Naziv vježbe: 2. Jednostavna mjerenja		Fakultet elektrotehnike i računarstva	Prezime i ime: [redacted]
Grupa: [redacted]	Dan: [redacted] 2021.	Zavod za primijenjenu fiziku	JMBAG: [redacted] Ocjena:
		Zagreb	

- Volumen valjka $V = \left(\frac{d}{2}\right)^2 \cdot \pi \cdot h$

fiz. veličina \ mjerenje	1.	2.	3.	4.	5.
d [cm]					
h [cm]					

$\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^{n} x_i$ = |n = 5| -> srednja vrijednost

$\bar{d} = \frac{1}{5} \cdot \sum_{i=1}^{5} d_i$

$\bar{d} =$ cm

$\bar{h} = \frac{1}{5} \cdot \sum_{i=1}^{5} h_i$

$\bar{h} =$ cm

$s(\bar{x}) = \sqrt{\frac{1}{n(n-1)} \cdot \sum_{i=1}^{n} (x_i - \bar{x})^2}$ = |n = 5| -> standardna devijacija srednje vrijednost

$s(\bar{d}) =$ cm

$s(\bar{h}) =$ cm

$\delta =$ cm -> rezolucija

$u_\delta = \frac{\delta}{\sqrt{12}}$ -> nesigurnost

$=$ cm

- Kombinirana nesigurnost

$u_h = s(\bar{h})$

$u_d = s(\bar{d})$

$u_{c,d}^2 = u_d^2 + u_\delta^2$

$u_{c,h}^2 = u_h^2 + u_\delta^2$

$d_{mjer} = (\bar{d} \pm u_{c,d})$ [m.j.]

$h_{mjer} = (\bar{h} \pm u_{c,h})$ [m.j.]

$d_{mjer} = (\pm)$ cm

$h_{mjer} = (\pm)$ cm

- Nesigurnost volumena

$u_V^2(h,d) = V^2 \cdot \left[\left(\frac{u_h}{h}\right)^2 + \left(\frac{2u_d}{d}\right)^2\right]$

$u_V(h,d) =$ cm

$\bar{V} = \left(\frac{\bar{d}}{2}\right)^2 \cdot \pi \cdot \bar{h}$

$\bar{V} =$ cm^3

$V_{mjer} = (\bar{V} \pm u_V)$ [m.j.]

$V_{mjer} = (\pm)$ cm^3

• Sila uzgona na tijelo

$F_u = N_3 - N_1$ ↘ posuda + voda

↙

posuda + voda + tijelo $\quad F_u = g \cdot \rho_v \cdot V_t$

• Volumen tijela

$$V_t = \frac{N_3 - N_1}{g \cdot \rho_v}$$

$$V_t = \frac{\cancel{g}'(m_3 - m_1)}{\cancel{g} \cdot \rho_v} = |g' = g|$$

$$V_t = \frac{m_3 - m_1}{\rho_v}$$

• Neprecisnost vage

$\delta_{m_1} =$ g $\quad \delta_{m_3} =$ g

• Nesigurnost mjerenja masa

$$u = \frac{\delta}{\sqrt{12}}$$

$u_{m_1} =$ g $\quad u_{m_3} =$ g

• Mjerenje masa i računanje volumena

$m_0 =$ g $\quad m_3 =$ g

$$V_t = \frac{m_3 - m_0}{\rho_v} = |t = 22^\circ C|$$

$$= \frac{\qquad}{0.99777} = \quad cm^3$$

• Nesigurnost volumena

$$u_V^2 = \left(\frac{\partial V}{\partial m_3}\right)^2 \cdot u_{m_3}^2 + \left(\frac{\partial V}{\partial m_0}\right)^2 \cdot u_{m_0}^2$$

$$u_V^2 = \left(\frac{u_{m_3}}{\rho_v}\right)^2 + \left(\frac{u_{m_0}}{\rho_v}\right)^2$$

