Sebesség (vektor):
Jele: v

$v = \frac{\Delta s}{\Delta t}$ sebesség = $\frac{\text{~~(idő változó)~~ megtett út}}{\text{út megtételéhez szükséges idő}}$

$$\text{Mértékegysége: } \frac{m}{s} \underset{:3{,}6}{\overset{\cdot 3{,}6}{\rightleftarrows}} \text{ vagy } \frac{km}{h}$$

~~Gyorsulás (vektor):~~
~~Jele: a~~

Sebesség/idő görbe alatti terület kiszámítása:

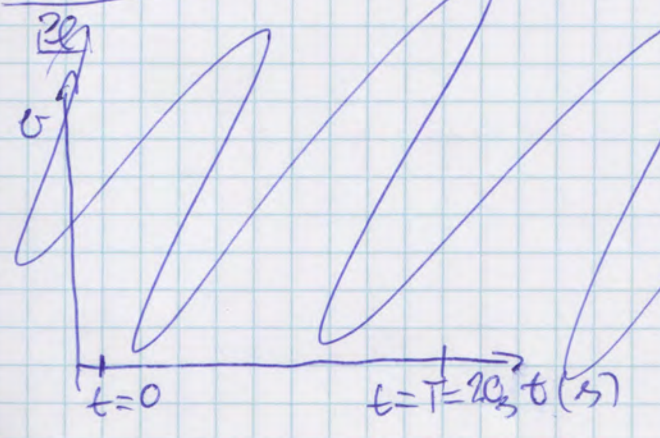
$$d = \text{Terület}(v/t) = \lim_{N\to\infty} \sum_{i=1}^{N} v(t_i)\Delta t = \lim_{N\to\infty} \sum_{i=1}^{N} v(t_i)\frac{T}{N}$$

N = a görbe alatti téglalapok száma

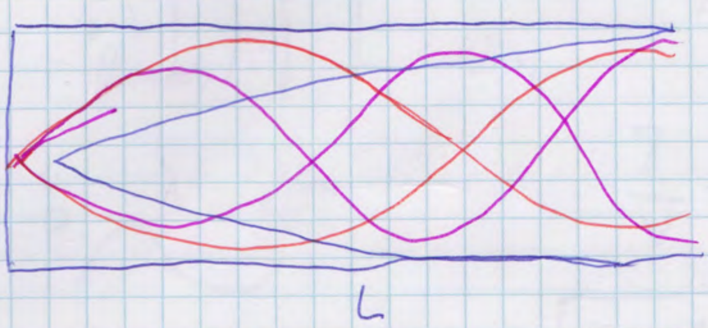
N = sok

A megtett távolság

$$d = \int v(t)\,dt$$



Sípok



$\lambda f = V$

$\lambda_0 = 4L$

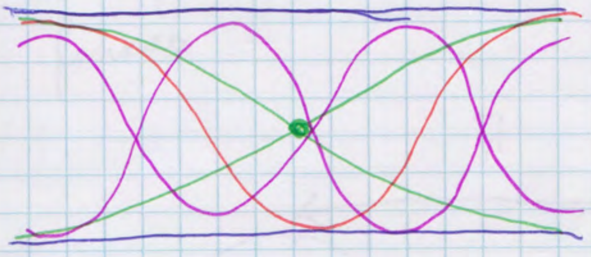
$f_0 = \frac{V}{\lambda} = \frac{V}{4L}$

↑ frekvencia

$\lambda_1 = \frac{4}{3}L \qquad f_1 = \frac{3V}{4L}$

$\lambda = \frac{4}{5}L \qquad f_1 \quad \frac{5V}{4L}$

$f_0 : f_1 : f_2 = 1 : 3 : 5$



$\lambda_0 = 2L \quad f_0 = \frac{V}{\lambda} = \frac{V}{2L}$

$\lambda_1 = L \quad f_1 = \frac{2V}{2L}$

$\lambda_2 = \frac{2}{3}L \quad f_2 = \frac{3V}{2L}$

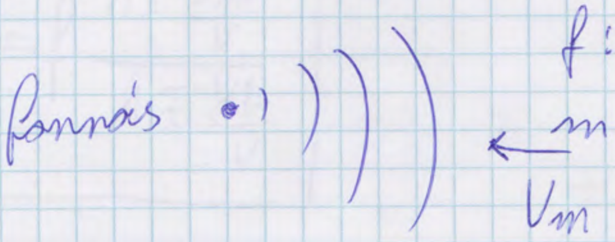
$f_0 : f_1 : f_2 = 1 : 2 : 3$

Doppler-effektus!

