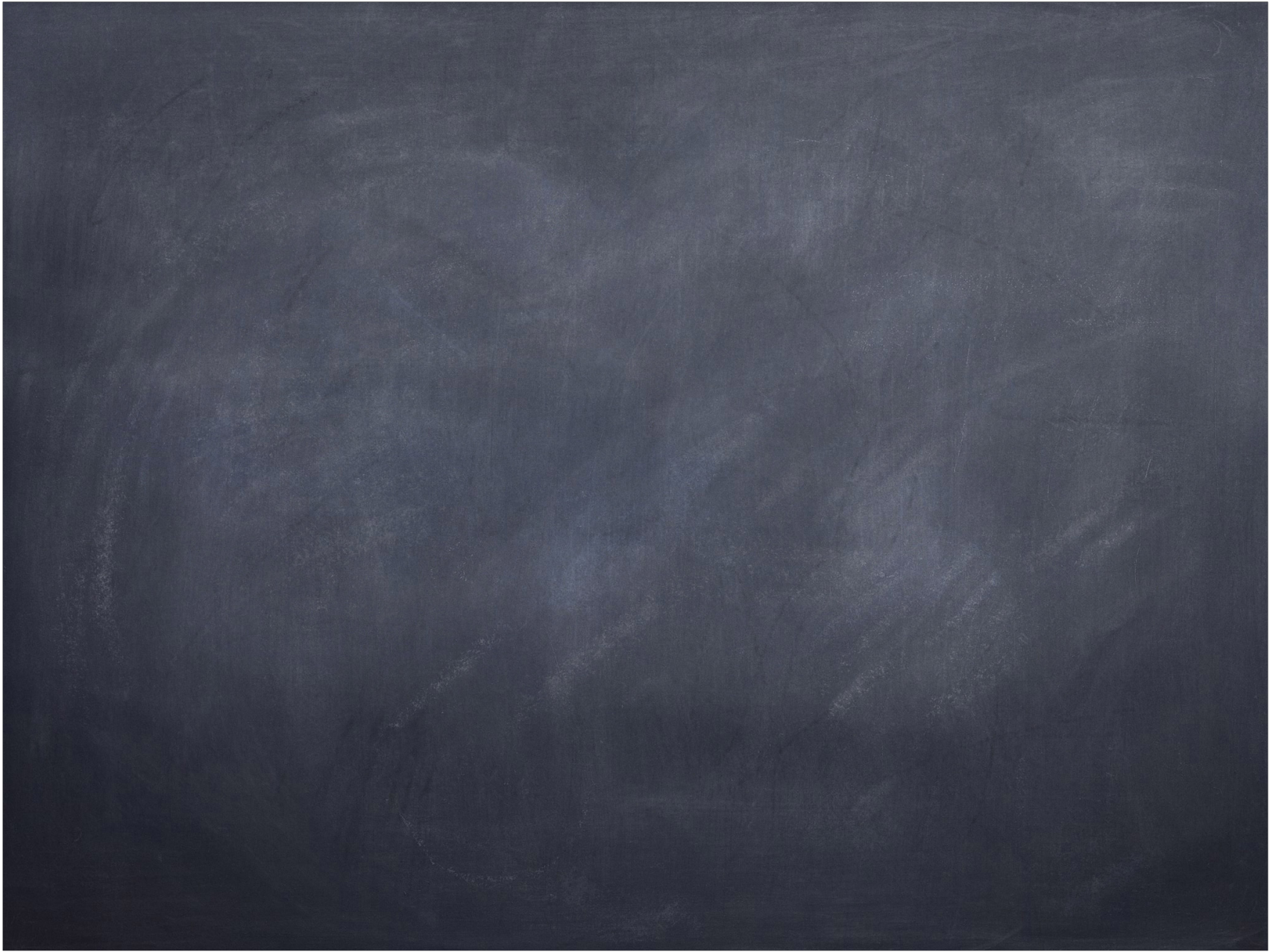


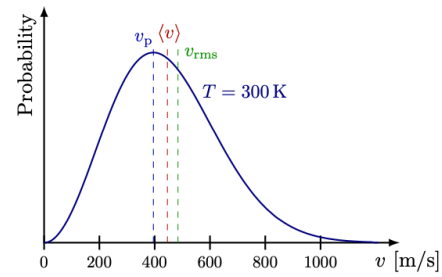
The total momentum change of all ptc/s hitting piston:



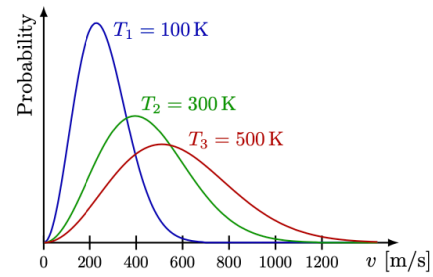








(a) The distribution is asymmetric.



(b) For different temperatures.

