物理实验 (1) 绪论课作业

刘泓尊　　2018011446　　计 84

一. 测量误差及数据处理的基础知识

1. 指出下列数字各是几位数字

(1) 1　　(2) 3　　(3) 5　　(4) 8

(5) 3　　(6) 3　　(7) 3　　(8) 4

2. 改正下列错误, 写出正确答案

(1) 0.10830

(2) $P = (3.169 \pm 0.020) \times 10^4 kg$

(3) $d = 10.43 \pm 0.32 cm$

(4) $t = 18.55 \pm 0.31 cm$

(5) $D = 18.7 \pm 1.4 cm$

(6) $h = (2.73 \pm 0.02) \times 10^5 km$

(7) $R = 6371 km = 6.371 \times 10^6 m = 6.371 \times 10^8 cm$

(8) $\theta = 60^\circ \pm 2'$

3. 推导圆柱体不确定度和合成公式

$$\begin{aligned} \frac{\triangle V}{V} &= \sqrt{\left(\frac{\partial \ln V}{\partial d}\right)^2 (\triangle d)^2 + \left(\frac{\partial \ln V}{\partial h}\right)^2 (\triangle h)^2} \\ &= \sqrt{\left(\frac{2\triangle d}{d}\right)^2 + \left(\frac{\triangle h}{h}\right)^2} \end{aligned} \tag{1}$$

4. 计算结果及不确定度, 并分析不确定度对间接测量值的影响

$$\rho = \frac{4M}{\pi D^2 H} = \frac{4 \times 236.124 \times 10^{-3}}{\pi \times (2.345 \times 10^{-2})^2 \times 8.21 \times 10^{-2}} = 6.66 g/cm^3 \tag{2}$$

$$\begin{aligned} \frac{\triangle \rho}{\rho} &= \sqrt{\left(\frac{\partial \ln \rho}{\partial M}\right)^2 (\triangle M)^2 + \left(\frac{\partial \ln \rho}{\partial D}\right)^2 (\triangle D)^2 + \left(\frac{\partial \ln \rho}{\partial H}\right)^2 (\triangle H)^2} \\ &= 0.006 \end{aligned} \tag{3}$$

$$\triangle \rho = 0.04 g/cm^3 \tag{4}$$

故

$$\rho = 6.66 \pm 0.04 g/cm^3 \tag{5}$$

$$\begin{aligned} \left(\frac{\partial \ln \rho}{\partial M}\right)^2 (\triangle M)^2 &= \left(\frac{\triangle M}{M}\right)^2 = 2.87 \times 10^{-10} \\ \left(\frac{\partial \ln \rho}{\partial D}\right)^2 (\triangle D)^2 &= \left(\frac{2\triangle D}{D}\right)^2 = 1.82 \times 10^{-5} \\ \left(\frac{\partial \ln \rho}{\partial H}\right)^2 (\triangle H)^2 &= \left(\frac{\triangle H}{H}\right)^2 = 1.36 \times 10^{-5} \end{aligned} \tag{6}$$

故 D 的影响最大.

5. 求重力加速度及其不确定度.

$$g = \frac{4\pi^2 l}{T^2} = 9.796 m/s^2 \tag{7}$$

$$\begin{aligned} \frac{\triangle g}{g} &= \sqrt{\left(\frac{\partial \ln g}{\partial l}\right)^2 (\triangle l)^2 + \left(\frac{\partial \ln g}{\partial T}\right)^2 (\triangle T)^2} \\ &= \sqrt{\left(\frac{\triangle l}{l}\right)^2 + \left(\frac{2\triangle T}{T}\right)^2} \\ &= 0.0006 \end{aligned} \tag{8}$$

故

$$g = 9.796 \pm 0.006 m/s^2 \tag{9}$$

6. 选择题或填空题

(1) BD (2) BD (3) $BCEF$ $ADGH$

7. 直线拟合题

$$\begin{aligned} \sum {x_i}^2 &= 21226.16 \\ \left(\sum x_i\right)^2 &= 153507.24 \\ \sum x_i y_i &= 8938.562 \end{aligned} \tag{10}$$

$$\begin{aligned} a &= \frac{\sum x_i y_i \sum x_i - \sum y_i \sum {x_i}^2}{(\sum x_i)^2 - n\sum x_i^2} = 18.371 \\ b &= \frac{\sum x_i \sum y_i - n\sum x_i y_i}{(\sum x_i)^2 - n\sum {x_i}^2} = 0.082 \\ r &= \frac{\sum (x_i - \overline{x})\sum (y_i - \overline{y})}{\sqrt{\sum (x_i - \overline{x})^2}\sqrt{\sum (y_i - \overline{y})^2}} = 0.99998 \end{aligned} \tag{11}$$

故

$$y = 0.082x + 18.371 \tag{12}$$

二. 电磁学实验基本仪器 练习题

1. 如何选择量程

测量时读数为 $50mA, 250mA, 500mA$ 时,$\triangle I$ 均为:

$$\triangle I = I_m \times K\% = 5.0mA \tag{13}$$

$50mA$ 时:

$$\frac{\triangle I}{I} \times 100\% = 10\% \tag{14}$$

$250mA$ 时:

$$\frac{\triangle I}{I} \times 100\% = 2\% \tag{15}$$

$500mA$ 时:

$$\frac{\triangle I}{I} \times 100\% = 1\% \tag{16}$$

由以上结果可知:

a. 使用电表时应采用量程合适的电表, 使得被测量**接近满量程**或大于满量程的 2/3.

b. 被测量**不得超过**电表的量程.

2.B　　3.B　　4.A