Experiment (1) :- Density of a Metal and Distance between it's Atoms.

* $\rho = \frac{m}{V}$, $\Delta m = 0.05\ gm$ (الميزان)

* $V = L \times w \times T$

* ملاحظة :-
تأخذ (error) للكتلة من (mass) عند قراءة الميزان مرة واحدة فقط .
وهو عند التجربة (error of mass) = 0.05 gm

* أولاً :- نقوم بقياس كل من الطول والعرض والارتفاع 6 مرات
* ثانياً :- نقوم بحساب (Average) لكل من (L, w, T)
* ثالثاً :- نحسب (error) لكل من $\bar{L}, \bar{w}, \bar{T}$ وذلك من خلال (standard deviation)

* $\bar{V} = \bar{L} \times \bar{w} \times \bar{T}$

$\Rightarrow$
$\bar{L} = \_\_\_\_ \pm \Delta L$ (Sm)
$\bar{w} = \_\_\_\_ \pm \Delta w$
$\bar{T} = \_\_\_\_ \pm \Delta T$

* $\rho = \_\_\_\_ \pm \Delta \rho$

* حساب $\Delta \rho$ ⇐

$$\frac{\Delta \rho}{\rho} = \frac{\Delta m}{m} + \frac{\Delta V}{V}$$

وحساب ΔV ⇐

$$\frac{\Delta V}{V} = \frac{\Delta L}{\bar{L}} + \frac{\Delta w}{\bar{w}} + \frac{\Delta T}{\bar{T}}$$

* $a = \sqrt[3]{\frac{A_w}{\rho \times N_A}}$, A_w : العدد الكتلي
, ρ : الكثافة
, N_A : عدد أفوجادرو
$\Rightarrow N_A = 6.023 \times 10^{23}$

Experiment 2 : Conservation of Linear Momentum.

* $\vec{P} = m\vec{v}$

$m_1 v_{1b} + m_2 v_{2b} = m_1 v_{1a} + m_2 v_{2a}$ ($v_{2b} = 0$)

$m_1 v_{1b} = m v_{1a} + m_2 v_{2a}$

* $P_b = P_a \Rightarrow R = \frac{P_a}{P_b} = 1 \Rightarrow$ This is the true value.

$\frac{m_1 x_1}{t} b = m_1 \frac{x_1}{t} a + m_2 \frac{x_2}{t} a$, t: constant

$R = \frac{(m_1 x_1)_a + (m_2 x_2)_a}{(m_1 x)_b} \pm \Delta R$

$\Rightarrow R = \frac{A}{B}$

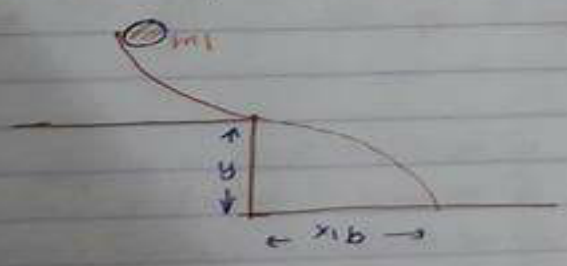
$\frac{\Delta R}{R} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$

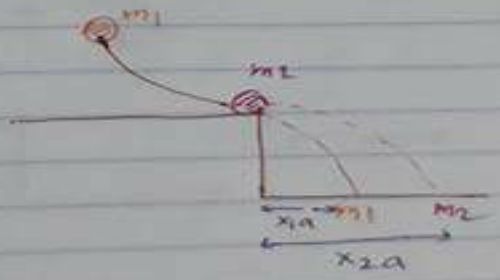
After: $(m_1 \bar{x}_1 + m_2 \bar{x}_2)_a$ — before: $(m_1 \bar{x}_1)_b$

$= m(x_{cm})$

* $\Delta B = m_1 \Delta x_1 b + x_1 b \Delta m_1$

* $\Delta A = m_1 (\Delta x_1)_a + x_1 a \Delta m_1 + m_2 (\Delta x_2)_a + x_2 a \Delta m_2$



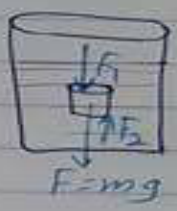


* Experiment 3 : Density of Liquids.

