Exercise N° 1 :

1) $V = \frac{4}{3}\pi r^3 \rightarrow \rho_g = \frac{m_T}{V_T} = \frac{10^6}{\frac{4}{3}\pi r^3} \rightarrow r = \sqrt[3]{\frac{10^6}{\frac{4}{3}\pi r^3}} = 6{,}215\ m$

$F = \frac{V_{immer}}{V_{total}} \cdot 100 = \frac{\rho_{glace}}{\rho_e} \cdot 100 = \frac{995}{1025} \cdot 100 = 97\ \%.$

2) $F_{arch} = P_G \implies \rho_{ice}.g.V_{total} = \rho_e.g.V_{immer}$

$F = \frac{V_{immer}}{V_{total}} \cdot 100 = \frac{\rho_{ice}}{\rho_e} \cdot 100 = \frac{995}{1025} \cdot 100 = 97\ \%.$

3) $\frac{V_{immer}}{V_{total}} = \frac{\rho_{ice}}{\rho_e} \implies V_{immer} = V_{total} \cdot \frac{\rho_{ice}}{\rho_e} = 975{,}61\ m^3.$

4) The volume fraction F is independent of the shape of the body, it has the relation only with the ratio of the densities, therefore F=97%.

Exercise N° 2 :

1) $P_{weight} = P_{ARCH} = F_1.V.\rho_{mer}.g = F_1.\frac{4}{3}\pi.R^3.\rho_{mer}.g$ $P_{weight} = \frac{1}{2}\frac{4}{3}\pi 0{,}1^3.1025.9{,}81 = 21\ N$

2) $P_{weight} = P_{ARCH} \Leftrightarrow F_2.V.\rho_{oil}.g = P_{weight}$ $F_2 = \frac{1}{2}\frac{\rho_{mer}}{\rho_{oil}}$ AN. $F_2 = \frac{1}{2}\frac{1025}{800} = 64\%$

Exercise N° 3 :

1) If we neglect the atmospheric pressure, the resultant of the pressure forces:

$= P_G.S.\vec{X}$ with: $S = a.b$ So : $\|\vec{R}\| = \rho.g.S.Z_g$ A.N. $\|\vec{R}\| = 1000.9{,}81.6.4 = 235440\ N$

2) The depth ZR of the center of pressure is given by the following expression:

$Z_R = \frac{I_{(G,Y)}}{Z_G.S} + Z_G$ Or: $I_{(G,Y)} = \frac{2^3.3}{12} = 2\ m^4$ A.N. $Z_R = 4{,}0833\ m$

3) Case of a glazed part of circular shape with a diameter d= 2 m:

$S = \frac{\pi.d^2}{4} = 3{,}141\ m^2$, $I_{(G,Y)} = \frac{\pi.d^4}{64} = 0{,}785\ m^4$

$\|\vec{R}\| = \rho.g.S.Z_g$ A.N. $\|\vec{R}\| = 123252\ N$ / $Z_R = \frac{I_{(G,Y)}}{Z_G.S} + Z_G$ A.N. $Z_R = \frac{0{,}785}{4.3{,}14} + 4 = 4{,}0625\ m$