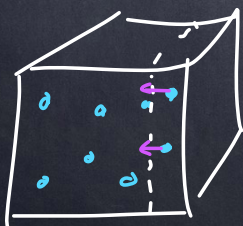


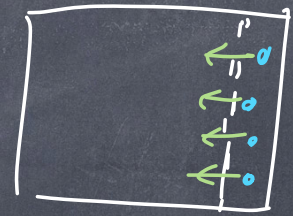
# PHY 117 HS2023

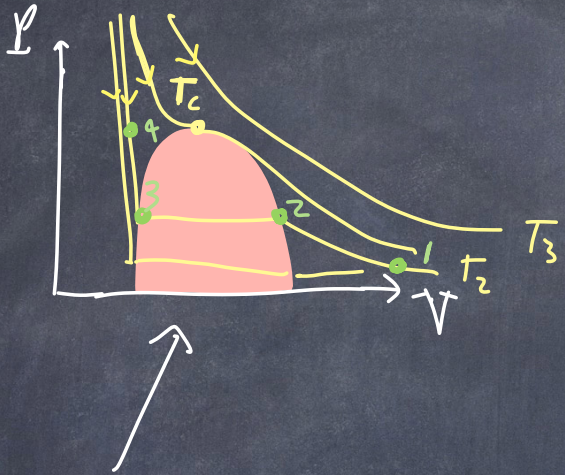
Week 6, Lecture 2

