

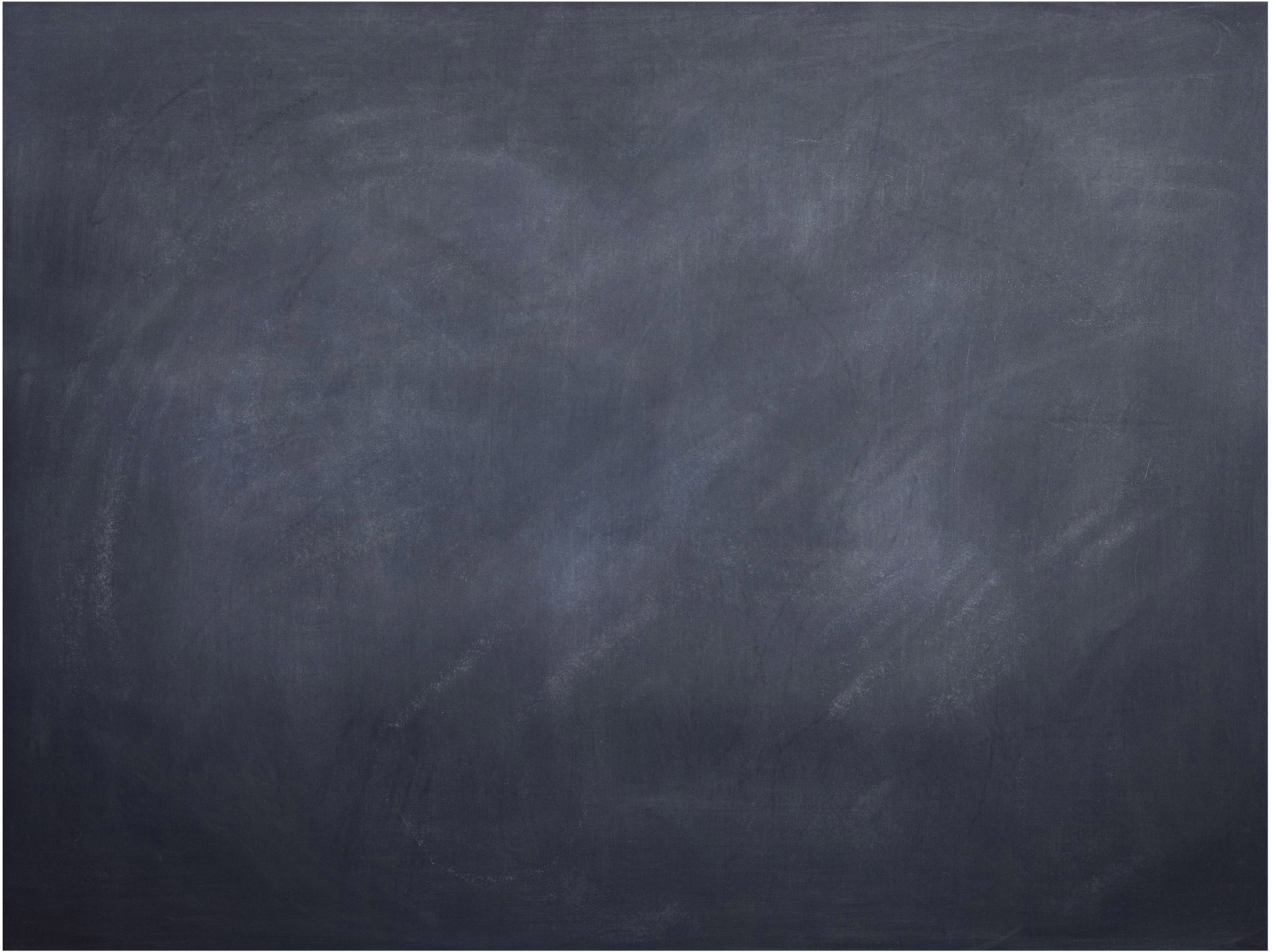
PHY 117 HS2026

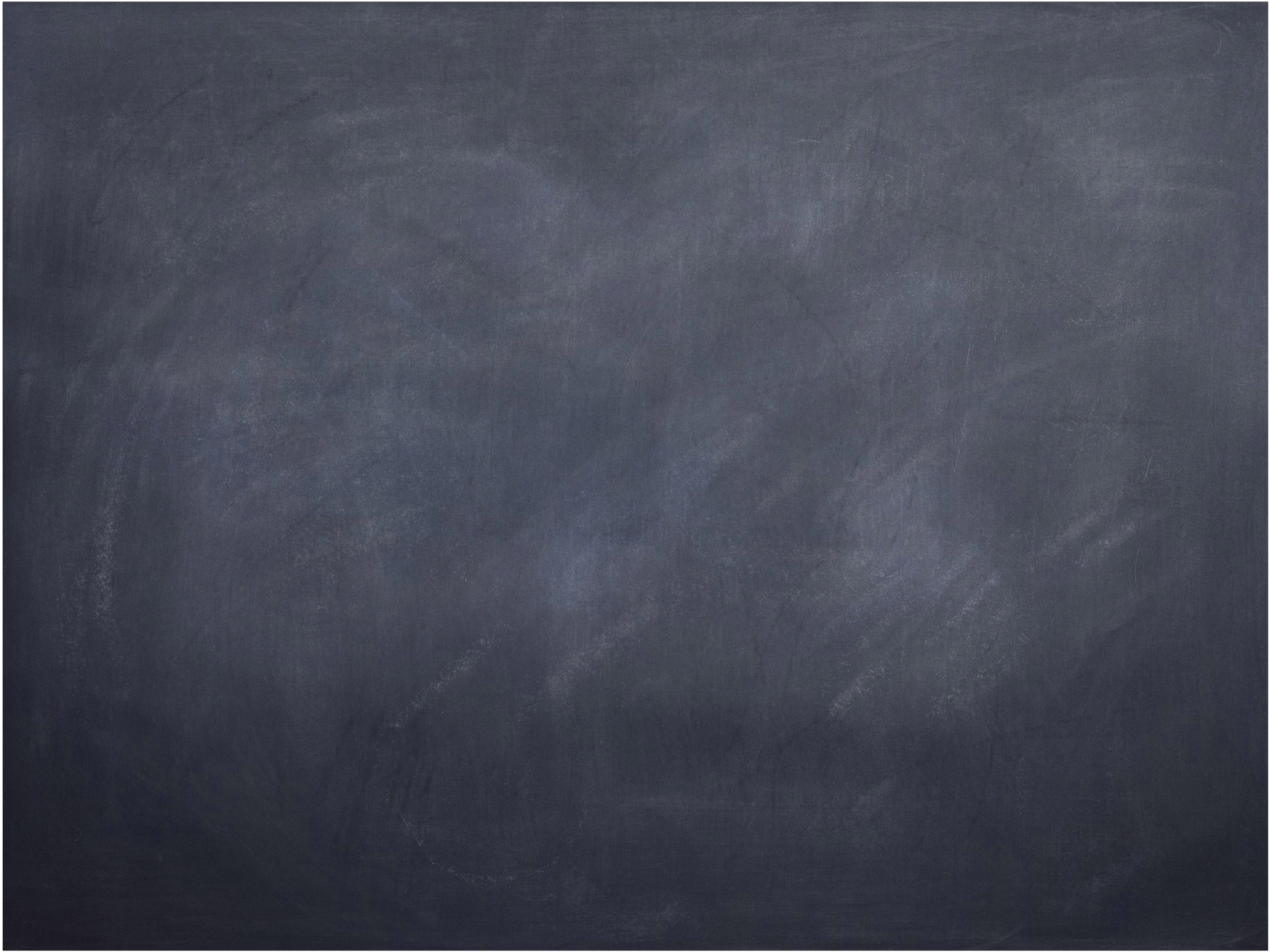
Today: corrections to ideal gas law
heat and temperature and work
internal energy
equipartition theorem
pressure, volume and work
thermal energy transfer processes

Week 6, Lecture 2

