

SOLUCIÓN DEL TALLER 03

MODELO MATEMÁTICO

$$C = M / V \quad C = \frac{2.5103}{500} = \frac{0.0050206}{5.0206} \quad \begin{matrix} \text{g/mL} \\ \text{g/L} \end{matrix}$$

$$\begin{matrix} C = \text{concentración} \\ M = \text{masa} \\ V = \text{volumen} \end{matrix} \quad \boxed{2.5103} \text{ g} \quad \begin{matrix} 5020.6 \\ \text{mg/L} \end{matrix}$$

M:

1.- Certificado de calibración : 0.1 mg → 0.0001 g

$$u(x_i) \quad 0.00005 \quad \text{g}$$

2. Control interno de la balanza

$$u(x_i) = 0.0001 \quad \text{g}$$

$$u_c = 0.000111803 \text{ g} \quad \text{uc relativa de la masa} = \boxed{4.45379\text{E-}05}$$

$$\mathbf{V \text{ Matraz volumétrico de } 500 \text{ mL}} = 0.5 \text{ l}$$

1. Especificación del fabricante: 0.25 mL = 0.000102062 l

$$u(x_i) = 0.102062073 \text{ mL} = 0.000102062 \text{ l}$$

2. Control interno de la fiola = 0.0054 mL = 0.0000054 l

3. Variaciones ambientales

$$u(x_i) = 0.1575 \text{ mL} = 0.0001575 \text{ l}$$

$$u_c = 0.000187755 \text{ l} \quad \text{uc relativa al volumen} = \boxed{0.000375511}$$

$$u_{\text{relativas } M \text{ y } V} = \boxed{0.000378143}$$

$$\text{Incertidumbre de la concentración} \quad \pm \quad 0.0019 \quad \text{g/L}$$

$$5.0206 \text{ g/L} \quad \pm \quad 0.0038 \quad \text{g/L}$$

$$5020.6 \text{ mg/l} \quad \pm \quad 3.8 \quad \text{mg/l}$$

MODELO MATEMÁTICO

$$\boxed{\text{Cdil} = C/\text{Fdil} = \frac{5020.6}{10} \text{ mg/l} \rightarrow 502.06 \text{ mg/l}}$$

$$\text{Factor de dilución} = \frac{100}{10} = 10$$

$$\mathbf{Pipeta volumétrica} \quad 10 \text{ mL} = 0.01 \text{ l}$$

1. Especificación del fabricante: 0.02 mL = 0.00002 l

$$u(x_i) = 8.16497\text{E-}06 \text{ l}$$

2. Control interno de la pipeta

$$u(x_i) = 0.0028 \text{ mL} = 0.0000028 \text{ l}$$

3. Variaciones ambientales
 $u(x_i) = 0.00315 \text{ mL} = 0.00000315 \text{ l}$
 $u_c = 9.18853\text{E-}06 \text{ l}$ $uc \text{ relativa al volúmen} = 0.000918853$

Matraz aforado **100 mL** = 0.1 l
1. Especificación del fabricante: 0.1 mL = 0.0001 l
 $u(x_i) = 0.040824829 \text{ mL} = 4.08248\text{E-}05 \text{ l}$
2. Control interno de la fiola de 100
 $u(x_i) = 0.0026 \text{ mL} = 0.0000026 \text{ l}$
3. Variaciones ambientales
 $u(x_i) = 0.0315 \text{ mL} = 0.0000315 \text{ l}$
 $u_c = 5.16302\text{E-}05 \text{ l}$ $uc \text{ relativa al volúmen} = 0.000516302$

$u_c P_{10} \text{ y } F_{100} = 0.001053973$

Incertidumbre relativa estándar = 0.001119755

Incertidumbre de la concentración = $cc * \text{incertidumbre relativa estándar}$
Incertidumbre estándar = 0.562184196 mg/l
Incertidumbre expandida = 1.124368391 mg/l