* $F_2 = F_1 + mg$

* $P = \frac{F}{A}$

3 Forces

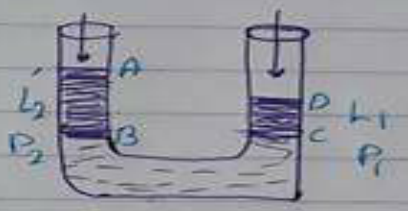


$F_2 - F_1 = mg$

$P_2 A - P_1 A = \rho V g$

$P_2 A - P_1 A = \rho h A g$

* $P_2 - P_1 = \rho h g$



$$= \begin{cases} P_B - P_A = \rho_2 L_2 g \\ P_C - P_D = \rho_1 L_1 g \end{cases}$$

$\Rightarrow P_2 L_2 = P_1 L_1$

$\Rightarrow \boxed{\rho_2 = \frac{L_1}{L_2}}$

* لتوازن السائل (L_1 ، L_2) 6 مرات
* ثم حساب المعدل ($\bar{L_1}$) ، ($\bar{L_2}$).

$\Delta L_1 = 0.2$ cm

$\Delta L_2 = 0.3$ cm

* $P = \frac{L_1}{L_2} \Rightarrow \frac{\Delta P}{P} = \frac{\Delta L_1}{L_1} + \frac{\Delta L_2}{L_2}$

* في الرسم :

① نعين النقاط يدوياً
② نعين النقطة الـ Average ، $(\bar{L_2}, \bar{L_1})$
③ نعيد العمليات حتى نحصل على النقطة (Average) المطلوبة
④ نأخذ ميل الخط.

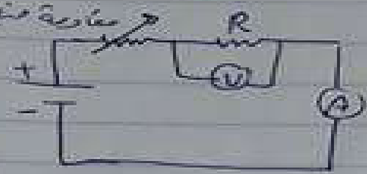
$y = mx + b$

$\bar{L_1} \quad P \quad L_2 \quad 0$

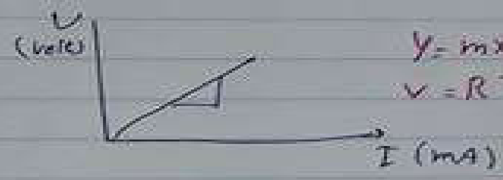
Slope = $(P) = \frac{\Delta L_1}{\Delta L_2}$

Experiment 4: DC Circuits

* $R = \frac{V}{I}$, $\Omega \equiv Volt/A$



* نقيس (V) ، (I) ← 6 times



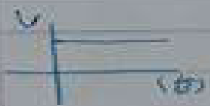
$y = mx + b$

$V = RI$

$V \propto I \Rightarrow V = RI$

* $Slope = R = \frac{\Delta V}{\Delta I}$

* ملاحظة :

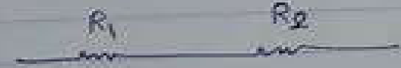


DC ⇐ تيار مباشر مستمر من البطارية أو أي مصدر ثابت

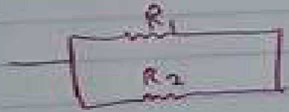
AC ⇐ متناوب

* العلاقات للنظرية النامة من أومية

* $mA \times 10^{-3} = A$
* $\mu A \times 10^{-6} = A$

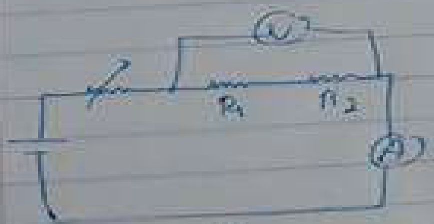
* 

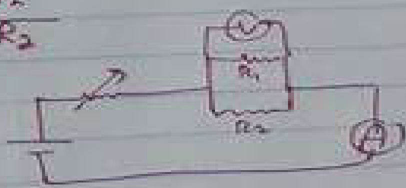
$R_s = R_1 + R_2$

* 

$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$

$R_P = \frac{R_1 R_2}{R_1 + R_2}$





$\frac{V_s}{I_s} = R_s$

$\frac{V_P}{I_P} = R_P$

عملي

* يتم حساب قيمة المقاومة العملية من خلال الانحدار .