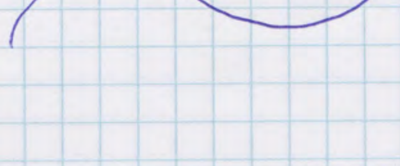
1,a

V: hang terjedési sebesség

f: frekvencia

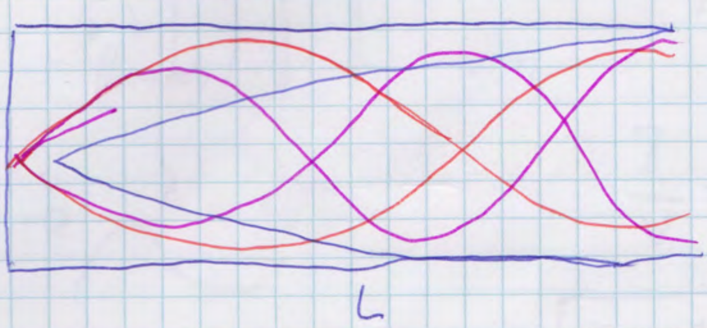


$\lambda = \frac{V}{f} \qquad f = \frac{V}{\lambda}$



$T = \frac{1}{f} = \frac{\lambda}{V}$

Sípok



$\lambda f = v$

$\lambda_0 = 4L$

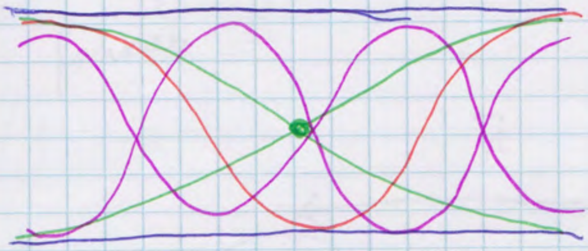
$f_0 = \frac{v}{\lambda} = \frac{v}{4L}$

frekvencia

$\lambda_1 = \frac{4}{3}L \qquad f_1 = \frac{3v}{4L}$

$\lambda_2 = \frac{4}{5}L \qquad f_1 \qquad \frac{5v}{4L}$

$f_0 : f_1 : f_2 = 1 : 3 : 5$



$\lambda_0 = 2L \quad f_0 = \frac{v}{\lambda} = \frac{v}{2L}$

$\lambda_1 = L \quad f_1 = \frac{2v}{2L}$

$\lambda_2 = \frac{2}{3}L \quad f_2 = \frac{3v}{2L}$

$f_0 : f_1 : f_2 = 1 : 2 : 3$

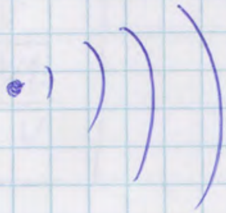
Doppler-effektus!