RESULTADO : 502.06 ± 1.12 mg/l

EVALUACIÓN TIPO A

fiola de 500 mL

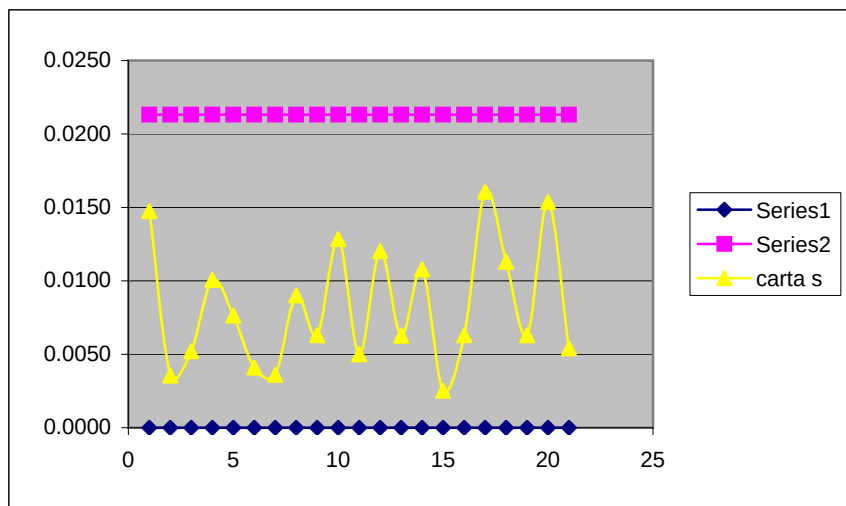
	Fecha	volumen (mL)			s
		rep1	rep2	rep3	(mL)
1	2007-10-02	500.025	500.002	499.998	0.0148
2	2007-10-03	499.990	499.997	499.993	0.0035
3	2007-10-04	499.995	500.005	500.003	0.0052
4	2007-10-05	499.990	500.002	500.010	0.0101
5	2007-10-06	499.990	500.005	499.995	0.0076
6	2007-10-07	499.992	500.000	499.998	0.0041
7	2007-10-09	500.002	499.997	499.995	0.0036
8	2007-10-10	499.990	500.008	500.003	0.0090
9	2007-10-11	499.995	500.003	499.990	0.0063
10	2007-10-12	499.997	500.013	499.987	0.0128
11	2007-10-13	499.985	499.995	499.990	0.0050
12	2007-10-14	500.020	500.003	499.997	0.0120
13	2007-10-16	499.997	500.003	499.990	0.0063
14	2007-10-17	500.002	499.985	500.005	0.0108
15	2007-10-18	499.995	499.990	499.992	0.0025
16	2007-10-19	500.003	499.995	499.990	0.0063
17	2007-10-20	499.992	500.022	499.997	0.0161
18	2007-10-21	499.998	500.008	499.985	0.0113
19	2007-10-23	499.995	500.003	499.990	0.0063
20	2007-10-24	499.992	500.020	499.995	0.0154
21	2007-10-25	499.987	499.998	499.990	0.0054

L-inf	L-sup
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213
0.0000	0.0213

PROMEDIO DE DESV ESTANDAR 0.0083 mL

Desviación estándar 0.0094 mL

Incertidumbre estándar 0.0054 mL



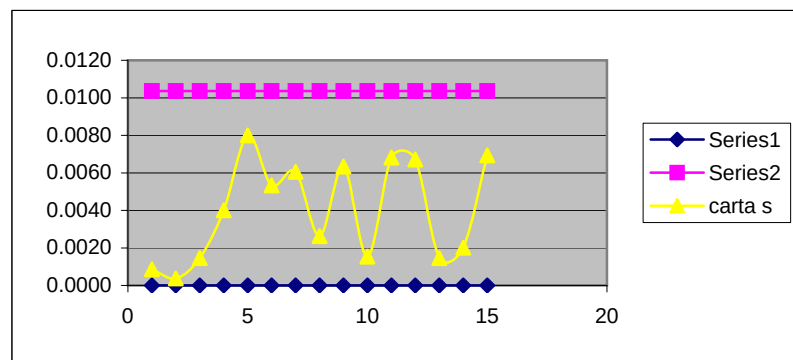
EVALUACIÓN TIPO A

fiola de 100 mL

	Fecha	volumen (mL)			Desv Std (mL)
		rep1	rep2	rep3	
1	2007-10-02	99.957	99.958	99.959	0.0009
2	2007-10-03	99.958	99.959	99.958	0.0004
3	2007-10-04	99.957	99.956	99.954	0.0015
4	2007-10-05	99.957	99.956	99.950	0.0040
5	2007-10-06	100.036	100.020	100.028	0.0080
6	2007-10-07	99.909	99.908	99.917	0.0053
7	2007-10-09	99.917	99.929	99.923	0.0061
8	2007-10-10	99.944	99.946	99.949	0.0026
9	2007-10-11	99.932	99.920	99.930	0.0063
10	2007-10-12	99.928	99.930	99.931	0.0015
11	2007-10-13	99.932	99.945	99.939	0.0068
12	2007-10-14	99.917	99.930	99.927	0.0067
13	2007-10-16	99.907	99.910	99.908	0.0015
14	2007-10-17	99.916	99.916	99.919	0.0020
15	2007-10-18	99.952	99.946	99.939	0.0069

L-inf	L-sup
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104
0.0000	0.0104

PROMEDIO DE DESV ESTANDAR	0.0040	mL
Desviación estándar	0.0046	mL
Incertidumbre estándar	0.0026	mL



EVALUACIÓN TIPO A

pipeta de 10 mL

	Fecha	volumen (mL)			Desv Std (mL)
		rep1	rep2	rep3	
1	2007-10-02	10.002	9.996	9.997	0.0031
2	2007-10-03	10.014	10.002	10.006	0.0061
3	2007-10-04	10.007	9.997	10.008	0.0061
4	2007-10-05	9.996	10.001	9.993	0.0037
5	2007-10-06	9.996	10.001	9.993	0.0037
6	2007-10-07	10.011	10.003	10.008	0.0039
7	2007-10-09	10.012	10.006	10.006	0.0035
8	2007-10-10	10.003	9.992	9.998	0.0055
9	2007-10-11	10.005	9.999	10.003	0.0030
10	2007-10-12	9.995	10.008	9.994	0.0077
11	2007-10-13	10.004	10.005	10.004	0.0007
12	2007-10-14	9.995	10.001	10.003	0.0040
13	2007-10-16	10.008	9.993	10.002	0.0074
14	2007-10-17	9.996	9.997	10.003	0.0035
15	2007-10-18	10.002	9.996	9.995	0.0036

L-inf	L-sup
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112
0.0000	0.0112

PROMEDIO DE DESV ESTANDAR	0.0044	mL
Desviación estándar	0.0049	mL
Incertidumbre estándar	0.0028	mL

$$C_4 = 0.8862$$