Oct. 25th, 2023

Prof. Ben Kilminster

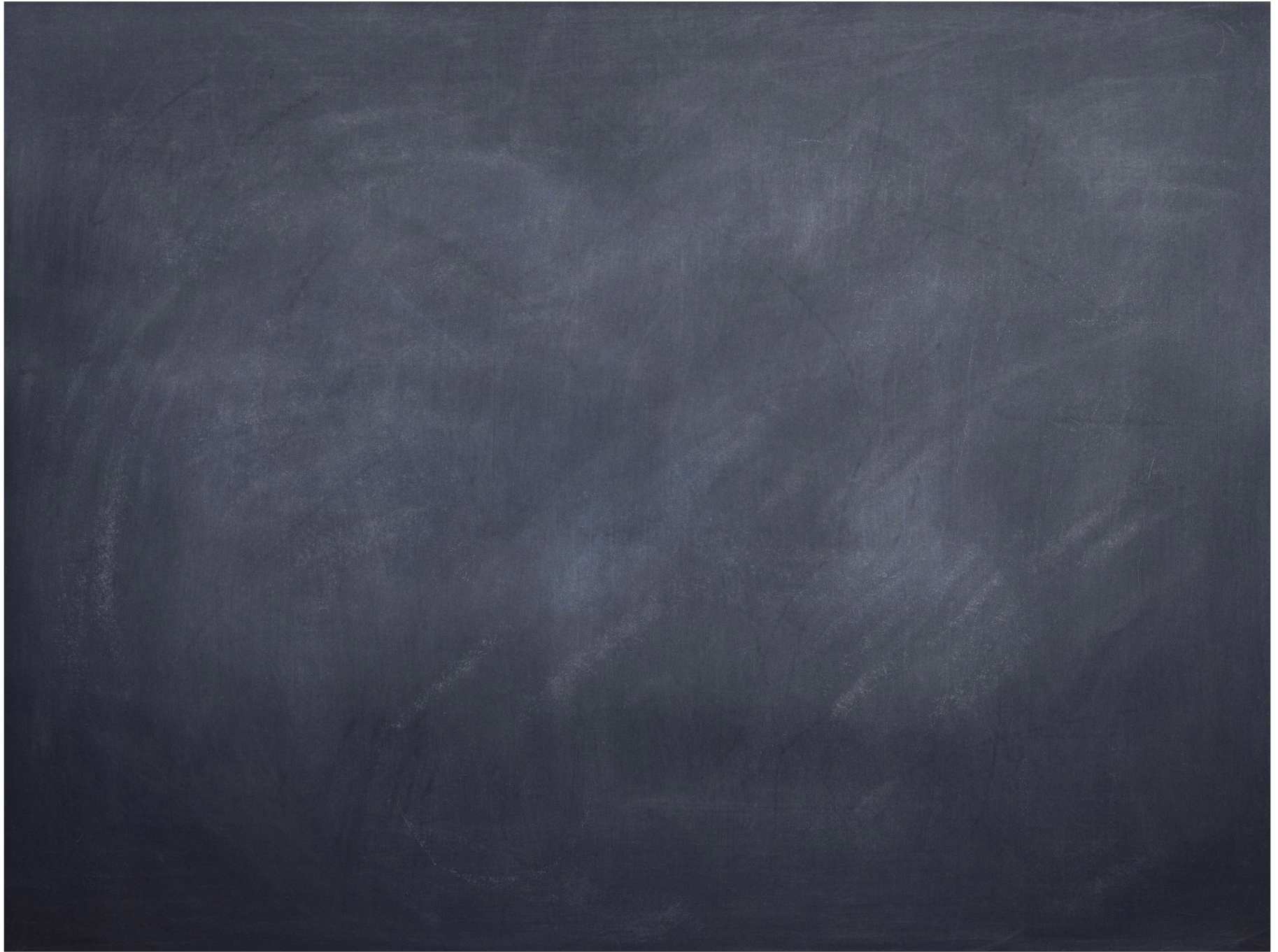




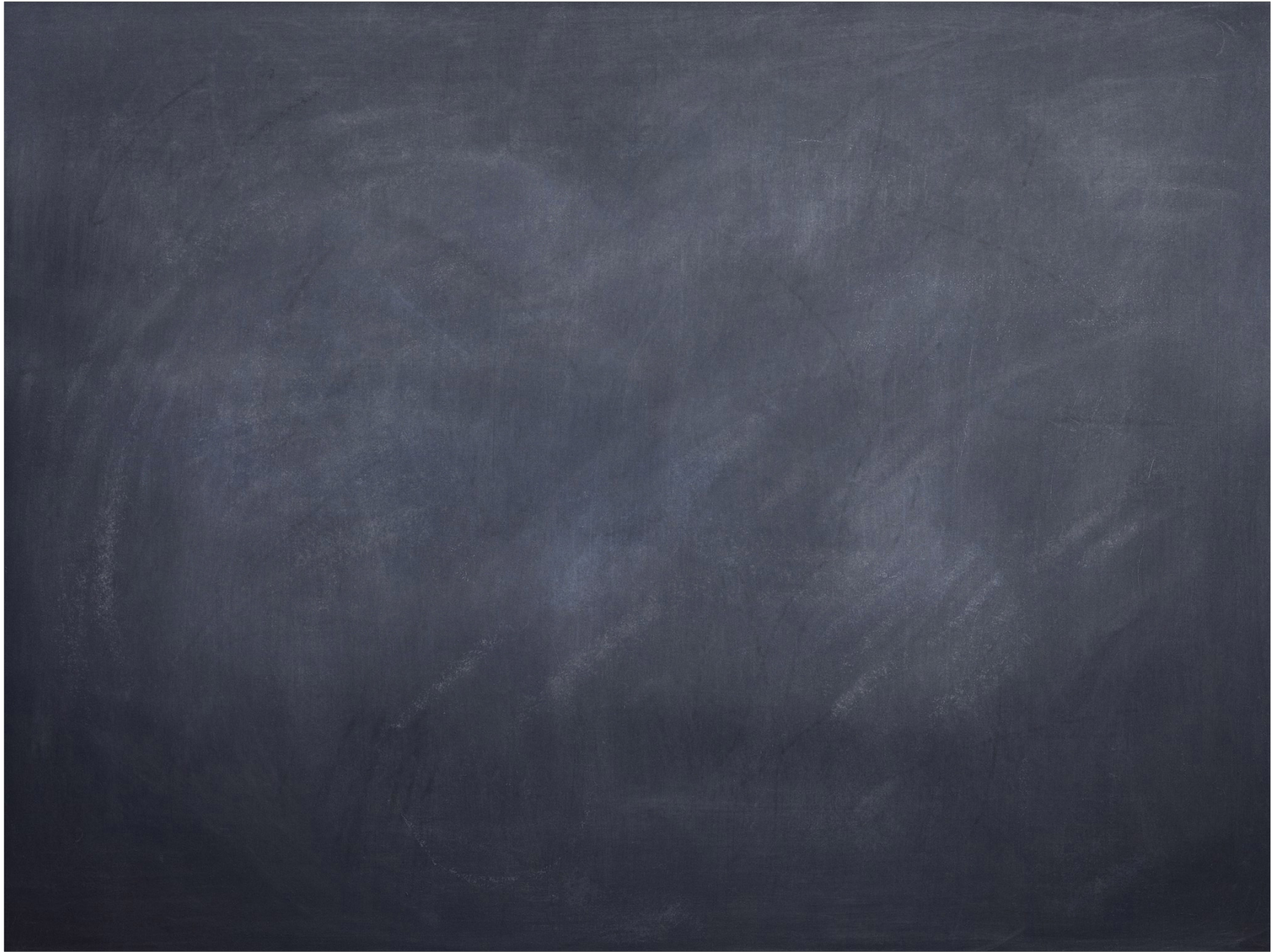


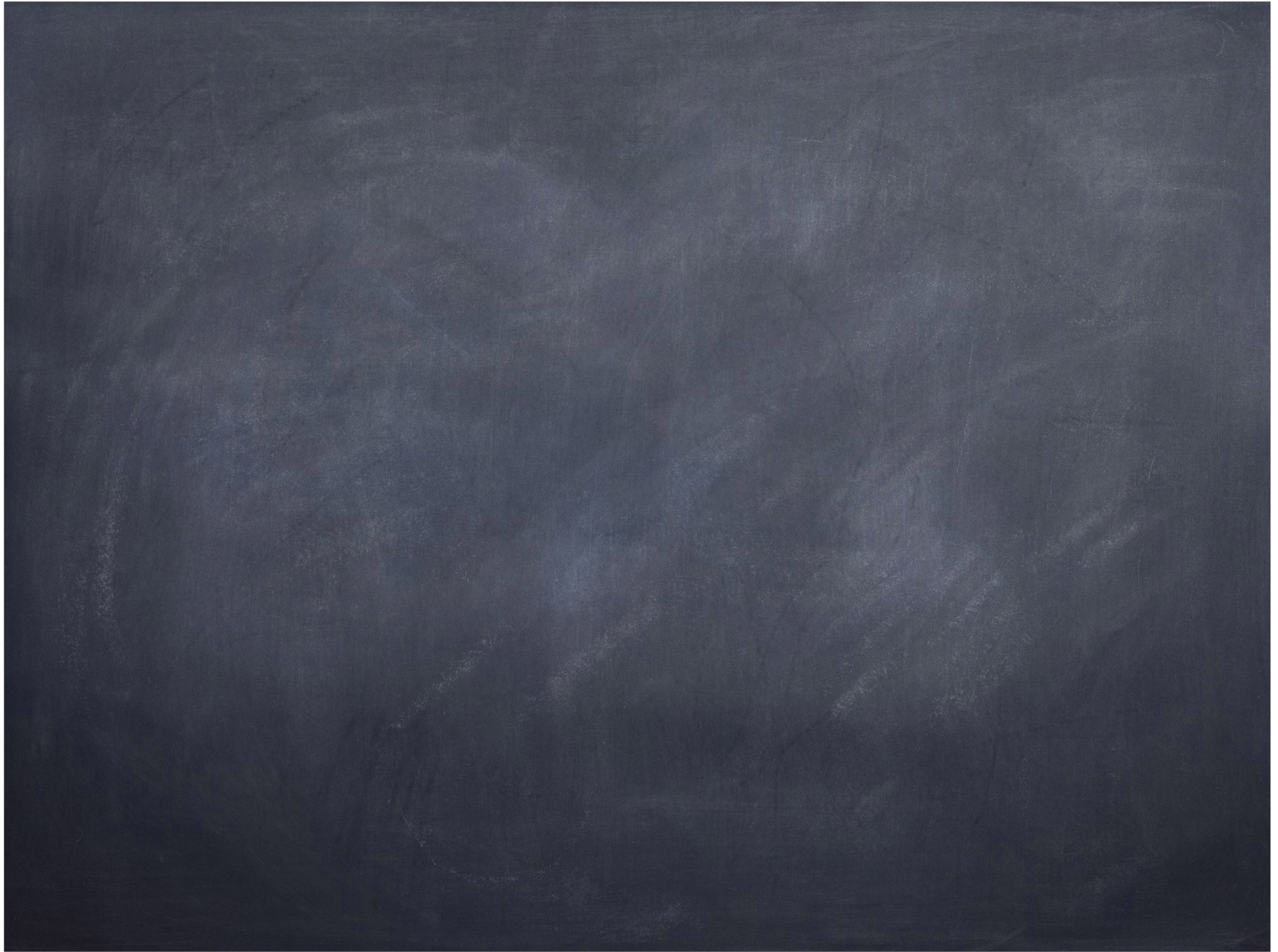
② → ③ :