1,a

v: hang terjedési sebesség

f: frekvencia

forrás

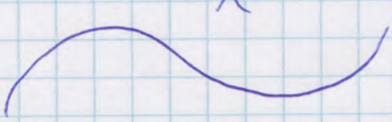


$\xleftarrow{m}$

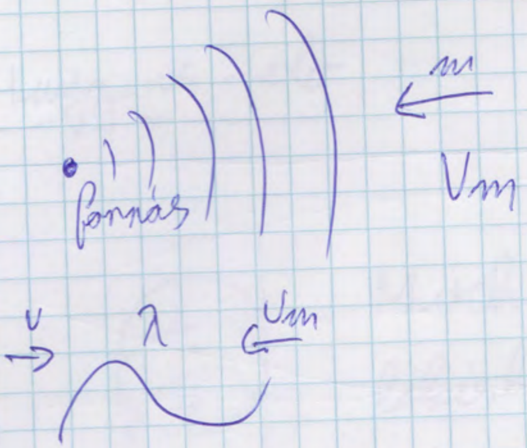
v_m

$\lambda = \frac{v}{f} \qquad f = \frac{v}{\lambda}$

λ



$T = \frac{1}{f} = \frac{\lambda}{v}$



$$\lambda = (v + v_m)\,T' = \frac{v + v_m}{f'}$$

$$\frac{\lambda}{v} = \frac{1}{f} = \frac{1 + \frac{v_m}{v}}{f'}$$

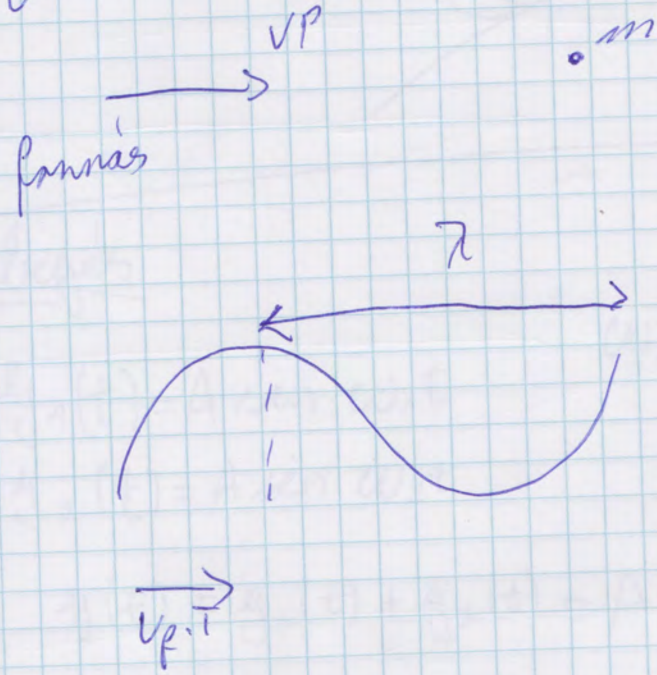
$$\boxed{f' = \left(1 \pm \frac{v_m}{v}\right) f}$$

A megfigyelő közelít a forrás felé.

− közeledés
+ távolodás

$$\boxed{f' = f\,\frac{1}{1 \mp \frac{v_f}{v}}}$$

1. b



$$\lambda = \lambda' + v_f \cdot T$$

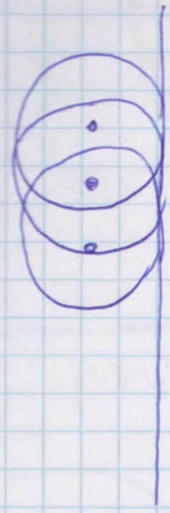
$$\frac{1}{f} = \frac{1}{f'} + \frac{v_f}{v} \cdot \frac{1}{f}$$

$$\frac{1}{f'} = \frac{1}{f}\left(1 - \frac{v_f}{v}\right)$$

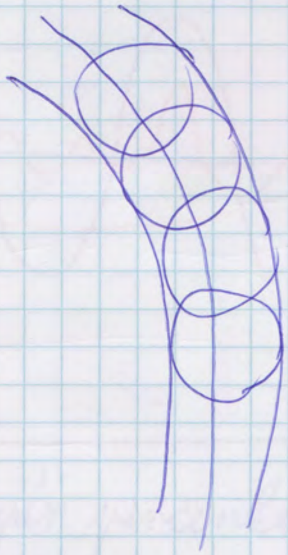
a–b.