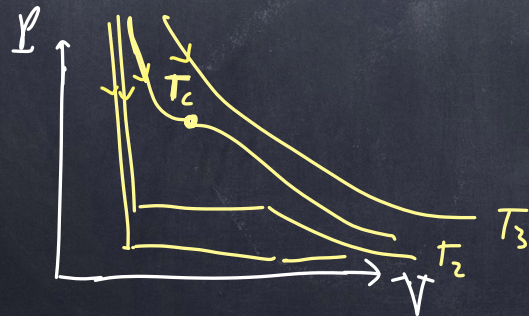
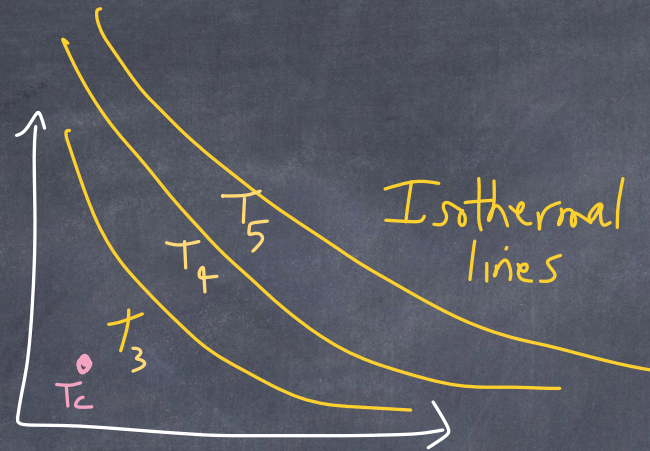
Oct. 21st, 2026

Prof. Ben Kilminster

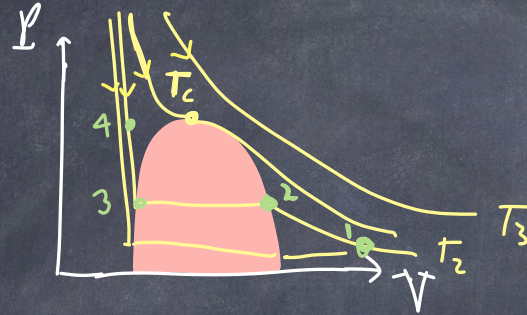




Ideal
gas
law



Above T_c , the behavior of the gas is described by the Van der Waals equation. But below T_c , we see something different.



