Fiche 7 : Incertitude d'une mesure indirecte --- correction

EX1/

Périmètre de la feuille

$P = 2\times l + 2\times L = 2\times 21 + 2\times 29{,}7 =$ **101,4 cm**

$UP^2 = Ul^2 + Ul^2 + UL^2 + UL^2$

$UP = \sqrt{2\times Ul^2 + 2\times UL^2}$

$UP = \sqrt{2\times 0{,}08^2 + 2\times 0{,}08^2} = 0{,}16$ = **0,2 cm**

P = (101,4 ± 0,2) cm

Surface de la feuille

$S = l\times L = 21\times 29{,}7 =$ **623,7 cm²**

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

$$US = S\times\sqrt{\left(\frac{Ul}{l}\right)^2 + \left(\frac{UL}{L}\right)^2}$$

$$US = 623{,}7\times\sqrt{\left(\frac{0{,}08}{21}\right)^2 + \left(\frac{0{,}08}{29{,}7}\right)^2} = \textbf{3 cm}^2$$

S = (624 ± 3) cm²

EX2/

$P = \pi\times D = \pi\times 2{,}8 =$ **8,796 cm**

Incertitude $UP = \pi\times UD = \pi\times 0{,}1 =$ **0,3 cm**

Résultat **P = (8,8 ± 0,3) cm**

EX3/

Epaisseur d'un CD :

$$e = \frac{h}{18} = \frac{2{,}50}{18} = 0{,}13888 \text{ cm} = \textbf{1,3888 mm}$$

Incertitude

$$Ue = \frac{Uh}{18} = \frac{0{,}08}{18} = 0{,}004 \text{ cm} = \textbf{0,04 mm}$$

e = (1,39 ± 0,04) mm

EX4/

Incertitude de lecture

$$Ulec = \sqrt{\frac{2}{3}}\times grad = \sqrt{\frac{2}{3}}\times 1 = \textbf{0,8 cm} = \textbf{0,008 m}$$

L = (10,000 ± 0,008) m

l = (4,000 ± 0,008) m

h = (1,500 ± 0,008) m

Périmètre de la piscine

$P = 2\times l + 2\times L = 2\times 4 + 2\times 10 =$ **28 m**

$UP^2 = Ul^2 + Ul^2 + UL^2 + UL^2$

$UP = \sqrt{2\times Ul^2 + 2\times UL^2}$

$UP = \sqrt{2\times 0{,}008^2 + 2\times 0{,}008^2} = 0{,}016$ = **0,02**

P = (28,00 ± 0,02) cm

Surface de la piscine

$S = L\times l = 10\times 4 =$ **40 m²**

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

$$US = S\times\sqrt{\left(\frac{UL}{L}\right)^2 + \left(\frac{Ul}{l}\right)^2}$$

$$\Delta S = 40\times\sqrt{\left(\frac{0{,}008}{10}\right)^2 + \left(\frac{0{,}008}{4}\right)^2} = \textbf{0,09 m}^2$$

S = (40,00 ± 0,09) m²

Volume de la piscine

$V = L\times l\times h = 10\times 4\times 1{,}5 =$ **60 m³**

$$\left(\frac{UV}{V}\right)^2 = \left(\frac{UL}{L}\right)^2 + \left(\frac{Ul}{l}\right)^2 + \left(\frac{Uh}{h}\right)^2$$

$$UV = V\times\sqrt{\left(\frac{UL}{L}\right)^2 + \left(\frac{Ul}{l}\right)^2 + \left(\frac{Uh}{h}\right)^2} =$$

$$60\times\sqrt{\left(\frac{0{,}008}{10}\right)^2 + \left(\frac{0{,}008}{4}\right)^2 + \left(\frac{0{,}008}{1{,}5}\right)^2} = \textbf{0,3 m}^3$$