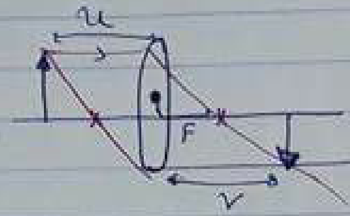
* $\Delta V = 0.1\ volt$ (check)
* $\Delta I = 1\ mA$

, $\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$

* Experiment 5: Focal length of a Convex Lens.

البعد البؤري

إذا مرّ الشعاع بالمركز لا ينعكس .



$$* \quad \frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

* نقيس كل من (u)، (v) ← 6 times

$$\frac{1}{v} = \frac{1}{F} - \frac{1}{u}$$

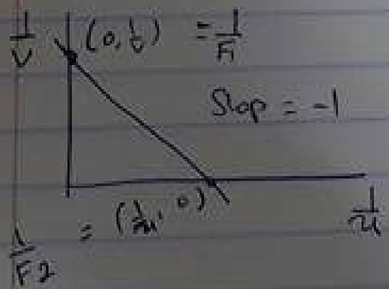
$$\downarrow \quad \downarrow \quad \downarrow$$

$$y = b + x$$

$$\Rightarrow \quad \frac{1}{v} = \frac{-1}{u} + \frac{1}{F}$$

$$\downarrow$$

$$y = -x + b$$



$$F_{avg} = \frac{F_1 + F_2}{2} \pm \Delta F$$

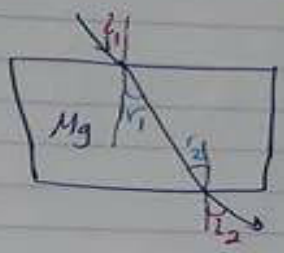
$$\frac{\Delta F}{f^2} = \frac{\Delta u}{u^2} + \frac{\Delta v}{v^2}$$

$$* \quad \Delta u = \Delta v = 0.2\ cm$$

Experiment 6: Index of Refraction. (معامل الإنكسار)

معامل انكسار الوسط اختلاف كثافة الوسط

$M = \frac{C}{V} = \frac{3\times10^8 \text{ m/s}}{V}$ (C: الضوء في الفراغ، V: الوسط)



$i_1 = i_2$

$r_1 = r_2$

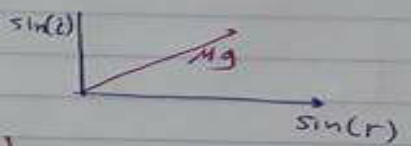
$Ma \sin(i_1) = Mg \sin(r_1)$

$\frac{\sin(i_1)}{\sin(r_1)} = Mg$

* نقيس (i_1)، (r_1)، (i_2)، (r_2) ← 6 times

* $\bar{i} = \frac{i_1 + i_2}{2}$, * $\bar{r} = \frac{\bar{r_1} + \bar{r_2}}{2}$

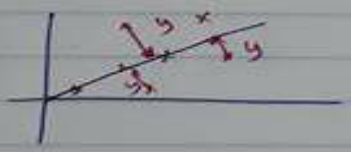
$Mg = \frac{\sin(\bar{i})}{\sin(\bar{r})}$

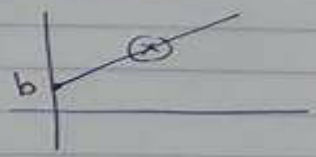


⇔ Last squar fit Method (LSFM)

slope (m) ← error slope

$(y = mx - b)$





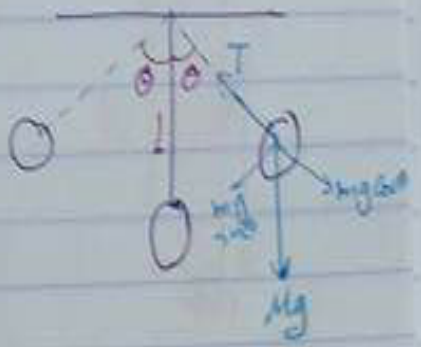
Glass true value (1.52)

Experiment 7: Measuring of g at BZU.

