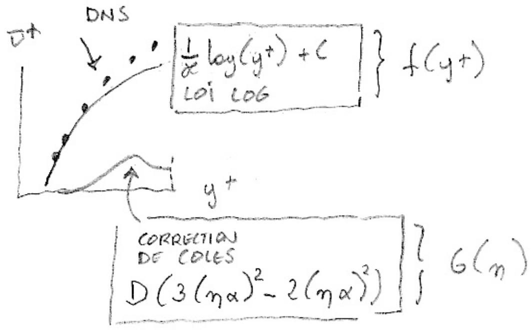
$\boxed{\text{EX 21}}$

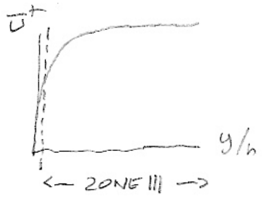
$\boxed{1}$ VOIR PROGRAMME PYTHON



$\boxed{2}$

$$\frac{2}{\sqrt{\lambda}} = \frac{\overline{U}_m}{\overline{U}_\tau} \simeq \int_0^1 \frac{1}{\kappa}\log\left(y^+(\eta)\right) + G(\eta)\, d\eta$$

ON CONSIDERE QUE JUSTE INTEGRER LA ZONE III DONNERA LE BON RESULTAT ....
C'EST LOGIQUE LORSQU'ON FAIT LE PLOT EN ECHELLE η



$$= \int_0^1 \frac{1}{\kappa}\log\underbrace{\Big[\underbrace{\frac{h\,\overline{U}_\tau}{\nu}}_{h^+}\frac{y}{h}\Big]}_{\log h^+ + \log\eta} + C + D\left(3(\alpha\eta)^2 - 2(\alpha\eta)^3\right) d\eta$$

$$= \frac{1}{\kappa}\log(h^+) + C + \frac{1}{\kappa}\underbrace{\int_0^1 \log(\eta)\,d\eta}_{\underbrace{\left[\eta\log\eta - \eta\right]_0^1}_{-1}} + D\underbrace{\left[3\frac{\alpha^2\eta^3}{3} - 2\frac{\alpha^3\eta^4}{4}\right]_0^1}_{\alpha^2 - \alpha^3/2}$$

INTEGRALE PAR PARTIES !

$$(\eta\log\eta)' = \log\eta + 1$$

$$\lim_{\eta\to 0} \eta\log\eta = 0 \;:-)$$

VERIFIE AVEC L'HOSPITAL :-)

$$= \frac{1}{\kappa}\log\Big(\underbrace{\frac{h\,\overline{U}_\tau}{\nu}}\Big) + \underbrace{\left[C - \frac{1}{\kappa} + D\left(\alpha^2 - \frac{1}{2}\alpha^3\right)\right]}_{[☺]}$$

$$\frac{1}{2}\,\frac{2h\,\overline{U}_m}{\nu}\,\frac{\overline{U}_\tau}{\overline{U}_m} = \frac{1}{2}\,Re_d\,\frac{\sqrt{\lambda}}{2}$$

$$\frac{2}{\sqrt{\lambda}} = -\frac{1}{\kappa}\log\left(\frac{4}{Re_d}\frac{1}{\sqrt{\lambda}}\right) + \frac{1}{\kappa}\log\left(\exp\left(\kappa\,[☺]\right)\right)$$

$\boxed{3}$

$$\frac{1}{\sqrt{\lambda}} = \underbrace{-\frac{1}{2\varkappa}\overbrace{\frac{1}{\log_{10}(e)}}^{2,3061}}_{-a} \log_{10}\left[\frac{4 \; Re_{-d}}{\underbrace{\exp\left[\varkappa\left[\ddot{\smile}\right]\right]}_{b}} \frac{1}{\sqrt{\lambda}}\right]$$

$a = 2,9982$
$b = 2,0309$

VOIR
PROGRAMME
PYTHON :-)

$\boxed{4}$ $\boxed{5}$

VOIR
PROGRAMME
PYTHON

Re_{-d}	λ
10^4	$14,47 \; 10^{-3}$
10^5	$8,34 \; 10^{-3}$
229 471	$7,06 \; 10^{-3}$
10^6	$5,36 \; 10^{-3}$

LA
DNS

À COMPARER AVEC
λ OBTENU
DANS LA DNS
$8,17 \; 10^{-3}$

PAS SI MAL :-)

EX. 22

1

$\alpha = 1/n$

$$\bar U_m = \bar U_c \underbrace{\int_0^1 \eta^{\alpha}\, d\eta}_{\left[\frac{\eta^{\alpha+1}}{\alpha+1}\right]_0^1 = \frac{1}{\alpha+1}} = \bar U_c \frac{1}{1/n+1} = \bar U_c \frac{n}{1+n}$$

$$\boxed{\bar U_m = \bar U_c \frac{n}{n+1}}$$

2

$$\int_0^1 \bar U_c - \bar U(\eta)\, d\eta = \bar U_c - \bar U_c\left(\frac{n}{n+1}\right) = \underbrace{\bar U_c\left(\frac{n+1-n}{n+1}\right)}_{\bar U_c \frac{1}{n+1}}$$

$$\int_0^1 \frac{\bar U_c - \bar U(\eta)}{\bar U_\tau}\, d\eta = \underbrace{\frac{1}{\bar U_m}}_{=\frac{n+1}{n}\frac{1}{\bar U_c}} \bar U_c \frac{1}{n+1} \underbrace{\frac{\bar U_m}{\bar U_\tau}}_{\frac{2}{\sqrt{\lambda}}}$$

$$\boxed{I_{Nik} = \frac{1}{n} \frac{2}{\sqrt{\lambda}}}$$

3

$$\frac{\bar U_c - \bar U(\eta)}{\bar U_\tau} = \underbrace{\frac{1}{\kappa}\log\left[\frac{h \bar U_\tau}{\nu}\right] - \frac{1}{\kappa}\log\left[\frac{y \bar U_\tau}{\nu}\right]}_{-\frac{1}{\kappa}\log\left[\underbrace{\frac{y}{h}}_{\eta}\right]} + \underbrace{G(1) - G(\eta)}_{D\left[3\alpha^2 - 2\alpha^3 - 3\alpha^2\eta^2 + 2\alpha^3\eta^3\right]}$$

LA ZONE !!! COUVRE QUASI TOUT !

4

$$I_{Coles} \simeq \underbrace{-\frac{1}{\kappa}\int_0^1 \log\eta\, d\eta}_{1/\kappa} + D\left[\underbrace{3\alpha^2 - 2\alpha^3 - \frac{3\alpha^2}{3} + \frac{2\alpha^3}{4}}_{\underbrace{2\alpha^2 - 3\alpha^3/2}_{=0}}\right]$$

$= 0$ CAR $\alpha = 4/3$:-)

$$\boxed{I_{Coles} = \frac{1}{\kappa}}$$

5

$$\frac{1}{\kappa} = \frac{1}{n}\frac{2}{\sqrt{\lambda}} \longrightarrow \boxed{n = \frac{2\kappa}{\sqrt{\lambda}}}$$

6 **7**

VOIR PROGRAMME PYTHON :-)

$\boxed{n = 8{,}5}$