Fiche 7 : # Incertitude d'une mesure indirecte

EX1/

Périmètre de la feuille : $P = 2\times l + 2\times L = 2\times 21 + 2\times 29{,}7 =$ **101,4 cm**

$u(P)^2 = u(l)^2 + u(l)^2 + u(L)^2 + u(L)^2$

$u(P) = \sqrt{2\times u(l)^2 + 2\times u(L)^2} = \sqrt{2\times 0{,}041^2 + 2\times 0{,}041^2} =$ **0,082 cm** ↳ **P = (101,400 ± 0,082) cm**

Surface de la feuille : $S = l\times L = 21\times 29{,}7 =$ **623,7 cm²**

$$\left(\frac{u(S)}{S}\right)^2 = \left(\frac{u(l)}{l}\right)^2 + \left(\frac{u(L)}{L}\right)^2$$

$$u(S) = S\times\sqrt{\left(\frac{u(l)}{l}\right)^2 + \left(\frac{u(L)}{L}\right)^2} = 623{,}7\times\sqrt{\left(\frac{0{,}041}{21}\right)^2 + \left(\frac{0{,}041}{29{,}7}\right)^2} =$$ **1,49 cm²** ↳ **S = (623,7 ± 1,5) cm²**

EX2/ $P = \pi\times D = \pi\times 2{,}83 =$ 8,890707 cm

$u(P) = \pi\times u(D) = \pi\times 0{,}041 =$ **0,13 cm** ↳ **P = (8,89 ± 0,13) cm**

EX3/ $e = \frac{h}{18} = \frac{2{,}50}{18} = 0{,}13888$ cm = **1,3888 mm**

$u(e) = \frac{u(h)}{18} = \frac{0{,}041}{18} = 0{,}0023$ cm = **0,023 mm** ↳ **e = (1,389 ± 0,023) mm**

EX4/

Incertitude de lecture $u(\text{longueur}) = \frac{\text{grad}}{\sqrt{6}} = \frac{1}{\sqrt{6}} = 0{,}41\ cm = 0{,}0041\ m$

L = (10,0000 ± 0,0041) m ; **l = (4,0000 ± 0,0041) m** ; **h = (1,5000 ± 0,0041) m**

Périmètre de la piscine : $P = 2\times l + 2\times L = 2\times 4 + 2\times 10 =$ **28 m**

$u(P) = \sqrt{2\times u(l)^2 + 2\times u(L)^2} = \sqrt{2\times 0{,}0041^2 + 2\times 0{,}0041^2} =$ **0,0082 m** ↳ **P = (28,0000 ± 0,0082) m**

Surface de la piscine $S = L\times l = 10\times 4 =$ **40 m²**

$$u(S) = S\times\sqrt{\left(\frac{u(L)}{L}\right)^2 + \left(\frac{u(l)}{l}\right)^2} = 40\times\sqrt{\left(\frac{0{,}0041}{10}\right)^2 + \left(\frac{0{,}0041}{4}\right)^2} =$$ **0,044 m²**

↳ **S = (40,000 ± 0,044) m²**

Volume de la piscine : $V = L\times l\times h = 10\times 4\times 1{,}5 =$ **60 m³**

$$u(V) = V\times\sqrt{\left(\frac{u(L)}{L}\right)^2 + \left(\frac{u(l)}{l}\right)^2 + \left(\frac{u(h)}{h}\right)^2} = 60\times\sqrt{\left(\frac{0{,}0041}{10}\right)^2 + \left(\frac{0{,}0041}{4}\right)^2 + \left(\frac{0{,}0041}{1{,}5}\right)^2} =$$ **0,18 m³**

↳ **V = (60,00 ± 0,18) m³**

EX5/ $U = R \times I \rightarrow R = \frac{U}{I} = \frac{19,82}{0,120} =$ **165,1666 Ω**

$$u(R) = R \times \sqrt{\left(\frac{u(U)}{U}\right)^2 + \left(\frac{u(I)}{I}\right)^2} = \frac{19,82}{0,120} \times \sqrt{\left(\frac{0,34}{19,82}\right)^2 + \left(\frac{0,005}{0,120}\right)^2} =$$ **7,4 Ω** ↳ **R = (165,2 ± 7,4) Ω**

