Correction Examen - MDF Approfondi

Exo 1 :

1) En appliquant le principe fondamental de la dynamique : $F + P_{atm} S_1 = P_1 S_1$ 0,5

$$\Rightarrow P_1 = \frac{4F}{\pi d_1^2} + P_{atm} \quad 0{,}5$$

$$= \frac{4 \times 62{,}84}{\pi \cdot 0{,}04^2} + 10^5 = 1{,}5 \text{ bar} \quad 0{,}5$$

2) $V_1 S_1 = V_2 S_2$ 0,5 $\Rightarrow V_1 = V_2 \frac{S_2}{S_1} = V_2 \left(\frac{d_2}{d_1}\right)^2 = \left(\frac{1}{4}\right)^2 V_2$ 0,5

$$\Rightarrow V_1 = \frac{V_2}{16} \quad 0{,}5$$

3) $$\frac{V_2^2 - V_1^2}{2} + \frac{P_2 - P_1}{\rho} + g(z_2 - z_1) = 0 \quad 0{,}5$$

$$\begin{cases} z_1 = z_2 \\ P_2 = P_{atm} \end{cases} \Rightarrow V_2 = \sqrt{\frac{512}{255} \, \frac{P_1 - P_{atm}}{\rho}} \quad 0{,}5$$

AN. $$V_2 = \sqrt{\frac{512}{255} \, \frac{(1{,}5 \cdot 10^5 - 10^5)}{1000}} = 10 \text{ m/s} \quad 0{,}5$$

4) $q_v = \frac{\pi d_2^2}{4} V_2$ 0,5 $= \frac{\pi \cdot 0{,}01^2}{4} \times 10$ 0,5 $= 0{,}785 \cdot 10^{-3} \text{ m}^3/\text{s}$ 0,5

Ex2

1) $\frac{u(y)}{U} = \frac{y}{\delta(x)}$

$\delta_2 = \int_0^{\delta} \frac{u}{U}\left(1 - \frac{u}{U}\right) dy = \int_0^{\delta} \frac{y}{\delta}\left(1 - \frac{y}{\delta}\right) dy = \frac{\delta(x)}{6}$ 0,5

$\tau_w = \mu \frac{\partial u}{\partial y}\Big|_{y=0} = \mu \frac{U}{\delta(x)} = \rho U^2 \frac{d\delta_2}{dx} = \frac{1}{6} \rho U^2 \frac{d\delta(x)}{dx}$ 0,5

$\Rightarrow \quad \delta(x)\, d\delta(x) = \frac{6\nu}{U} dx$

$\Rightarrow \int_0^{\delta} \delta(x)\, d\delta(x) = \int_0^{x} \frac{6\nu}{U} dx \Rightarrow \frac{\delta^2(x)}{2} = \frac{6\nu}{U} x$ 0,5

$\Rightarrow \quad \frac{\delta(x)}{x} = \frac{3{,}46}{\sqrt{Re_x}}$ 0,5

2) $\tau_w = \mu \frac{\partial u}{dy}\Big|_{y=0} = \mu \frac{U}{\delta}$ 0,5

$C_f = \frac{\tau_w}{\frac{1}{2}\rho U^2} = \frac{\mu \frac{U}{\delta}}{\frac{1}{2}\rho U^2} = \frac{2\mu}{\rho U \frac{3{,}46 x}{\sqrt{Re_x}}} \Rightarrow C_f = \frac{0{,}571}{\sqrt{Re_x}}$

0,5 0,5 0,5