Relationship between temperature, heat, internal energy.

Heat is energy transferred because of a temperature difference. We use the symbol Q for the energy transferred as heat.

<u>substances</u>	<u>specific heat</u> $c \left[\frac{\text{J}}{\text{kg} \cdot \text{K}} \right]$	<u>molar heat capacity</u> $C_m \left[\frac{\text{J}}{\text{mol} \cdot \text{K}} \right]$
copper	386	24.5
aluminum	900	24.2
silicon	710	42.2
water	4186	75.3
pine wood	1500	
oak wood	2400	



Experiment:

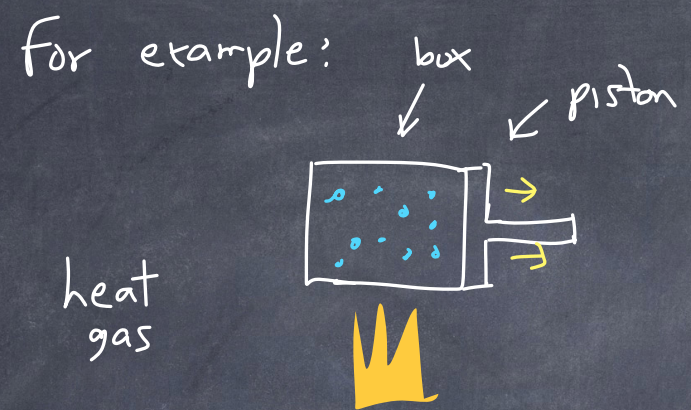


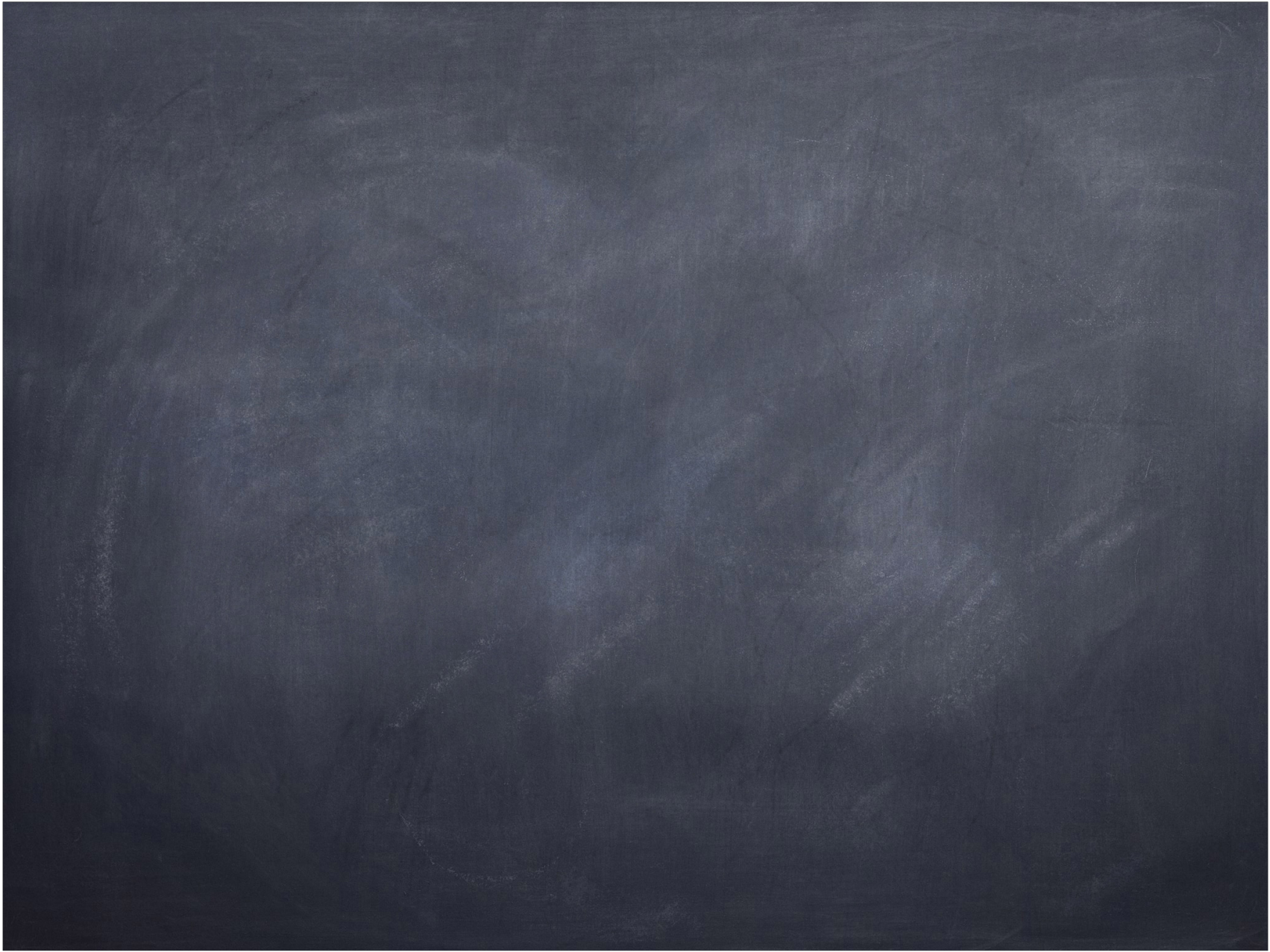
Heat cold metals with room-temperature water.
Each block is 1 mole. Copper, aluminium,
water is 60 mL.
Silicon.