$$u_V^2 = \frac{u_{m_3}^2 + u_{m_0}^2}{\rho_v^2}$$

$$u_v(m_3, m_0) = \frac{\sqrt{u_{m_3}^2 + u_{m_0}^2}}{\rho_v}$$

$U_v(m_3, m_0) =$ $\quad cm^3$

• Standardni zapis

$V_t = \bar{V}_t \pm \mu_v$

$= (\quad \pm \quad) \; cm^3$

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valjak $V = \left(\frac{d}{2}\right)^2 \cdot \pi \cdot h$

mjerenje	1	2	3	4	5	srednja vrijednost	standardna devijacija s.v.
d							
h							

srednja vrijednost: $\bar{d} = \frac{1}{5} \cdot \sum_{i=1}^{5} d_i$

$\bar{h} = \frac{1}{5} \cdot \sum_{i=1}^{5} h_i$

standardna devijacija srednje vrijednosti

$U_d = S(\bar{d}) = \sqrt{\frac{1}{5 \cdot (5-1)} \cdot \sum_{i=1}^{5} (d_i - \bar{d})^2}$

$U_h = S(\bar{h}) = \sqrt{\frac{(h_1 - \bar{h})^2 + (h_2 - \bar{h})^2 + (h_3 - \bar{h})^2 + (h_4 - \bar{h})^2 + (h_5 - \bar{h})^2}{5 \cdot (5-1)}}$

rezolucija $\delta =$ ____ i pripadna nesigurnost $U_\delta = \frac{\delta}{\sqrt{12}} =$ ____

kombinirana nesigurnost mjerenja

$u_{c,d} = \sqrt{u_d^2 + u_\delta^2} =$ ____

$u_{c,h} = \sqrt{u_h^2 + u_\delta^2} =$ ____

$\Rightarrow d_{mjer.} = (\bar{d} \pm u_{c,d})\,[m.j.]$

$h_{mjer.} = (\bar{h} \pm u_{c,h})\,[m.j.]$

$d_{mjer.} = ($

$h_{mjer.} = ($

volumen $\bar{V} = \left(\frac{\bar{d}}{2}\right)^2 \cdot \pi \cdot \bar{h}$

$u_v(d,h) = \bar{V} \cdot \sqrt{\left(\frac{u_h}{\bar{h}}\right)^2 + \left(\frac{2u_d}{\bar{d}}\right)^2}$

$\bar{V} =$ ____

$u_v(d,h) =$ ____

$\Rightarrow V_{mjer.} = (\bar{V} \pm u_v)\,[m.j.]$

$V_{mjer.} = ($

2.2

Koristeći izvod, vršimo 2 mjerenja: ① mase posude i vode, ② mase posude i vode s tijelom u vodi

$$\Rightarrow V_t = \frac{m_3 - m_0}{\rho_v}$$, gdje je m_3 masa očitana na vagi u ② i m_0 masa na vagi u ①

NEPRECIZNOST VAGE

$\delta_{m_0} =$ _____ $\delta_{m_3} =$ _____

GUSTOĆA VODE U SOBI (PRIJE TEMP.)

$\rho_v =$ _____

$$\Rightarrow u_{m_0} = \frac{\delta_{m_0}}{\sqrt{12}} =$$ _____ $$u_{m_3} = \frac{\delta_{m_3}}{\sqrt{12}} =$$ _____

MJERENA MASA:

$m_0 =$ _____ $m_3 =$ _____

VOLUMEN

$$\bar{V}_t = \frac{m_3 - m_0}{\rho_v} =$$ _____

$$u_v^2(m_3, m_0) = \left(\frac{\partial V}{\partial m_3}\right)^2 \cdot u_{m_3}^2 + \left(\frac{\partial V}{\partial m_0}\right)^2 u_{m_0}^2 = \frac{u_{m_3}^2}{\rho_v^2} + \frac{u_{m_0}^2}{\rho_v^2} = \frac{1}{\rho_v^2} \cdot \left(u_{m_3}^2 + u_{m_0}^2\right)$$

$$u_v(m_3, m_0) = \frac{1}{\rho_v} \cdot \sqrt{u_{m_3}^2 + u_{m_0}^2} =$$ _____

Rj. $V_t = \bar{V}_t \pm u_v =$ _____