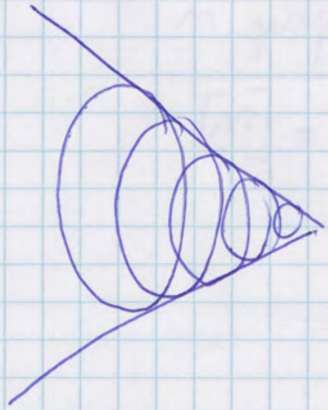
$$\boxed{f' = f\,\frac{1 \pm \frac{v_m}{v}}{1 \mp \frac{v_f}{v}}}$$

Huygens-elv,



Mach-kúpja
lökéshullám





Lebegés

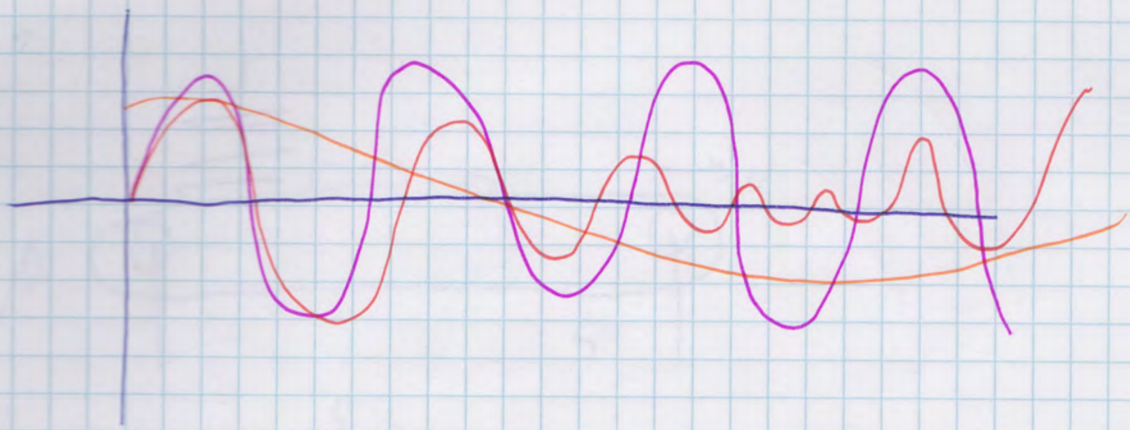
$\omega_1 \approx \omega_2 \qquad \omega_1 \neq \omega_2$

$$y_1(t) = A \sin \omega_1 t$$

$$y_2(t) = A \sin \omega_2 t$$

$$y(t) = y_1(t) + y_2(t) = A(\sin \omega_1 t + \sin \omega_2 t) =$$

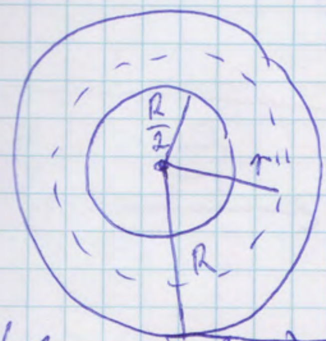
$$= 2A \underbrace{\sin \frac{\omega_1 + \omega_2}{2} t}_{\text{rezgési fg.}} \; \underbrace{\cos \frac{\omega_1 - \omega_2}{2} t}_{\text{lebegési}}$$

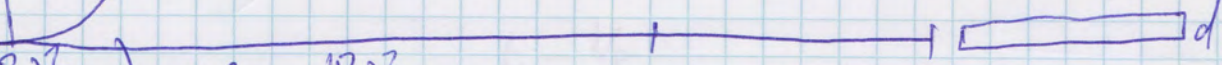


1.

n papír percenként

$$[n] = \frac{db}{s}$$





$$\frac{1}{2}\left(R^2\pi - \left(\frac{R}{2}\right)^2\pi\right) = r^2\pi - \left(\frac{R}{2}\right)^2\pi$$