liquid N_2 Temp: $-196^\circ C$

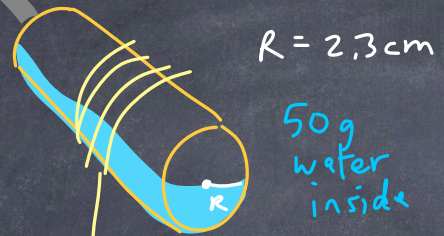
What is final equilibrium temperature?
Which cools the most?

So far, we changed a system's energy only by heating it.





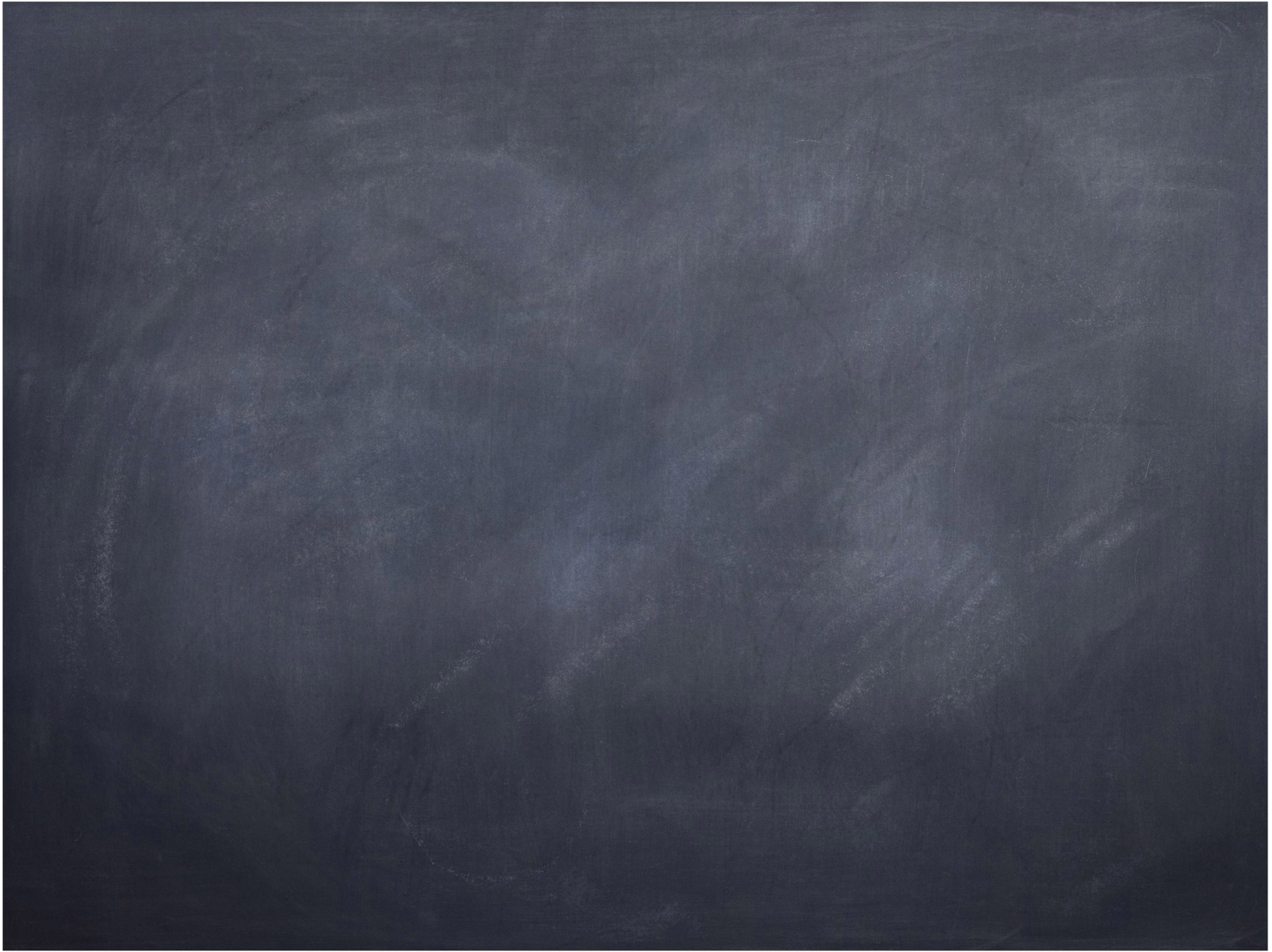
Can we use torque to increase temperature?