③ → ④ :



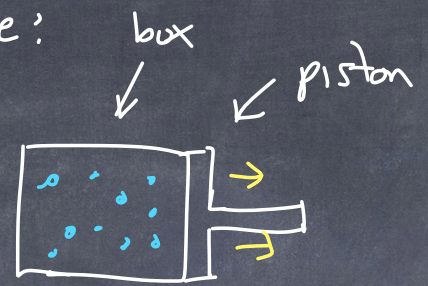




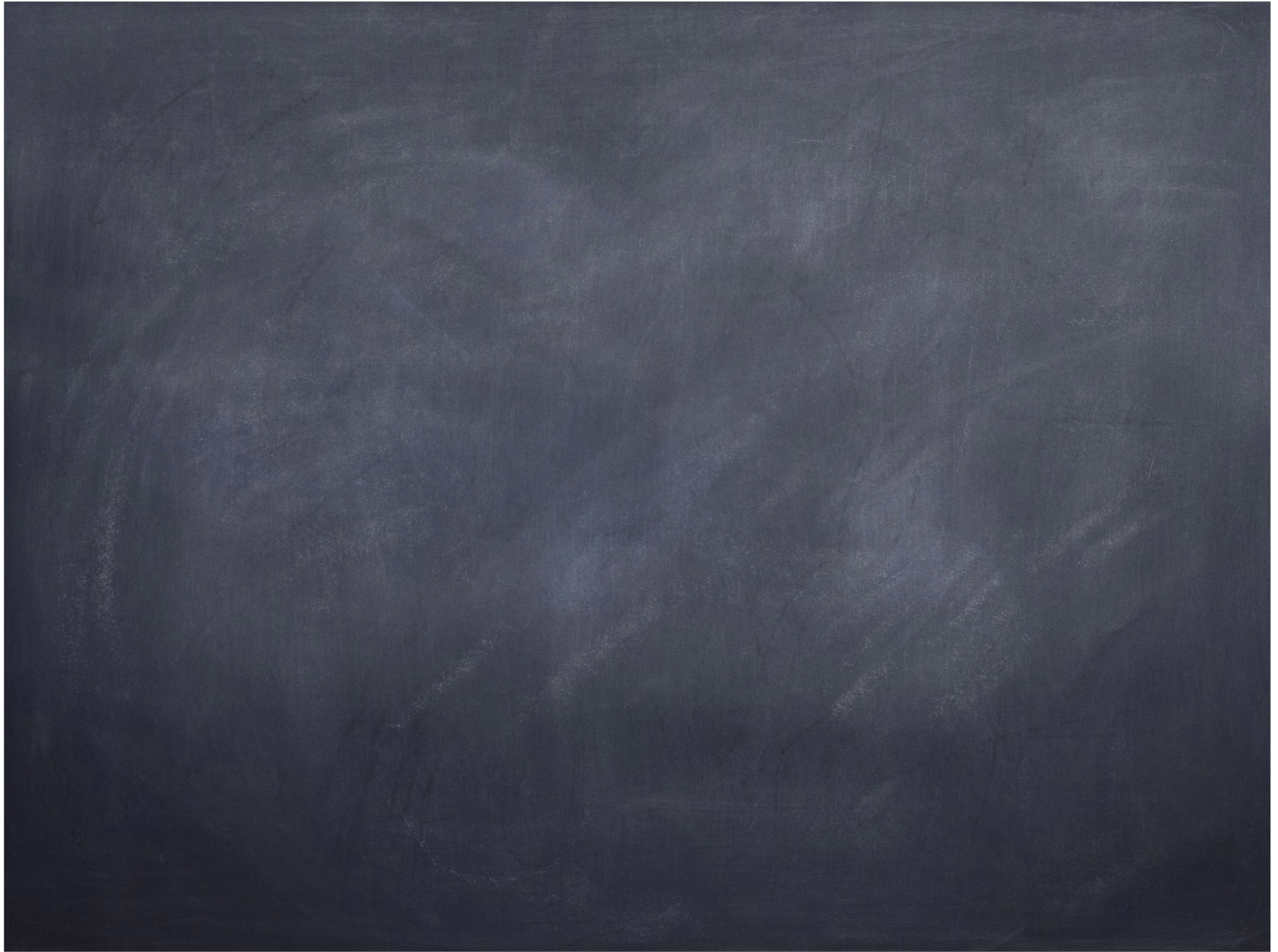




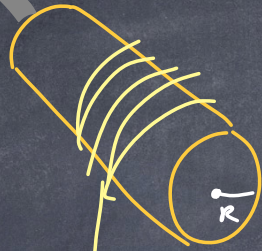
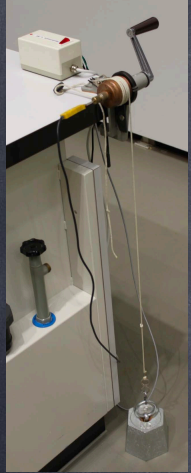
for example:



heat  
gas



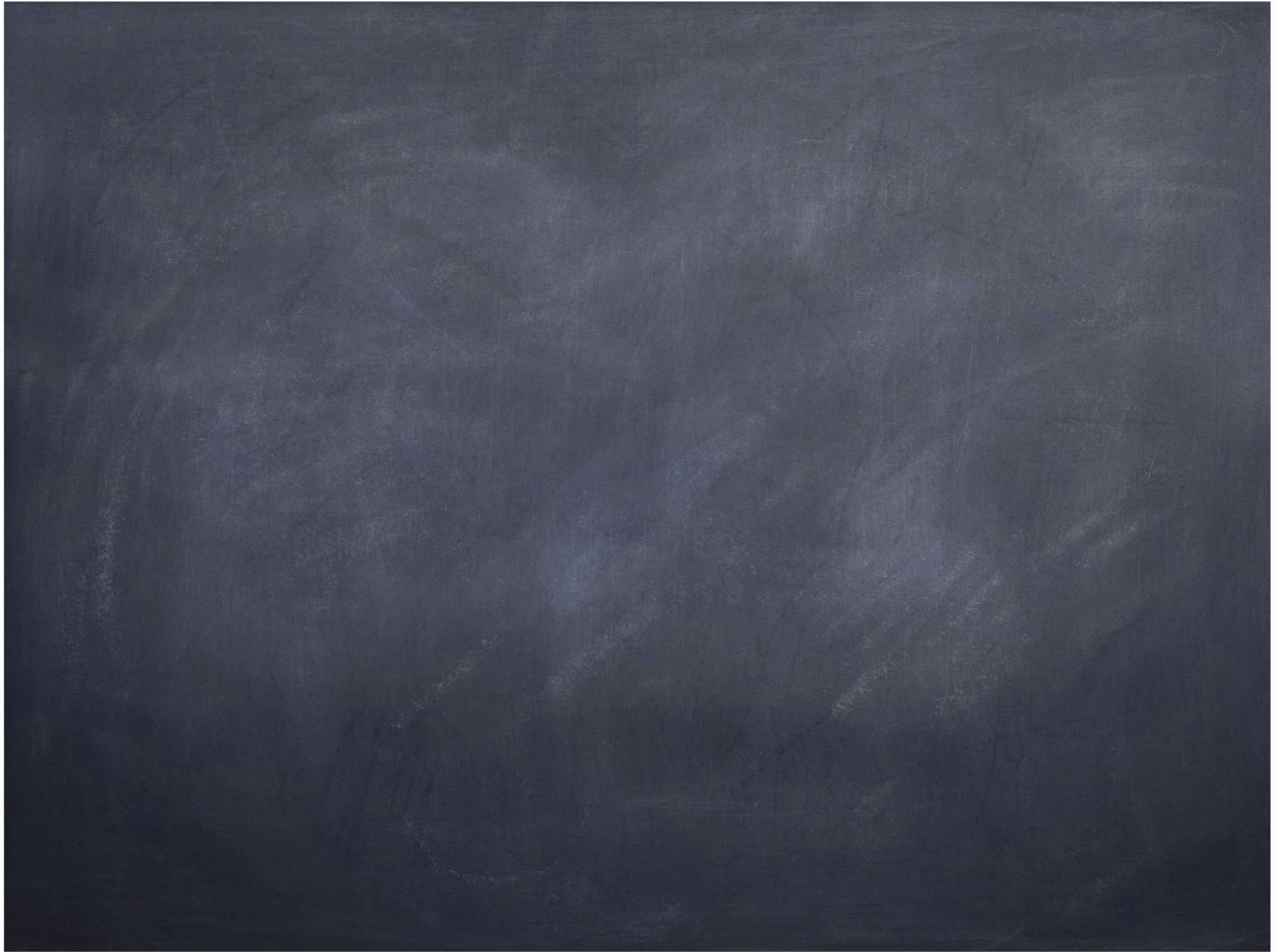
Can we use torque to increase temperature?