$\omega = ?$

$n \cdot a$

$$V = n \cdot a$$

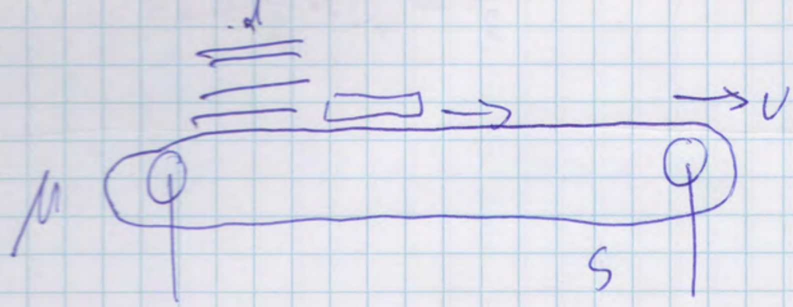
$$\omega = \frac{V}{R} = \frac{na}{R}$$

$$\left[\frac{\frac{1}{s} \cdot m}{m} = \frac{1}{s}\right]$$

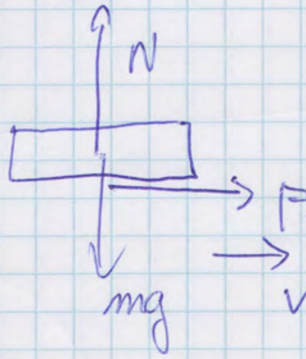
$$\frac{3}{8}R^2 + \frac{1}{4}R^2 = r^2$$

$$r = R\sqrt{\frac{5}{8}}$$

2.



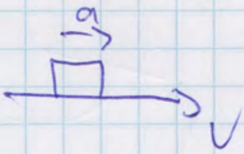
a



$F_s = \mu mg = ma$

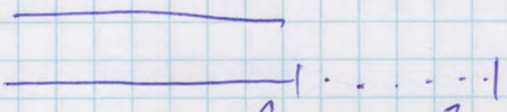
$a = \mu g$

b,



$v = at = \mu g t$

$t = \frac{v_0}{\mu g}$



$d = \frac{1}{2} a (\Delta t)^2 = \frac{1}{2} \mu g (\Delta t)^2$

$\Delta t = \sqrt{\frac{2d}{\mu g}}$

$\log_a b = c \to b = a^c$

$\log_a a^x$

$\log_a x = b \Rightarrow x = a^b$

$\log_a x^n = n \cdot \log_a x$

$\log_a \sqrt[n]{x^\beta} = \frac{\beta}{n} \cdot \log_a x$

$\log_a x = \frac{\log_b x}{\log_b a}$

$tg\, x = \frac{\sin x}{\cos x}$ $\quad ctg = \frac{\cos x}{\sin x}$

$\sin^2\alpha + \cos^2\alpha = 1$

$\sin^2\alpha = 1 - \cos^2\alpha$

$\cos^2\alpha = 1 - \sin^2\alpha$

$\cos\alpha = \sin\left(\frac{\pi}{2} - \alpha\right)$

$\sin\alpha = \cos\left(\frac{\pi}{2} - \alpha\right)$

$\cos\alpha = \sin\left(\alpha + \frac{\pi}{2}\right)$

$-\sin\alpha = \cos\left(\alpha + \frac{\pi}{2}\right)$

$\sin\alpha = \sin(\pi - \alpha)$

$-\cos\alpha = \cos(\pi - \alpha)$

$\sin 2\alpha = 2\sin\alpha \cdot \cos\alpha$

$\sin(\alpha \pm \beta) = \sin\alpha \cdot \cos\beta \pm \cos\alpha \cdot \sin\beta$

$\cos 2\alpha = \cos^2\alpha - \sin^2\alpha$

$\cos(\alpha \pm \beta) = \cos\alpha \cdot \cos\beta \mp \sin \cdot \sin\beta$

$\sin^2\alpha = \frac{1 - \cos 2\alpha}{2}$

$\cos^2\alpha = \frac{1 + \cos 2\alpha}{2}$

Számtani:

$a_n = a_1 + (n-1)d$

$S_n = n \cdot a_1 + \frac{n \cdot (n-1)}{2} \cdot d$

$b_2 = \frac{b_1 + b_3}{2}$

$2b_2 = b_1 + b_3$

Mértani:

$a_n = a_1 \cdot q^{n-1}$

$S_n = a_1 \cdot \frac{q^{n-1}}{q-1}$

$q = 1 \to S_n = n \cdot a_1$

$b_1 \cdot b_3 = b_2^2 \to \sqrt{b_1 \cdot b_3} = |b_2|$

$tg = \frac{\sin\alpha}{\cos\alpha}$ $ctg = \frac{\cos\alpha}{\sin\alpha}$

$\sin^2\alpha + \cos^2\alpha = 1$

~~$\sin^2 = \cos(1-\cos x)$~~

$\sin^2\alpha = 1 - \cos^2\alpha$

$\cos^2\alpha = 1 - \sin^2\alpha$

$\cos\alpha = \sin\left(\frac{\pi}{2} - \alpha\right)$

$\sin\alpha = \cos\left(\frac{\pi}{2} - \alpha\right.$

számtani!