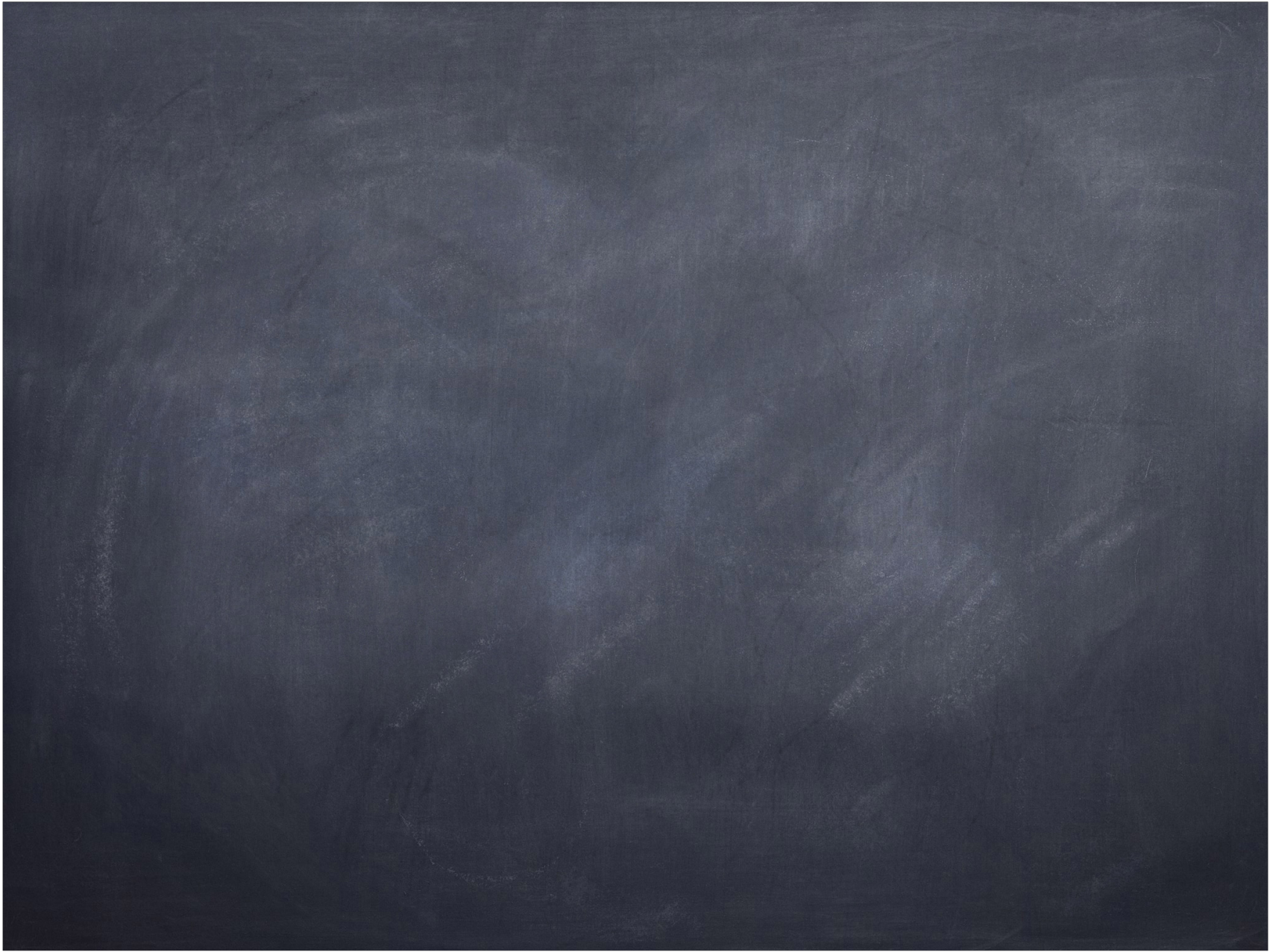


F_g : tension string

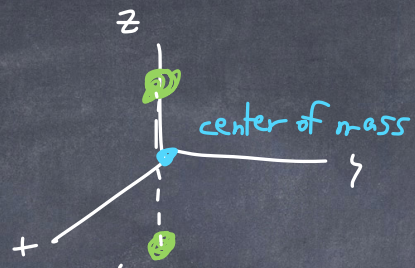
5 kg

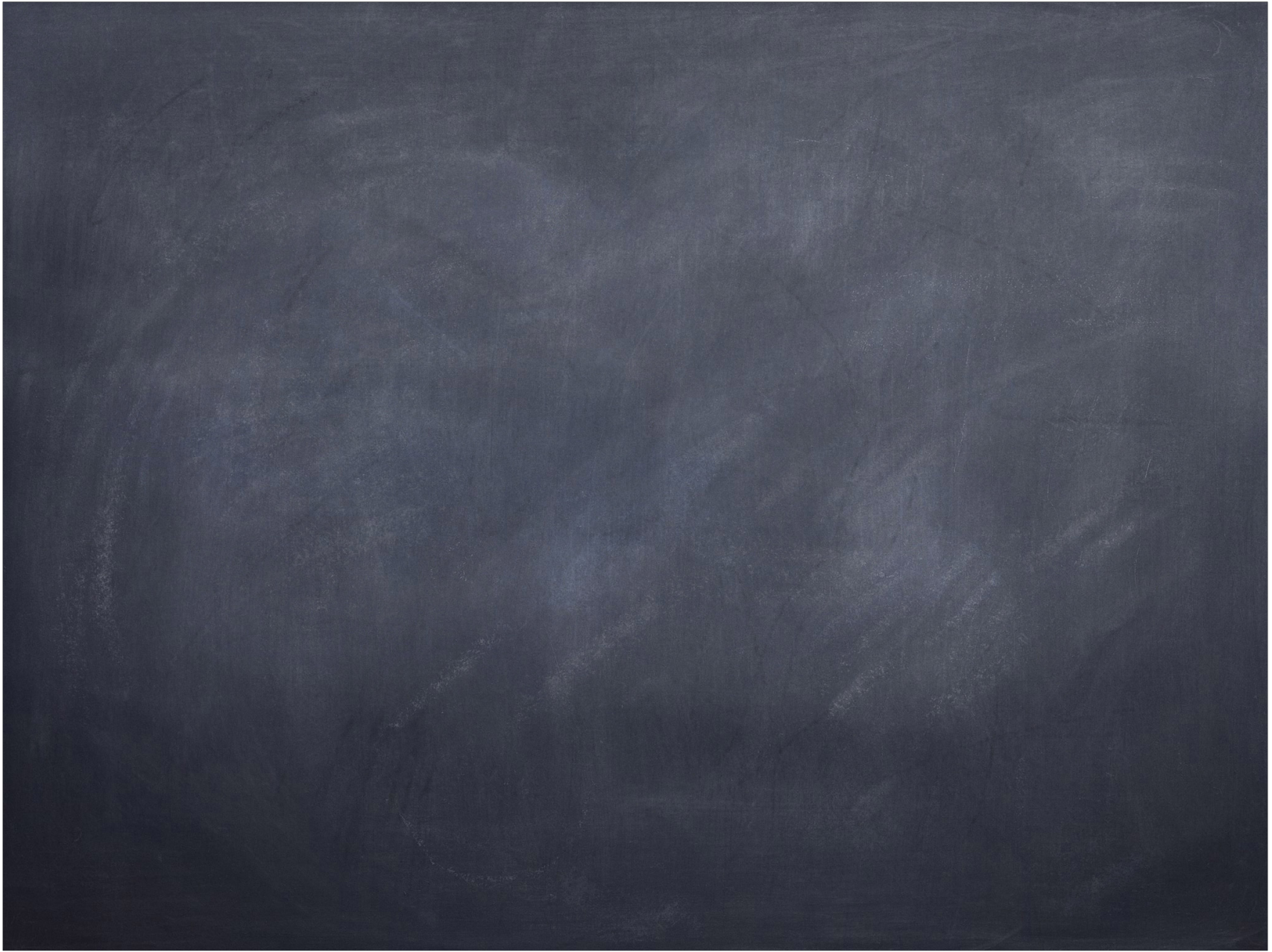
$$F_g = Mg$$



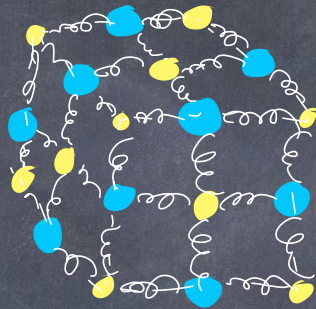
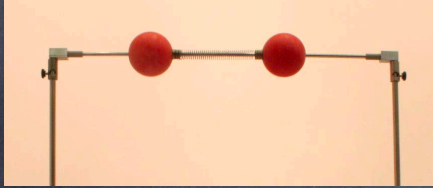


Consider a diatomic molecule in a gas ($N_2, O_2, N_2 \dots$)
(at constant volume)