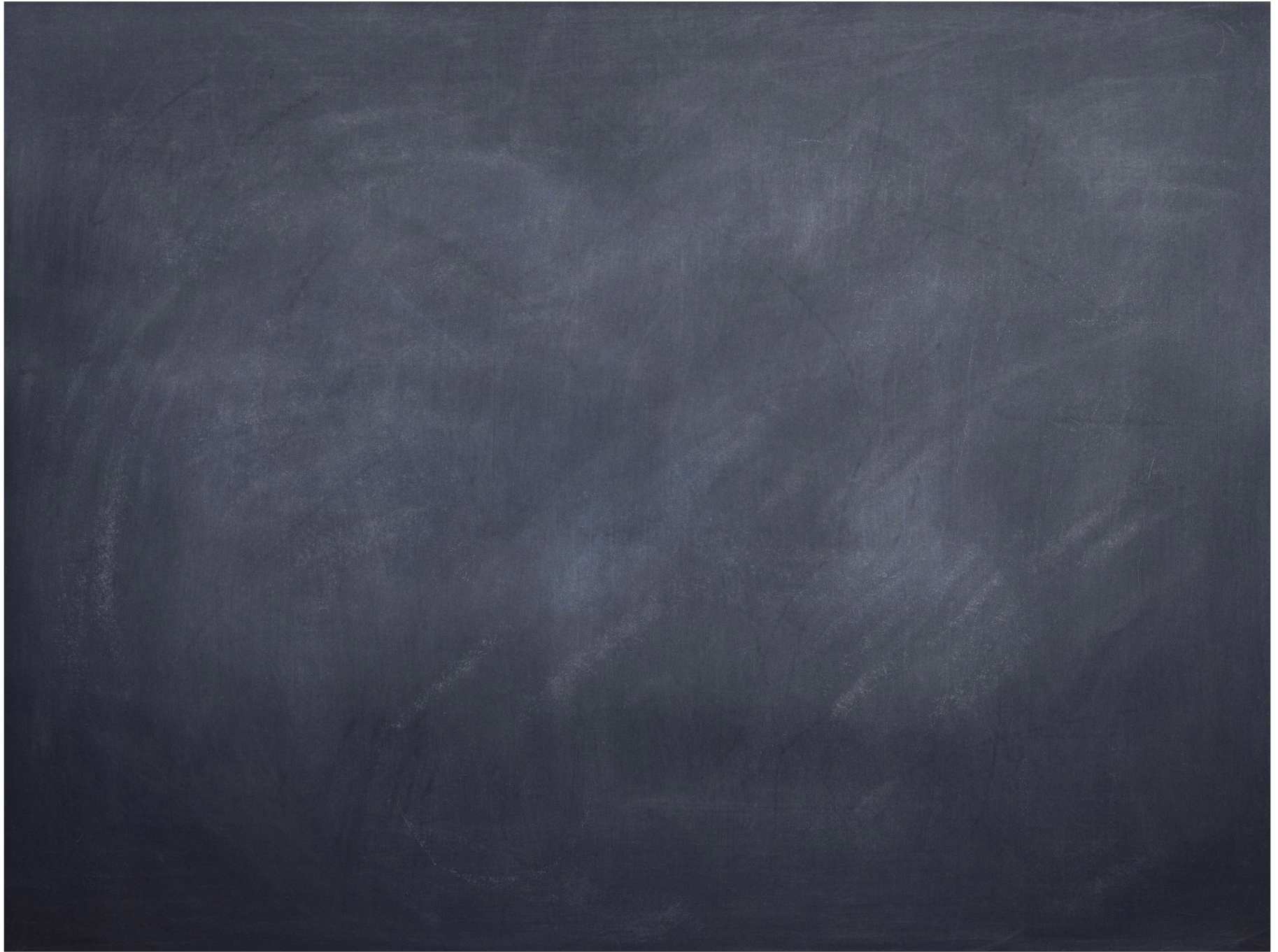


$F_g$  : tension string

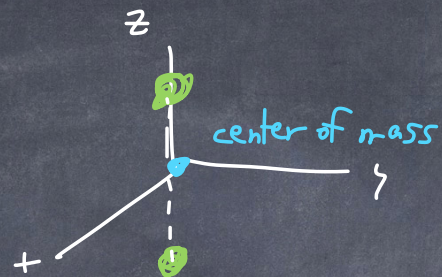
5 kg

$$F_g = Mg$$

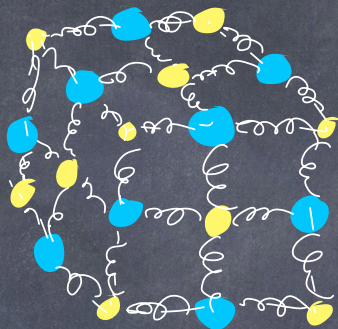
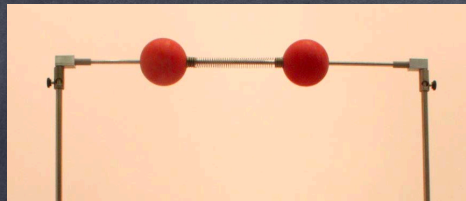




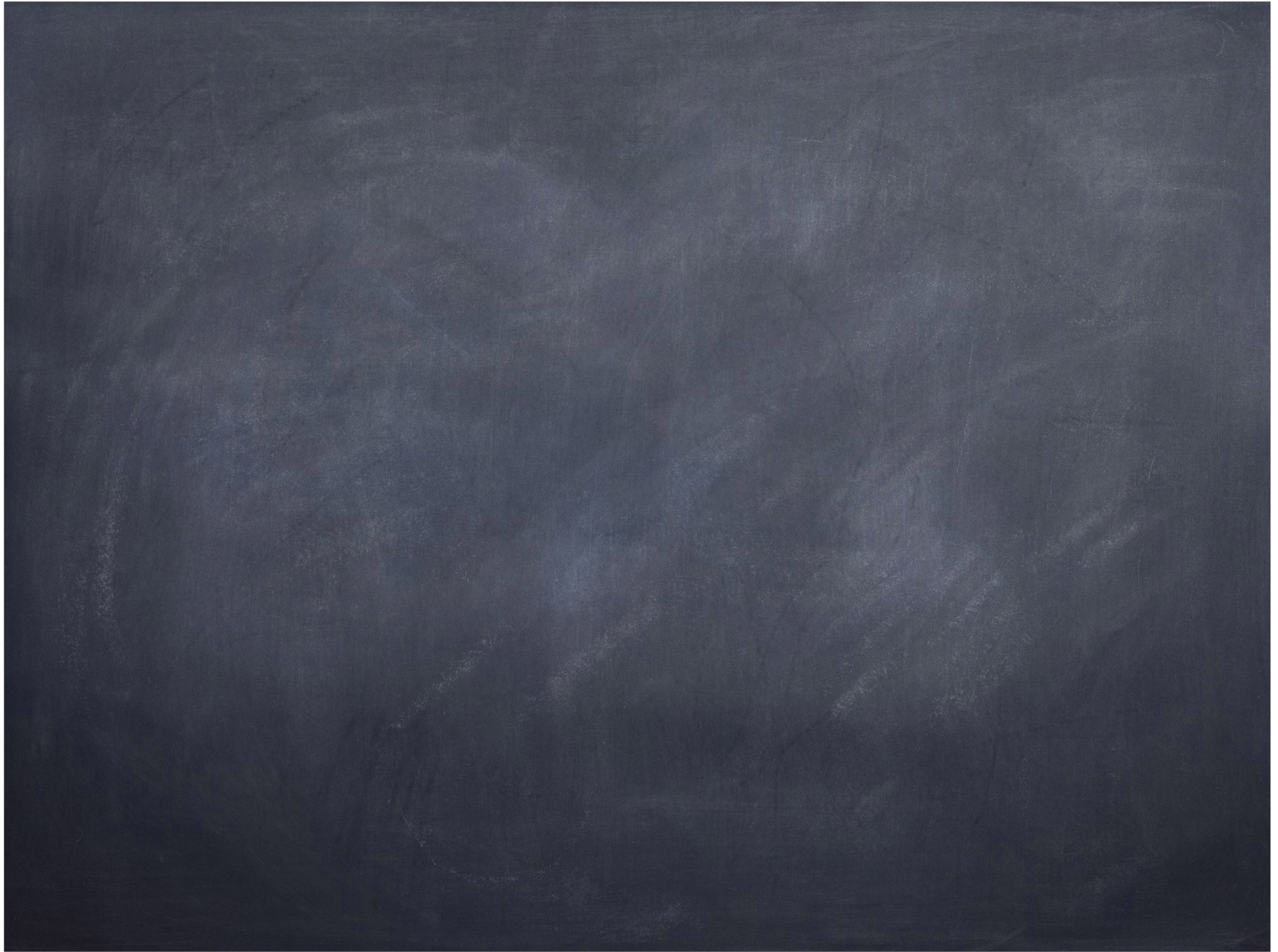
Consider a diatomic molecule in a gas ( $N_2, O_2, N_2 \dots$ )