$a_n = a_1 \cdot (\cancel{d}\, n-1)d$

$S_n = \frac{a_1 + a_n}{2} \cdot n =$

$= \frac{2a_1 + (n-1)d}{2} n$

mértani!

$a_n = a_1 \cdot q^{n-1}$

$S_n = a_1 \cdot \frac{q^n - 1}{q - 1}$

$S_n = a_1 \cdot n$, ha $q = 1$

$b_2 = \frac{b_1 + b_3}{2}$

$2b_2 = b_1 + b_3$

Thermodinamika:

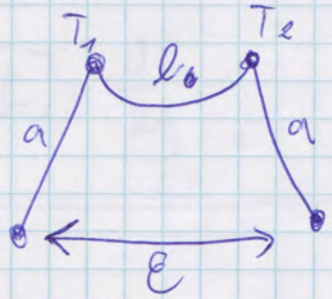
① Hőmérséklet ② Hőmennyiség

① Hőmérséklet mérése

- hőfok

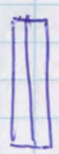
hőmérő

- hőtágulás $l(T) = l_0(1+\alpha(T-T_0))$ hosszanti
- gázok nyomás és térfogatváltozása $V(T) = V_0(1+\beta(T-T_0))$ térfogati $\beta = 3\alpha$
- elektromos ellenállás változás $R(T) = R_0(1+\alpha(T-T_0))$
- elektromoshatás



$\varepsilon \sim \Delta T$

- mechanikai



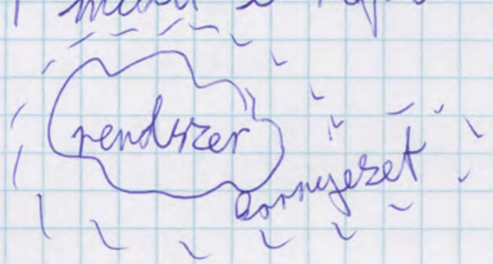
- kémiai reakció színváltozás
- hőmérsékleti sugárzás
- mágneses hatás

Celsius 0-100°C normál nyomás

Abszolút 0 K → -273°C

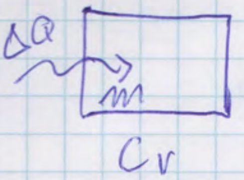
② Hőmennyiség:

ΔT miatt létrejövő energia csere



Fázisátalakítás, belső energiaváltozás:

hőközlés

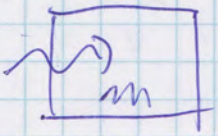


ΔT

$\Delta Q = c_v m \Delta T$ hőfelvétel
hőleadás

$[c_v]\ \frac{J}{kgK}$ ← Joule

látens hő
(nem látott)



$\Delta T = 0$

$\Delta Q_f = L \cdot m$

$[L] = \frac{J}{kg}$

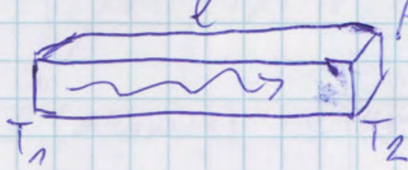
Fázis átalakítás:

szilárd ⟷ folyékony ⟷ gáz

szublimáció (szilárd ⟷ gáz)

~~Hő~~ Hőközlési folyamatok:

- hővezetés:



$I_q \sim A \frac{T_1 - T_2}{l}$

$T_1 > T_2$

$I_q = -\lambda$

↑

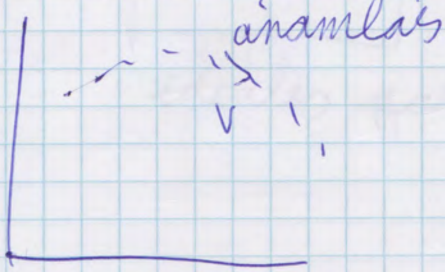
hővezetési együttható

$[\lambda] = \frac{J}{mKs}$

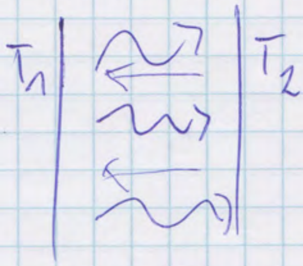
- hőátadás

$I_q \sim h\Delta T$

- konvekció



- hősugárzás:



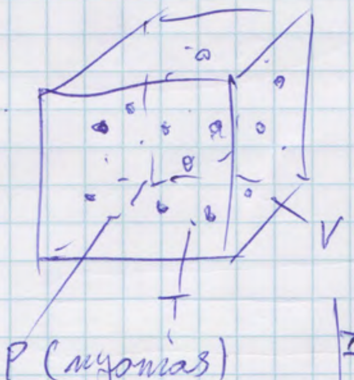
$T_1 > T_2$

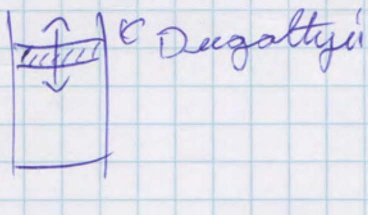
$\frac{\Delta Q}{\Delta t} = I = e\sigma T^4 A$

$\sigma = 5{,}67 \cdot 10^{-8} \frac{W}{m^2 K^4}$

Gáztörvények:

Ideális gáz





I Gay-Lussac

$p =$ áll. $\frac{V}{T} = const.$

II Gay-Lussac

$V =$ áll. $\frac{p}{T} = const.$

Boyl - Mariotte:

$T = \text{áll.}$ $PV = \text{const.}$

$$\frac{PV}{T} = \text{const}$$

$[n] = \text{mol}$ $[T] = K$ $\boxed{SI}$

$A = 6 \cdot 10^{23}$ Avogandó szám

$R = 8{,}31 \frac{J}{mol\,K}$

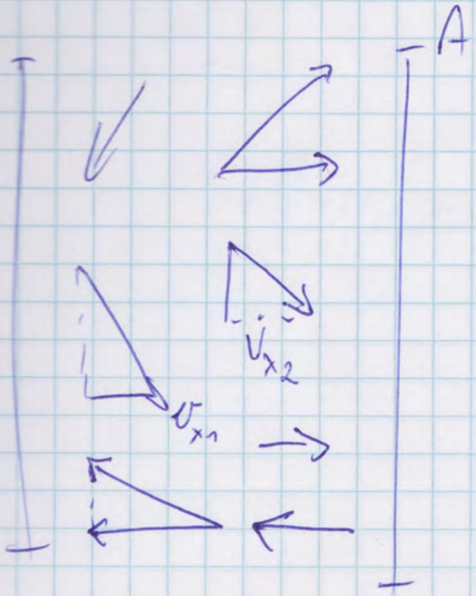
$$\boxed{\frac{PV}{T} = Rn}$$

ideális gázok állapotegyenlete

$\frac{PV}{T} = nR \quad [n] = mol$

Kinematikus gázelmélet

Ideális gáz



$\cancel{m}\, n_1 \quad [n_1] = \frac{1}{m^3}$ darab

$n_2 \quad [n_2] = \frac{1}{m^3}$

$[P] = \frac{N}{m^2}$

$\bar{F}_1 = \frac{\Delta I_1^{ö}}{\Delta t} = n_1 m_1 V_{x_1}^2 \cdot A \qquad P_1 = \frac{F_1}{A} = n_1 m V_{x_1}^2$

$F_2 \frac{\Delta I_2^{ö}}{\Delta t} = n_2 m V_{x_2}^2 A \qquad P_2 = \frac{F_2}{A} = n_2 m V_{x_2}^2$