$Mg \sin\theta = F = ma$

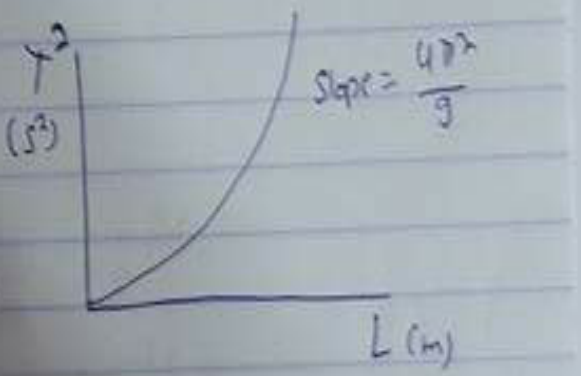
$T = mg\cos\theta$

$* \quad t^2 = \frac{4\pi^2 L}{g}$



$\frac{\Delta g}{g} = \frac{\Delta m}{m}$ ∈

$g \Rightarrow$ Slope من g حساب



* Period T : الزمن الدوري

* لتوقيت الزمن لعشر دورات على الأقل وعدة مرتين.
* نحسب $\bar{T}_{10}$ أي المعدل.
* نقسم على 10 ونحن نحصل على (T) period.

Experiment 8 : Half-life of a Draining Water Column.

$-\frac{dh}{dt} \propto h$

$-\frac{dh}{dt} = \frac{\lambda h}{1}$

$\int_{h_0}^{h} \frac{dh}{h} = \int_{0}^{t} -\lambda \, dt$

$\ln h - \ln h_0 = -\lambda t$

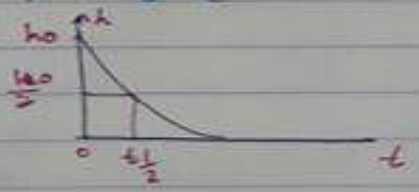
$\ln \frac{h}{h_0} = -\lambda t \Rightarrow \frac{h}{h_0} = e^{-\lambda t}$

$\Rightarrow h = h_0 e^{-\lambda t}$

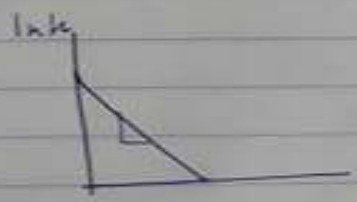
$\Downarrow$

$Y = Y_0 e^{-kx}$

$\Leftarrow$



Slope $= \lambda$ $\Leftarrow$



$\Rightarrow$

$\ln h = \ln h_0 - \lambda t$

$Y = b - mx$

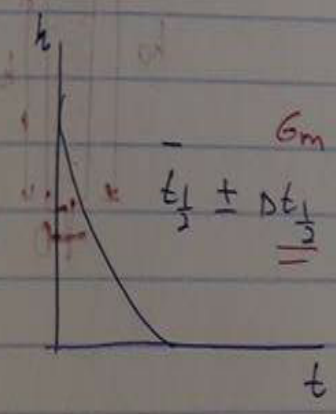
$h = h_0 e^{-\lambda t_{\frac{1}{2}}}$

$\frac{h_0}{2} = h_0 e^{-\lambda t_{\frac{1}{2}}} \Rightarrow \frac{1}{2} = e^{-\lambda t_{\frac{1}{2}}}$