EX6/ $V = \frac{d}{t} = \frac{125,35}{2,16} =$ **58,0324 m.s^{-1}**

$$u(V) = V \times \sqrt{\left(\frac{u(d)}{d}\right)^2 + \left(\frac{u(t)}{t}\right)^2} = \frac{125,35}{2,16} \times \sqrt{\left(\frac{0,15}{125,35}\right)^2 + \left(\frac{0,01}{2,16}\right)^2} =$$ **0,28 m.s^{-1}**

↳ **V = (58,03 ± 0,28) m.s^{-1}**

EX7/ $V = \pi \times R^2 \times h = \pi \times 1,5^2 \times 13,2 =$ **93,30530 cm^3**

$$\left(\frac{u(V)}{V}\right)^2 = \left(\frac{u(\pi)}{\pi}\right)^2 + \left(\frac{u(R)}{R}\right)^2 + \left(\frac{u(R)}{R}\right)^2 + \left(\frac{u(h)}{h}\right)^2$$

$$\left(\frac{u(V)}{V}\right)^2 = 2 \times \left(\frac{u(R)}{R}\right)^2 + \left(\frac{u(h)}{h}\right)^2$$

$$u(V) = V \times \sqrt{2 \times \left(\frac{u(R)}{R}\right)^2 + \left(\frac{u(h)}{h}\right)^2} = 93,30530 \times \sqrt{2 \times \left(\frac{0,041}{1,5}\right)^2 + \left(\frac{0,041}{13,2}\right)^2} =$$ **3,6 cm^3**

↳ **V = (93,3 ± 3,6) cm^3**

EX8/ $C_1 = \frac{C_0 \times V_0}{V_1} = \frac{200 \times 10}{100} =$ **20 mmol.L^{-1}**

$$u(C_1) = C_1 \times \sqrt{\left(\frac{u(C_0)}{C_0}\right)^2 + \left(\frac{u(V_0)}{V_0}\right)^2 + \left(\frac{u(V_1)}{V_1}\right)^2} = 20 \times \sqrt{\left(\frac{0,20}{200}\right)^2 + \left(\frac{0,025}{10}\right)^2 + \left(\frac{0,25}{100}\right)^2} =$$

0,073 mmol.L^{-1} ↳ **C_1 = (20,000 ± 0,073) mmol.L^{-1}**

EX9/

Valeur de la tension $u(U) = \frac{p}{\sqrt{3}} = \frac{1}{\sqrt{3}} \times (4.10^{-5} \times 5,12807 + 6.10^{-6} \times 10) =$ **1,5.10^{-4} V**

↳ **U = (5,12807 ± 0,00015) V**

Valeur de l'intensité $u(I) = \frac{p}{\sqrt{3}} = \frac{1}{\sqrt{3}} \times (10^{-3} \times 0,542310 + 10^{-4} \times 1) =$ **3,7.10^{-4} A**

↳ **I = (0,54231 ± 0,00037) A**

Valeur de la puissance $P = U \times I = 5,12807 \times 0,54231 =$ **2,7810036 W**

$$u(P) = P \times \sqrt{\left(\frac{u(U)}{U}\right)^2 + \left(\frac{u(I)}{I}\right)^2} = U \times I \times \sqrt{\left(\frac{u(U)}{U}\right)^2 + \left(\frac{u(I)}{I}\right)^2}$$

$$= 5,12807 \times 0,54231 \times \sqrt{\left(\frac{0,00015}{5,12807}\right)^2 + \left(\frac{0,00037}{0,54231}\right)^2} =$$ **1,9.10^{-3} W** ↳ **P = (2,7810 ± 0,0019) W**