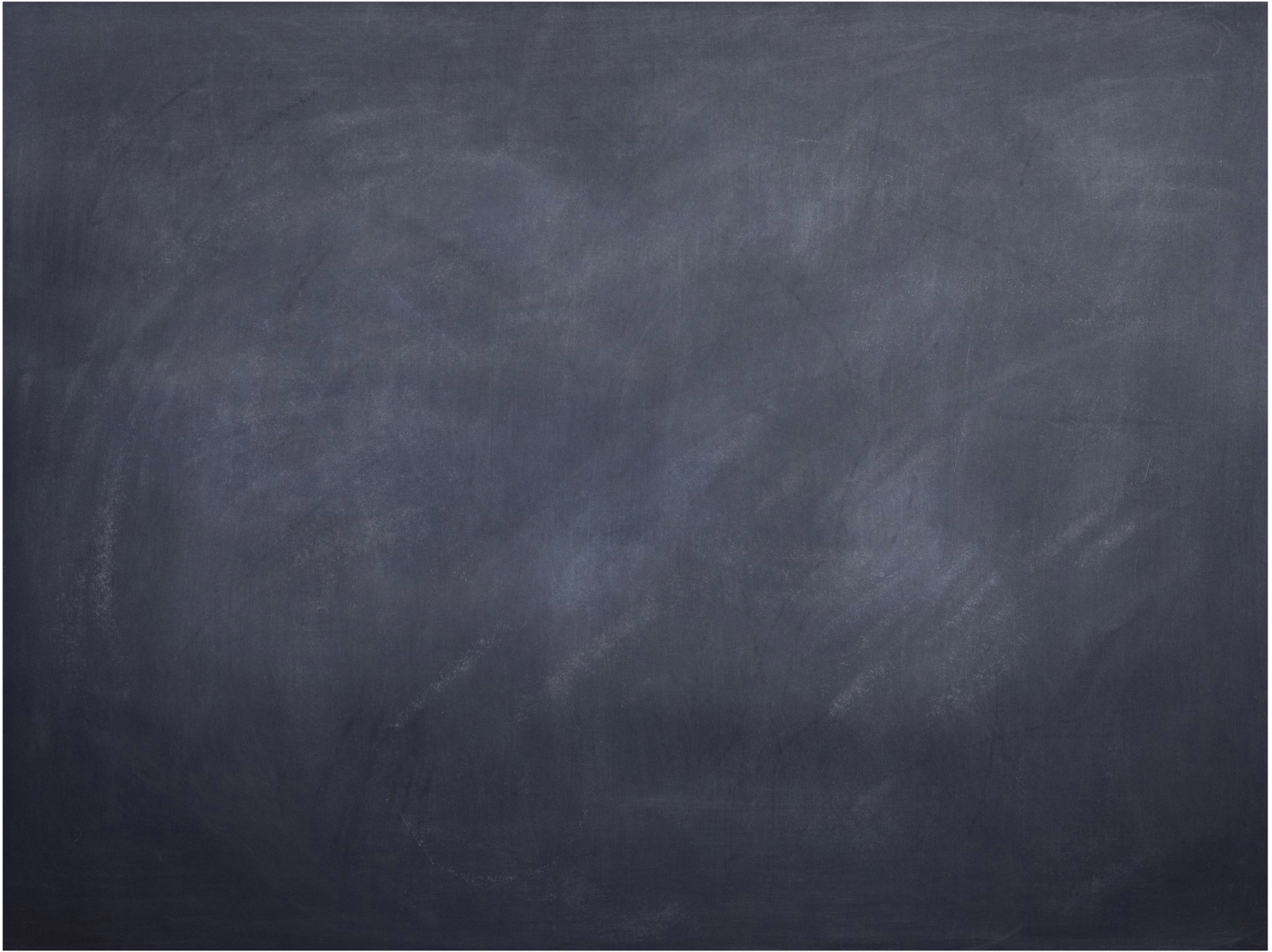




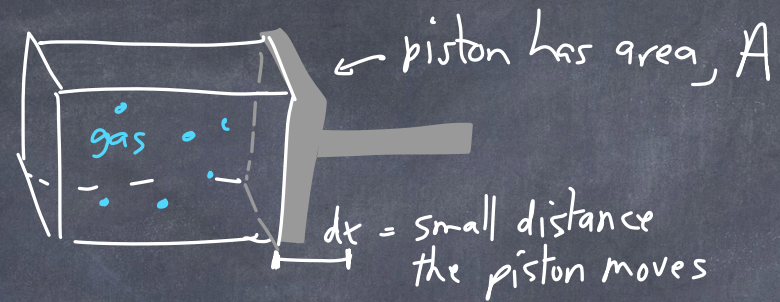
Likewise, for a solid, such as NaCl



Atoms are held together
in a solid, bound
like springs.