Likewise, for a solid, such as NaCl

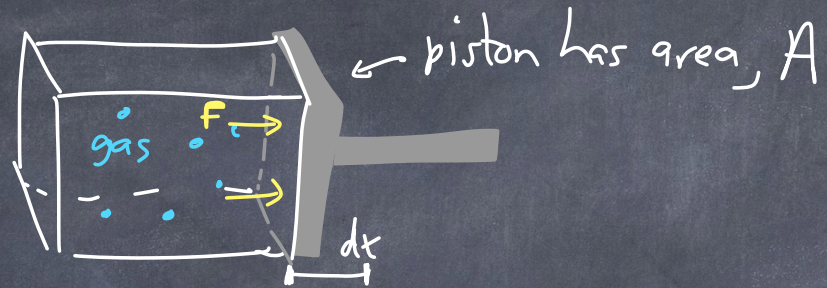


Atoms are held together  
bound like springs.



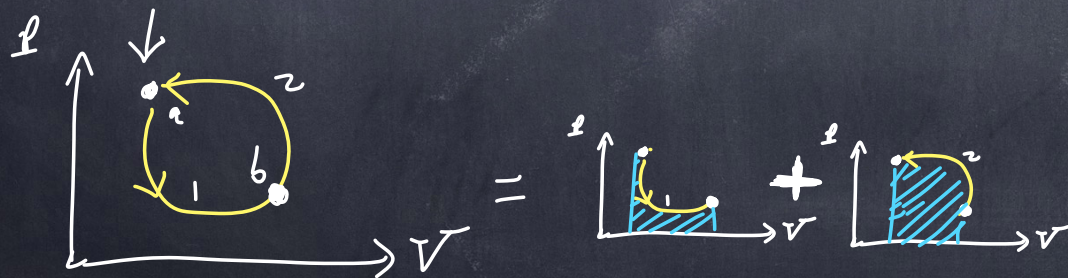
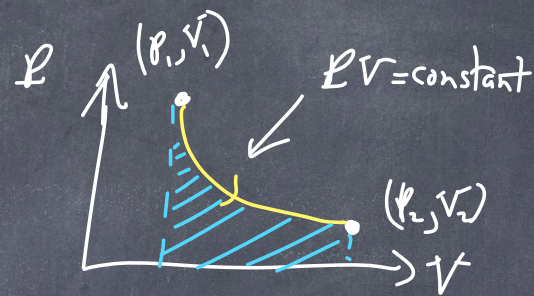
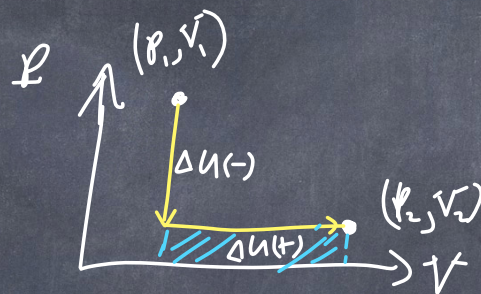
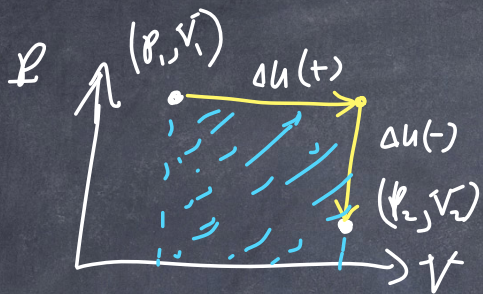


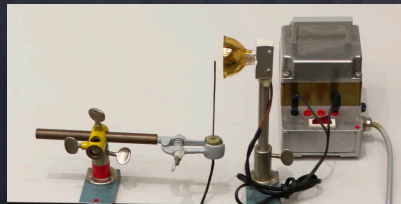
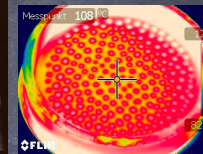
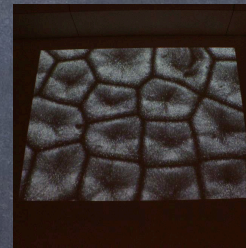
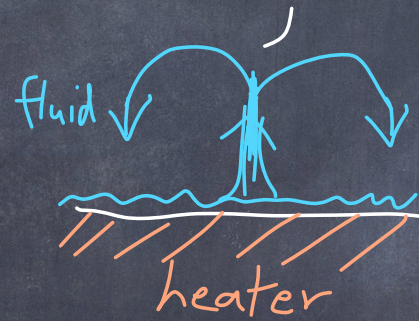
work done by a gas to move a piston

