

题型分布

- Q1 Improve accuracy
- Q2 Process of experiment
 - Details in implement of measurements: start/end/range/division
 - Details to improve accuracy
- Q3 data process
 - Sig fig+ precision
 - Complicated relationship
- Q4 determine precision quantitatively
 - For measurements:
 - If single measure/ compare method: $U=1/2 \text{ range}=1/2 \text{ Resolution}$
 - If several measurements: $U=1/2 \text{ range}=(\text{max}-\text{min})/2$
 - For results:
 - If $A=B+/-C$ $U(A)=U(B)+U(C)$
 - If $A=B \times / \div C$ $\%U(A)=\%U(B) +\%U(C)$
 - If $A=kB$ $\%U(A)=\%U(B)$
 - Determine the validity of result
 - Reference value in the range of result
 - Reference range has overlap with the range of result

Q1 Improve accuracy

Q2. 实验过程

- 测量数据的细节
- 提高精度

Q3. 数据处理

Q4. determine precision quantitatively

• $u/\%u$

1. measurement { ① 单次测量: $u = \frac{\text{resolution}}{2}$
 ② 多次测量: $u = \frac{\text{range}}{2}$

2. $X = A \times / \div B$ $\%u(X) = \%u(A) + \%u(B)$

$X = \text{constant} \cdot A$ $\%u(X) = \%u(A)$

$X = A + / - B$ $u(X) = u(A) + u(B)$

- accuracy 准确度
- random - repeat { average
graph } ← explain techniques
 - systematic { zero error
parallax error: eye level
simultaneous reading

确保水平/垂直: set square & ruler
测直径: change different orientations ...

precision

• 常考

1. 测 period. 变精确.
- ① put timing marker at centre of oscillation
 - ② measure multiple oscillations
 - ③ repeat & average
 - ④ start timing after several oscillations

2. 变水平
use set square to keep ruler in horizontal

3. Criticize 表格中数据
- ① precision of ... not constant
 - ② number of data is too small
 - ③ no repeat readings
 - ④ range too small
 - ⑤ 缺单位

4. 水浴法减小误差
- ① stir the water
 - ② thermometer shouldn't touch the container

- 参考值与测量值范围中交叉, 则范围有效

- 滑动变阻器: variable resistor

- { intercept 截距
gradient 斜率

- 电容实验中的注意事项
ensure capacitors are fully discharged

- 注意单位统一

- y against x

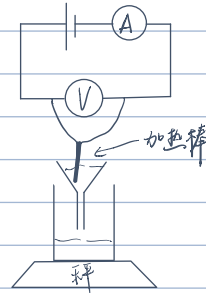
- 控制变量

- 流程.
 - ① 公式 + 测量量 $\left\{ \begin{array}{l} \text{constant} \\ \text{variable} \end{array} \right.$

- ② apparatus
- ③ 实验测量 $\left\{ \begin{array}{l} \text{detail} \\ \text{accuracy} \end{array} \right.$
- ④ repeat for different h.
- ⑤ 作图

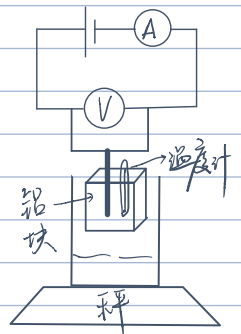
1. measure the specific latent heat of fusion of ice

- ① $L = \frac{\Delta E}{m} = \frac{VIst}{m}$
- ② measurements: V, I, st, m ③ apparatus
- ④ plot a graph. 横-st, 纵-m
- ⑤ errors
 - 漏斗与周围温差加快了冰的融化. E 标 > E 样 L 标 > L 样
 - 同时读数 录像/倒计时
 - 碎冰并落 用带冰的滤纸



2. measurements the specific heat capacity of Al

- ① $C = \frac{\Delta E}{m \Delta T} = \frac{VIst}{m(T_f - T_i)}$
- ② measurement
- ③ apparatus
- ④ repeat reading T after for different time
- ⑤ plot $\Delta T - VIst$
- ⑥ gradient = $\frac{1}{cm}$
- ⑦ errors
 - 空气热传递效率高 倒油 to improve the thermal contact

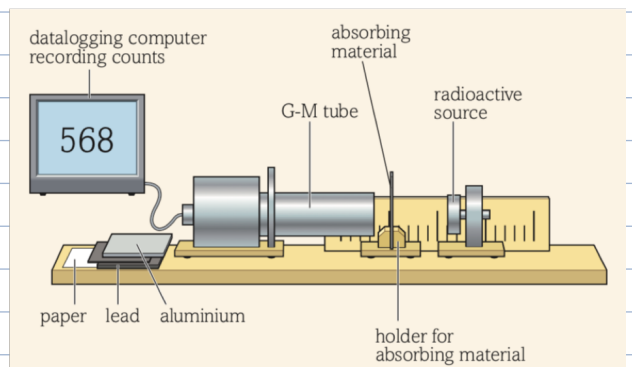


3. investigate the absorption of γ by lead

experiment: penetration of γ in lead

- 1. measurement $\left\{ \begin{array}{l} \text{thickness of lead pieces} \\ \text{count rate} \end{array} \right.$

- 2. apparatus $\left\{ \begin{array}{l} \text{vernier caliper} \\ \text{G-M tube - counter, stopwatch} \\ \text{lead paper with different thickness} \\ \gamma \text{ source (用 } \alpha \text{ 蒙脱过滤)} \end{array} \right.$



- 3. process
 - ① measure background count rate. 制作 γ source
 - ② 先测 - 没有 lead, count rate
 - ③ 改变 lead 厚度. record 相同 time period in count rate
 - ④ correct count rate \rightarrow 测量量 - background
 - ⑤ 画图 correct count rate \rightarrow 纵 - thickness

$$y = \ln \frac{A}{A_0} \quad x = t$$

4. 实验: 用单摆测g

1. process

- ① measurements - apparatus
 l = length of string + $\frac{\text{diameter}}{2}$
 T - stopwatch $\checkmark \rightarrow l_0$



- ② repeat measure (l_0 & T) for different l_0

- ③ process the data
 $x \rightarrow l = l_0 + \frac{d}{2}$ $y \rightarrow T^2$

- ④ plot $y-x$ graph \rightarrow best fit line, determine gradient

$$g = \frac{4\pi^2}{\text{gradient}}$$

2. How to improve accuracy

- ① small angle ($\theta < 10^\circ$) \rightarrow constant T

- ② repeat measure at different orientations and take average \rightarrow uniform \rightarrow random error \downarrow

- ③ long string $\rightarrow T \uparrow \rightarrow \% \text{ error} \downarrow$

- ④ $\left\{ \begin{array}{l} \text{string} \\ \text{ball} \end{array} \right. \begin{array}{l} \text{small} \\ \text{large} \end{array}$

- ⑤ fiducial point at equilibrium position

- ⑥ $N T = t$ $\% \text{ error} = \frac{t}{\text{value}}$

5. 测电容

1. Choose the value of resistor to give a reasonable discharge time
2. Measure the resistance of the resistor (using a multimeter)
3. Charge the capacitors to the initial p.d.
4. Ensure that the ammeter and stopwatch are close together
5. Start the stopwatch at the initial current
6. Record the current (from the ammeter) at times determined using stopwatch
7. Take many measurements

b. G.M tube