TD N°02

Ex1 :

$V_A = 5\left(1 - \frac{r^2}{R^2}\right)$ m/s

$V_{max} \Rightarrow r = 0$

$V_{max} = 5\left(1 - \frac{0}{R^2}\right) = 5$ m/s

$V_{avg} = \frac{V_{max}}{2} = 2,5$ m/s

$V_{avg} = \frac{1}{Surface} \int_0^R V_A \, dS$ $\quad dS = 2\pi r \, dr$

Ex2 :

$\mu = 8,2 \times 10^{-2}$ kg.s/m²

$V = Ay^2 + By + C$ $\quad C = 0$

$V = Ay^2 + By$ $\quad V_{max} = 100$ cm/s

$100 = A(15)^2 + B(15)$ $\quad y = 15$ cm

$100 = 225A + 15B$

$\frac{dV}{dy}\Big|_{V_{max}} = 2Ay + B = 30A + B = 0$

$225A + 15B = 100$

$30A + B = 0 \Rightarrow B = -30A$

$225A + 15(-30)A = 100$

$A = -0,44$

$30A + B = 0 \Rightarrow B = -30A$

$= -30(-0,44)$

$B = 13,2$

$V = -0,44y^2 + 13,2y$

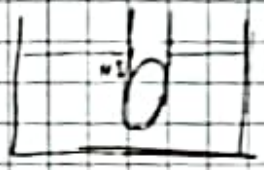
$\frac{dV}{dy} = -0,88y + B$

$\tau = \mu \frac{dV}{dy}$

y (cm)	V (cm/s)	$\frac{dV}{dy}$	τ (Pa)
0	0	13,2	$= 13,2 \mu = 1,0$
5	95,65	8,93	0,75
10	89,3	4,53	0,37
15	100	0	0

Velocity ↗ Viscosity and y radial ↘

Ex3 :



$H = \frac{4\delta \cos\theta}{\rho \cdot g \cdot d}$

N.A : $H = \frac{4 \cdot 0,515 \cos 130}{13570 \times 9,8 \times 1,5 \times 10^{-3}}$

$H = 3,68 \times 10^{-3}$ m $= 3,68$ mm

Ex4 :

$H = \frac{4\delta \cos\theta}{\rho \cdot g \cdot d}$

$H = \frac{4 \times 0,074 \cos 0}{1000 \times 9,8 \times 3 \times 10^{-3}} = 0,01$ m $= 10$

Ex5 :

1) $-\frac{dV}{V} = \frac{dP}{\varepsilon}$

$dV = \frac{dP \, V_i}{\varepsilon}$

N.A : $dV = -\frac{-20 \times 10^5}{2,25 \times 10^9} \cdot 30 \times 10^{-3}$

$dV = 2,6 \times 10^{-5}$ m³

2) $\varepsilon = ?$ $\quad \begin{cases} V = 30l \rightarrow 40 \text{ bar} \\ 29,73l \rightarrow 246,8 \text{ bar} \end{cases}$

N.A : $-\frac{dV}{V} = \frac{dP}{\varepsilon} \Rightarrow \varepsilon = -\frac{dP}{dV} V_i$

N.A : $\varepsilon = \frac{P_2 - P_1}{V_2 - V_1} \cdot V_i = \frac{(246,8 - 10)10^5}{(29,73 - 30)10^{-3}}$

$\varepsilon = 8,298 \cdot 10^9$ Pa $= 9,36$ Pa

Ex6 :

$$\beta_t = \frac{1}{V_i}\frac{dV}{dT}$$

$$\beta_t = \frac{1}{2\times10^{-3}} \frac{0,1\times10^{-3}}{20+273}$$

$$\beta_t = 1,7\times10^{-5}\ K$$

Ex7 :

$$PV = nRT \Rightarrow PV = \frac{m}{M}RT$$

$$\Rightarrow \rho V = mrT$$

$$\frac{m}{V} = \rho = \frac{P}{rT} = \frac{10\times10^5}{286,7\times(27+38)}$$

$$\rho = 11,69\ kg/m^3$$

$$\omega = \rho \cdot g = 11,62\times9,81 = 114\ N/m^3$$

$$v_s = \frac{1}{\rho} = \frac{1}{11,62} = 0,086\ m^3/kg$$

Ex8 :

$$PV = mrT \Rightarrow T = \frac{PV}{mr}$$

$$T = \frac{10^5\times40\times10^{-3}}{48\times10^{-3}\times286,7} = 290\ K$$

$$= 17\ °C$$

Ex9 :

$$PV = nRT \Leftrightarrow PV = mrT$$

$$m = \frac{PV}{rT} = \frac{10^5\times250}{286,7\times(25+273)}$$

$$m = 292,61\ kg$$

$$n = \frac{m}{M} = \frac{292,61\times10^3}{32}$$

$$n = 9,14\times10^3\ mol$$

~~Ex10 :~~

Ex11 :

$$\sum \vec{F}_{ext} = \vec{0}$$

$$\vec{F} + \vec{P} = \vec{0}$$

Projection

$$P_M - F = 0$$

$$P\sin\theta - \mu A\frac{dV}{dh} = 0$$

$$mg\sin\theta - \mu A\frac{dV}{dh} = 0$$

$$\sin\theta = \frac{\mu A\frac{dV}{dh}}{\frac{\pi d^2}{4}dh}\frac{1}{mg}$$

$$\sin\theta = \frac{\mu A\frac{dV}{dh}}{\frac{\pi d^2}{4}dh}\frac{1}{mg}$$

n-a : $\sin\theta = 9,57\times\frac{\pi\times(0,243)^2}{4}\times\frac{0,3}{0,6\times10^3}\times\frac{1}{18,14\times0,1}$

$$\sin\theta = 0,128 \Rightarrow \theta = 7°$$

$\sin\theta = \frac{P_1}{P}$

$P_M = P\sin\theta$

$A = \pi r^2 = \frac{1}{4}\pi d^2$

Ex12 :

$$F_1 = F_2$$

$$\mu_1 A\frac{dV}{d(R-y)} = \mu_2 A\frac{dV}{dy}$$

$$\frac{\mu_1}{d(R-y)} = \frac{k\mu_1}{dy}$$

$$\mu_1 A\frac{dV}{d(R-y)} = \mu_2 A\frac{dV}{dy}$$

$$\frac{\mu_1}{d(R-y)} = \frac{k\mu_1}{dy} \Rightarrow \frac{1}{R-y} = \frac{k}{y}$$

$$\Rightarrow y = kR - ky \Rightarrow y + ky = kR$$

$$y(k+1) = kR \Rightarrow y = \frac{kR}{k+1}$$

$$y = \frac{2}{3} = 0,66\ m$$

$\mu_2 = k\mu_1$