

测量不确定度评定记录

Q/G2209415010 (B0)

表单编号:

1. 测量过程名称:

氢氧化钾标准溶液配置-滴定

2. 测量设备 (测量系统) 误差或准确度等级:

允许误差: $\pm 0.05\text{ml}$

3. 测量数据:

测量频次	1	2	3	4	5
数据 (g)	49.8373	49.8226	49.8275	49.8299	49.8391
测量频次	6	7	8	9	10
数据 (g)	49.8263	49.8256	49.8289	49.8264	49.8318

4. X 的平均值:

根据数学模型使用恒量法计算:

$$V_{20} = \frac{m(\rho_B - \rho_A)}{\rho_B(\rho_W - \rho_A)} [1 + \beta(20 - t)]$$

测量频次	1	2	3	4	5
数据 (ml)	49.984	49.970	49.974	49.977	49.986
测量频次	6	7	8	9	10
数据 (ml)	49.973	49.973	49.976	49.973	49.979

$$\bar{m} = \frac{m_1 + \dots + m_{10}}{10} = 49.8295 \quad \bar{V} = \frac{V_1 + \dots + V_{10}}{10} = 49.977$$

5. A 类相对不确定度评定 $u_{A \text{ REL}}$

$$u_{A \text{ REL}}(\bar{V}) = \frac{u_A(\bar{V})}{\bar{V}} = \frac{S(V)}{\sqrt{n} \times \bar{V}} = \frac{5.2378 \times 10^{-3}}{\sqrt{10} \times 49.977} = 3.3142 \times 10^{-5}$$

6. B 类相对不确定度评定 $u_{B \text{ REL}}$

6.1 质量称量引入的相对不确定度分量 $u_{\text{REL}}(m)$

$$u_{\text{REL}}(m) = \frac{a}{k \times \bar{m}} = \frac{0.0005}{\sqrt{3} \times 49.8295} = 5.7762 \times 10^{-6}$$

6.2 密度变化引入的相对不确定度分量 $u_{\text{REL}}(\rho)$

6.2.1 空气密度引入的不确定度 $u(\rho_A)$

$\rho_A = 0.0012 \pm 0.0001 \text{g/cm}^3$, 带入数学模型得 $V_1 = 49.981 \text{ml}$, $V_2 = 49.973 \text{ml}$, $\Delta V = 0.009 \text{ml}$

$$u(\rho_A) = \frac{a}{k} = \frac{0.009}{\sqrt{3}} = 5.1962 \times 10^{-3} \text{ml}$$

6.2.2 水密度引入的不确定度 $u(\rho_W)$

$\rho_W = 0.9981 \pm 0.0001 \text{g/cm}^3$, 带入数学模型得 $V_1 = 49.982 \text{ml}$, $V_2 = 49.972 \text{ml}$, $\Delta V = 0.01 \text{ml}$

$$u(\rho_w) = \frac{a}{k} = \frac{0.01}{\sqrt{3}} = 5.7888 \times 10^{-3} \text{ ml}$$

$$u_{\text{REL}}(\rho) = \frac{\sqrt{u^2(\rho_A) + u^2(\rho_w)}}{\bar{V}} = 1.5565 \times 10^{-4}$$

6.3 温度引入的相对不确定度分量 $u_{\text{REL}}(t)$

6.3.1 玻璃膨胀系数引入的不确定度 $u(\beta)$

$\beta = 25 \times 10^{-5} \pm 2.5 \times 10^{-5}$, 带入数学模型得 $V_1 = 49.974 \text{ ml}$, $V_2 = 49.974 \text{ ml}$, $\Delta V = 0 \text{ ml}$

$$u(\beta) = \frac{a}{k} = \frac{0}{\sqrt{3}} = 0 \text{ ml}$$

6.3.2 温度计测量温度引入的不确定度 $u(t')$

温度计允许误差为 $\pm 0.2^\circ\text{C}$, 则 $t = 22.3^\circ\text{C}$, $V_1 = 49.9739 \text{ ml}$, $V_2 = 49.9744 \text{ ml}$, $\Delta V = 0.0005 \text{ ml}$

$$u(t') = \frac{a}{k} = \frac{0.0005}{\sqrt{3}} = 2.8854 \times 10^{-4} \text{ ml}$$

$$u_{\text{REL}}(t) = \frac{\sqrt{u^2(\beta) + u^2(t')}}{\bar{V}} = 5.7736 \times 10^{-6}$$

6.4 B类相对不确定度

$$u_{\text{B REL}}(V) = \sqrt{u^2_{\text{REL}}(m) + u^2_{\text{REL}}(\rho) + u^2_{\text{REL}}(t)} = 1.5586 \times 10^{-4}$$

7. 合成不确定度 u_c

$$u_c = \sqrt{u^2_{\text{A REL}} + u^2_{\text{B REL}}} \times \bar{V} = 0.008 \text{ ml}$$

8. 扩展不确定度 U , ($K=2$)

$$U = u_c \times K = 0.016 \text{ ml}$$