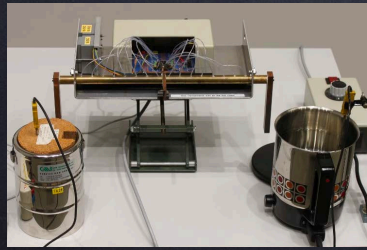
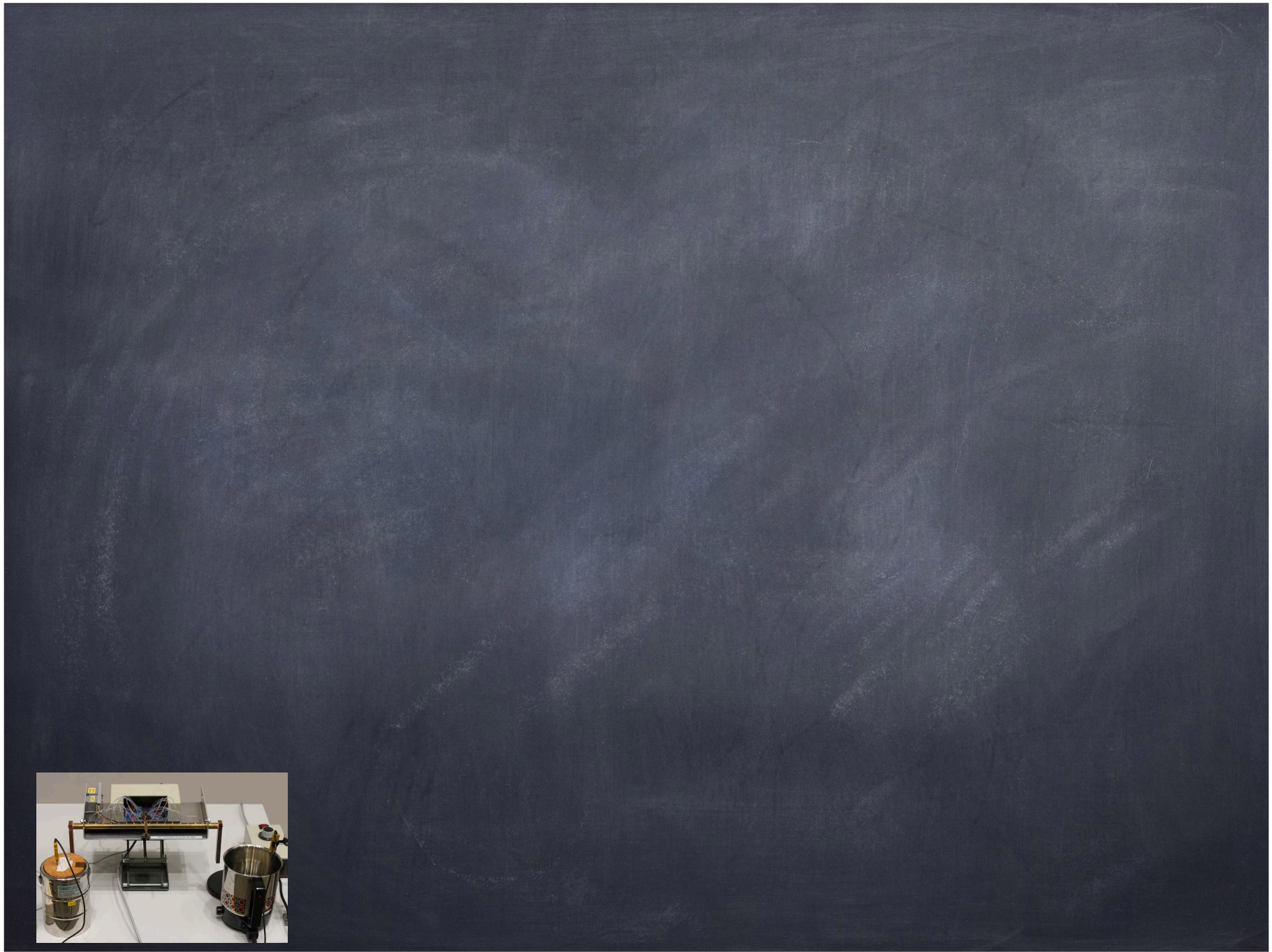


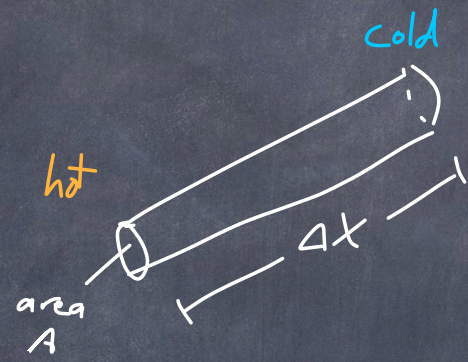
To go from  $(P_1, V_1)$  to  $(P_2, V_2)$

it depends on how we do it.