V = (60,0 ± 0,3) m³

EX5/

$$U = R \times I \rightarrow R = \frac{U}{I} = \frac{19,8}{0,120} = \mathbf{165\ \Omega}$$

$$\left(\frac{UR}{R}\right)^2 = \left(\frac{UU}{U}\right)^2 + \left(\frac{UI}{I}\right)^2$$

$$UR = R \times \sqrt{\left(\frac{UU}{U}\right)^2 + \left(\frac{UI}{I}\right)^2} =$$

$$\frac{19,8}{0,120} \times \sqrt{\left(\frac{0,3}{19,8}\right)^2 + \left(\frac{0,005}{0,120}\right)^2} = \mathbf{7\ \Omega}$$

R = (165 ± 7) Ω

EX6/

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

$$\left(\frac{UV}{V}\right)^2 = \left(\frac{Ud}{d}\right)^2 + \left(\frac{Ut}{t}\right)^2$$

$$UV = V \times \sqrt{\left(\frac{Ud}{d}\right)^2 + \left(\frac{Ut}{t}\right)^2} =$$

$$\frac{125,35}{2,16} \times \sqrt{\left(\frac{0,15}{125,35}\right)^2 + \left(\frac{0,01}{2,16}\right)^2} = \mathbf{0,3\ m.s^{-1}}$$

V = (58,0 ± 0,3) m.s^{-1}

EX7/

Volume du cylindre

$$V = \pi \times R^2 \times h = \pi \times 1,5^2 \times 13,2 = \mathbf{93,305\ cm^3}$$

Incertitude

$$\left(\frac{UV}{V}\right)^2 = \left(\frac{U\pi}{\pi}\right)^2 + \left(\frac{UR}{R}\right)^2 + \left(\frac{UR}{R}\right)^2 + \left(\frac{Uh}{h}\right)^2$$

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

$$UV = V \times \sqrt{2 \times \left(\frac{UR}{R}\right)^2 + \left(\frac{Uh}{h}\right)^2}$$

$$UV = 93,305 \times \sqrt{2 \times \left(\frac{0,08}{1,5}\right)^2 + \left(\frac{0,08}{13,2}\right)^2} = \mathbf{7cm^3}$$

V = (93 ± 7) cm^3

EX8/

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

$$\left(\frac{UC_1}{C_1}\right)^2 = \left(\frac{UC_0}{C_0}\right)^2 + \left(\frac{UV_0}{V_0}\right)^2 + \left(\frac{UV_1}{V_1}\right)^2$$

$$UC_1 = C_1 \times \sqrt{\left(\frac{UC_0}{C_0}\right)^2 + \left(\frac{UV_0}{V_0}\right)^2 + \left(\frac{UV_1}{V_1}\right)^2} =$$

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

0,07 mmol.L^{-1}

C$_1$ = (20,00 ± 0,07) mmol.L^{-1}

EX9/

Valeur de la tension

$$UU = \frac{2}{\sqrt{3}} \times p =$$

$$\frac{2}{\sqrt{3}} \times (4.10^{-5} \times 5,12807 + 6.10^{-6} \times 10) = \mathbf{3.10^{-4}\ V}$$

U = (5,1281 ± 0,0003) V

Valeur de l'intensité

$$UI = \frac{2}{\sqrt{3}} \times p =$$

$$\frac{2}{\sqrt{3}} \times (10^{-3} \times 0,542310 + 10^{-4} \times 1) = \mathbf{7.10^{-4}\ A}$$

I = (0,5423 ± 0,0007) A

Valeur de la puissance

$$P = U \times I = 5,1281 \times 0,5423 = \mathbf{2,780968\ W}$$

$$\left(\frac{UP}{P}\right)^2 = \left(\frac{UU}{U}\right)^2 + \left(\frac{UI}{I}\right)^2$$

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

$$UP = 5,1281 \times 0,5423 \times \sqrt{\left(\frac{0,0003}{5,1281}\right)^2 + \left(\frac{0,0007}{0,5423}\right)^2} =$$

4.10^{-3} W

P = (2,781 ± 0,004) W