Figure 17.4: Maxwell-Boltzmann distribution for oxygen gas O_2 with atomic weight ~ 16 per atom.

Quiz 2:

The spring constant would be the same on the moon than on the earth. ($k = \frac{mg}{\Delta x}$, and g is different on the moon)

Unanswered

Right

Wrong

answer

3

125

117

k is a constant, independent of the type of force.
If we pull on a spring with any force F , it will extend by Δx , so $k = \frac{F}{\Delta x}$.

More info...

for instance, assume
 $g_{\text{moon}} = g_{\text{earth}}/6$



$$g_{\text{earth}} = 9.81 \text{ m/s}^2$$

To calculate k , we hang a weight.

$$k = \frac{F}{\Delta x} = \frac{mg_{\text{earth}}}{\Delta x_{\text{earth}}}$$



$$g_{\text{moon}} = 1.62 \text{ m/s}^2$$

$$\Delta x_m = \Delta x_{\text{earth}}/6$$

$$k = \frac{mg_{\text{moon}}}{\Delta x_{\text{moon}}} = \frac{mg_{\text{earth}}/6}{\Delta x_{\text{earth}}/6}$$

$$k = \frac{mg_{\text{earth}}}{\Delta x_{\text{earth}}}$$

Quiz 3:

Question

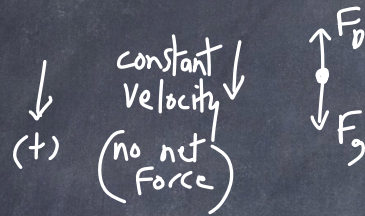
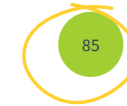
What is true about a falling object?

If the object reaches a constant velocity (terminal velocity), there is no net work on the object.

5

T

F



$$\Sigma F = F_g - F_D = 0$$

forces balance

F_g does (+) work

F_D does (-) work

$$W_g = +F_g \cdot \Delta x \quad W_d = -F_d \cdot \Delta x$$

$$W_{net} = W_g + W_d = 0$$

T

F

The area under the velocity vs. time curve represents acceleration.

4



$$a = \frac{dv}{dt} = \frac{\Delta v}{\Delta t}$$

acceleration is the slope
of velocity vs. time

$$v = \frac{dx}{dt} \Rightarrow dx = v dt$$

$$\int dx = \int v dt$$

$$x = \int v dt$$

the area under v vs. t curve
is position

Quiz 4:

T

F

Unanswered

Right

Wrong

When torque is zero, angular momentum is zero.

2

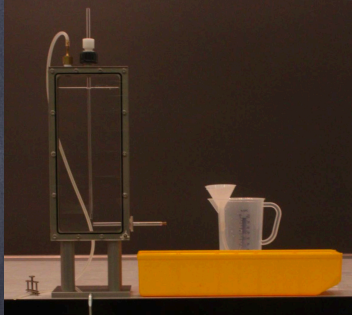
54

58

Imagine a wheel spinning at constant angular speed.

⇒ It has no torque so its not accelerating.

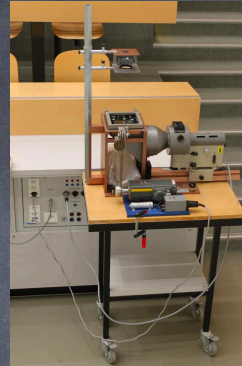
⇒ But it does have constant angular momentum $L = I\omega$.



H21



Th57



Th36



Th58



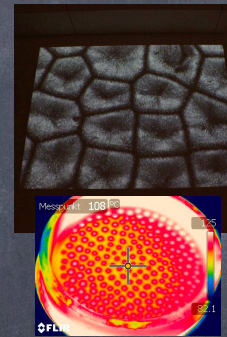
Th12



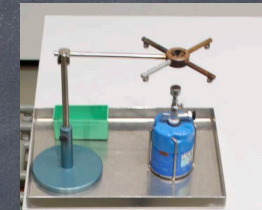
Th63



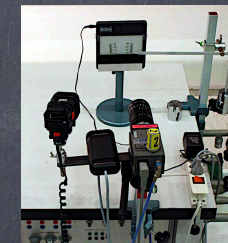
Th54



Th35



Th20



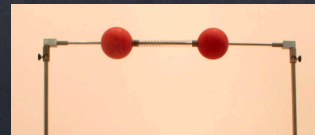
E12



Th19



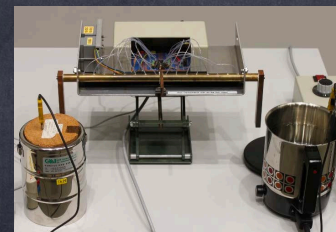
Th28



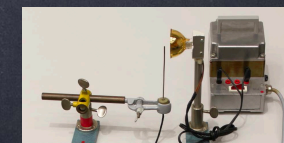
Th27



Th2



Th22



Th48