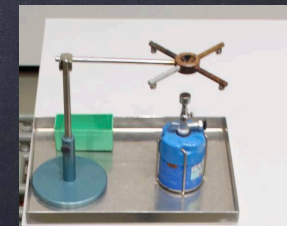




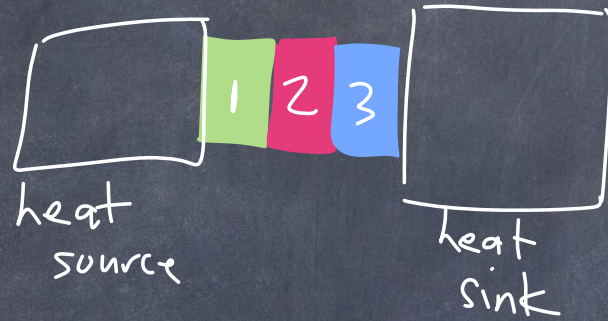




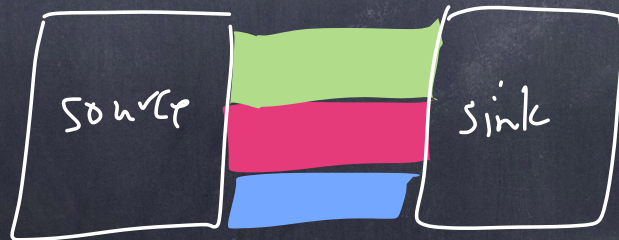
| <u>materials</u> | $k \left[ \frac{W}{m \cdot K} \right]$ |
|------------------|--|
| air              | 0.026                                  |
| ice              | 0.592                                  |
| Copper           | 401                                    |
| wood             | 0.11 - 0.15                            |
| glass            | $\sim 0.8$                             |
| aluminum         | 237                                    |



series



parallel



# Thermal expansion of solids

$T_0$    
 $L_0$  (length)

$T_0 + \Delta T$    




Material

$\alpha \left[ \frac{1}{K} \right]$

Aluminium

$24 \text{ E-}6$

Steel

$11 \text{ E-}6$

copper

$17 \text{ E-}6$

brass

$19 \text{ E-}6$

ice

$51 \text{ E-}6$

water ( $20^\circ \text{C}$ )

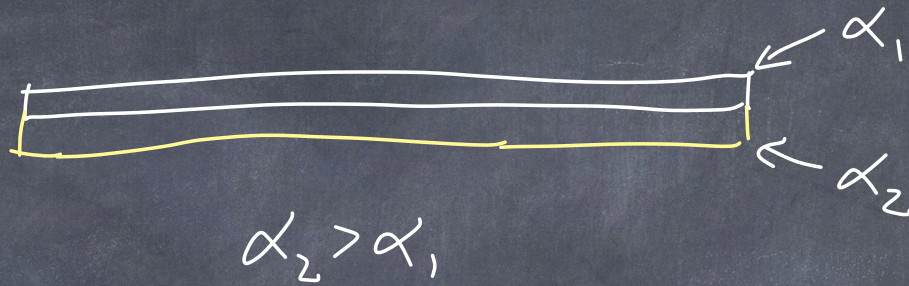
$0.207 \text{ E-}3$

alcohol

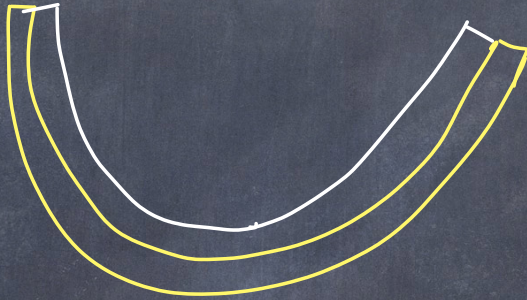
$1.1 \text{ E-}3$

we can turn this into a thermometer.

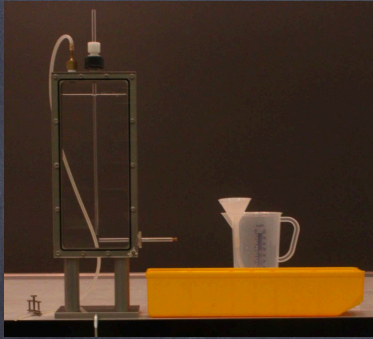
$T_0$



$T_0 + \Delta T$



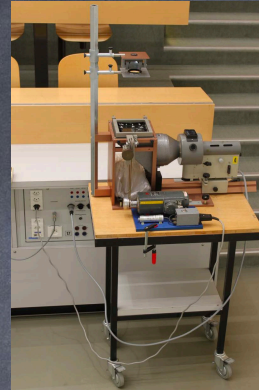
Bimetal thermometer.



H21



Th57



Th36



Th58



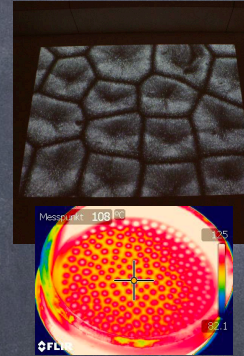
Th12



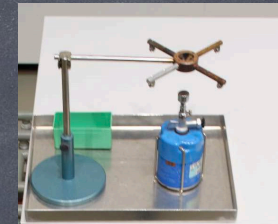
Th63



Th54



Th35



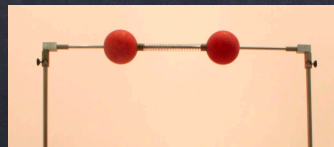
Th20



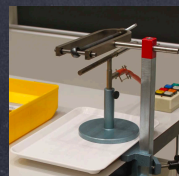
Th19



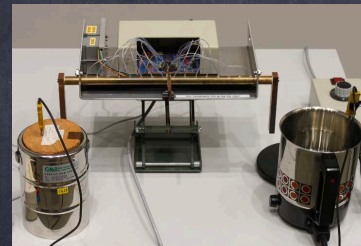
Th28



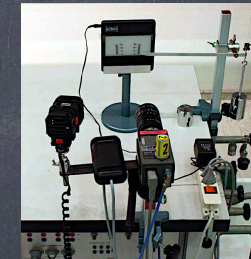
Th27



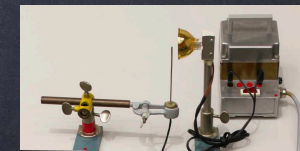
Th2



Th22



E12



Th48