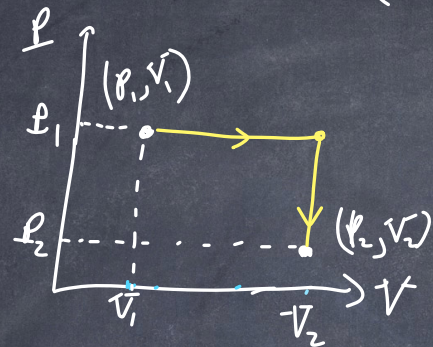


work done by a gas to move a piston

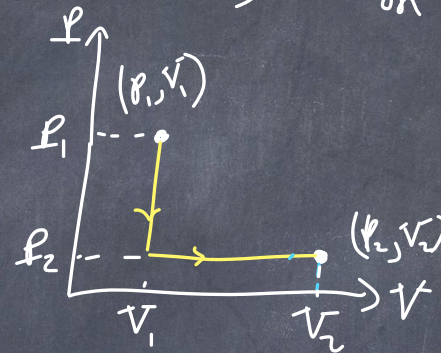


To go from (P_1, V_1) to (P_2, V_2) work depends on how we do it.

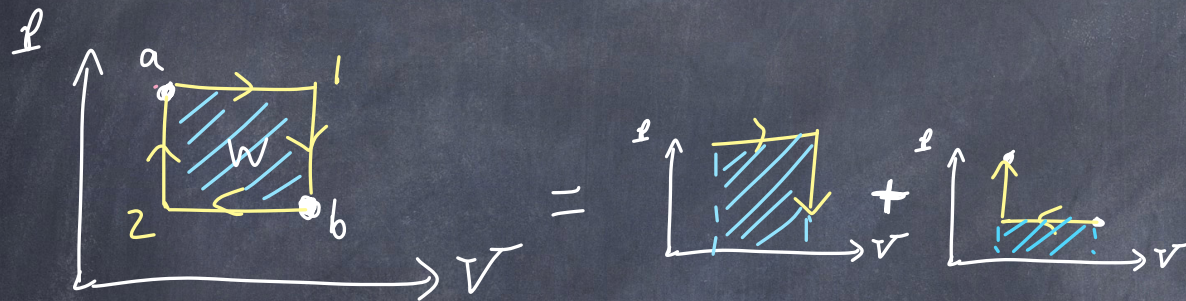
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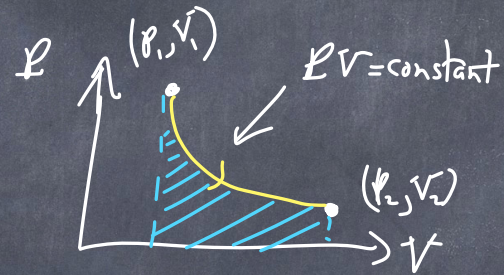
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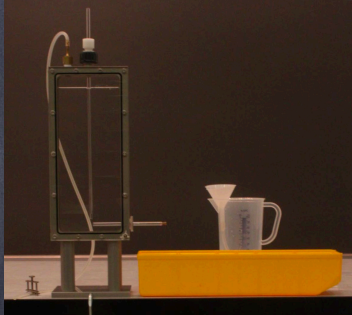


In a cycle, we return to the same P and V ,
and therefore to the same temperature.



Another way to get From P_1, V_1 to P_2, V_2

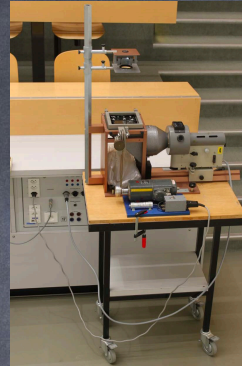




H21



Th57



Th36



Th58



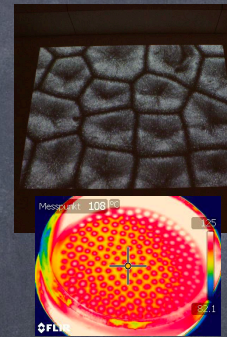
Th12



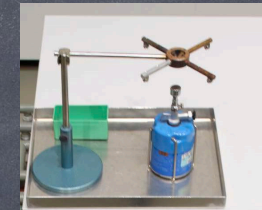
Th63



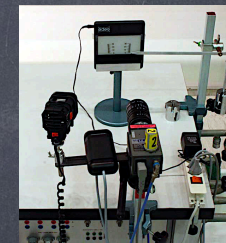
Th54



Th35



Th20



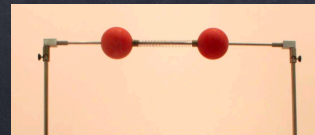
E12



Th19



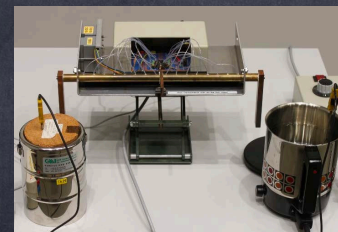
Th28



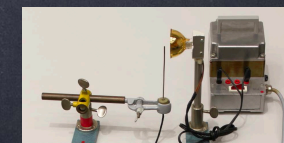
Th27



Th2



Th22



Th48