MF314 - Ecoulement autour d'un cylindre.

1 - . Ecoulement irrotationnel $\rightarrow \vec{rot}\,\vec{v} = \vec{0} \Rightarrow \exists \phi \backslash \; \boxed{\vec{v} = \vec{grad}\,\phi}$

. — incompressible $\rightarrow div\, v = \vec{0} \Rightarrow \boxed{\Delta\phi = 0}$

2 - a - $\vec{U} = U\vec{e_x} = \vec{grad}\,\phi_U = \frac{d\phi_U}{dx}\vec{e_x} \rightarrow \underline{\phi_U = Ux}$

b - $\phi = \phi_U + \phi_{dipole} = Ux + \frac{K\cos\theta}{2\pi r} \xrightarrow[r\to\infty]{} \phi_U$ (ok) $\searrow \underline{\vec{v} = U\vec{e_x}}$

c - C.L. : vitesse normale au cylindre, nulle.

$x = r\cos\theta \longrightarrow \phi = Ur\cos\theta + \frac{K\cos\theta}{2\pi r}$

$v_r = \frac{\partial\phi}{\partial r} = U\cos\theta - \frac{K\cos\theta}{2\pi r^2}$; $v_r(R) = 0 \Rightarrow \underline{K = U\,2\pi R^2}$

d - $\rightarrow \boxed{\phi = U\cos\theta\left(1 + \frac{R^2}{r}\right)}$ $\quad v_r = \frac{\partial\phi}{\partial r} = U\cos\theta\left(1 - \frac{R^2}{r^2}\right)$

$v_\theta = \frac{\partial\phi}{r\partial\theta} = -U\sin\theta\left(1 + \frac{R^2}{r^2}\right)$

e - $\vec{v}(A) = \begin{vmatrix} 0 \\ 0 \end{vmatrix}$ Point d'arrêt $\quad \vec{v}(A') = \begin{vmatrix} 0 \\ 0 \end{vmatrix}$

f - Pour fluides incompressibles : resserrement des ldc $\Rightarrow v \nearrow$