$\Rightarrow \ln 2 = \lambda t_{\frac{1}{2}}$

$\Rightarrow t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$

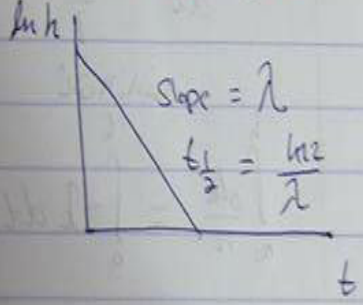
* تابع كوبت 8 :-



$\bar{G_m}$

$t_{\frac{1}{2}} \pm \Delta t_{\frac{1}{2}}$

* الوسائل :-



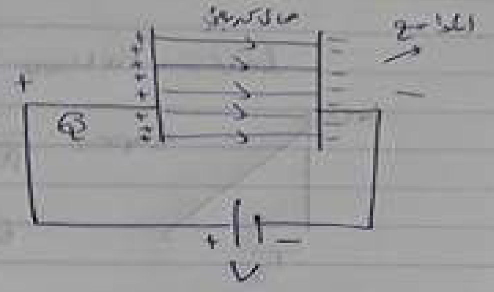
$t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$

Experiment 9: RC Circuit.

$Q \propto V$

$Q = CV$

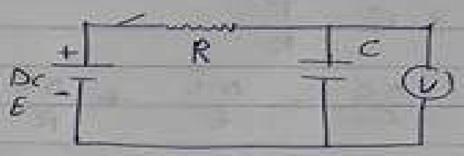
$\frac{I}{F}$



$\mu F \times 10^{-6} = F$

$mF \times 10^{-3} = F$

* $V_c = \frac{Q}{C}$, $V_R = IR$



$E = V_R + V_C$

$E = IR + \frac{Q}{C}$

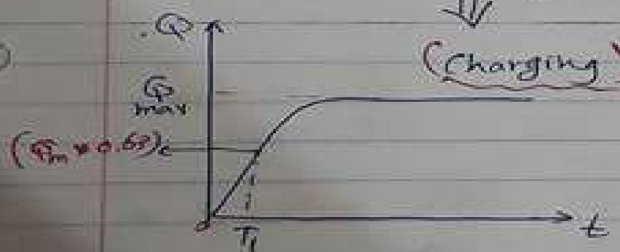
$E = R\frac{dQ}{dt} + \frac{Q}{C}$

$Q_t = Q_{max}(1 - e^{-\frac{t}{RC}})$

increasing.

⇓

(Charging)



$T = RC$

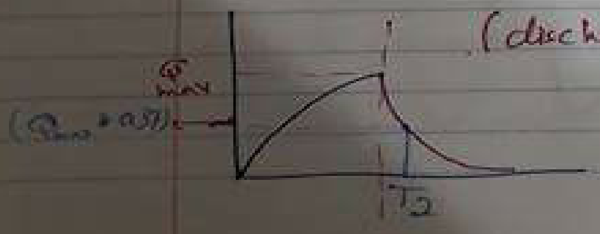
⇓

$Q = Q_{max}(1 - e^{-1})$

$0.37 = \frac{1}{2.7}$

$\Rightarrow Q = Q_{max} \cdot (0.63)$

(discharging)



$Q_t = Q_{max}\, e^{-\frac{t}{RC}}$

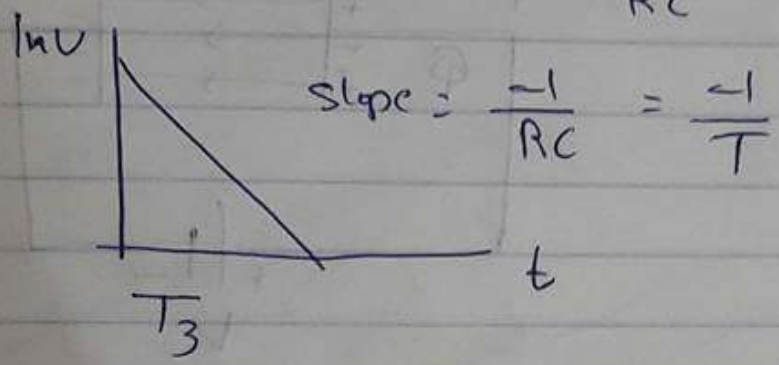
$Q = Q_{max} \cdot 0.37$

$V = V_{max} \times 0.37$

يتبع ⟹

* $Q_t = Q_{max}\, e^{\frac{-t}{RC}}$

$\ln V = \ln V_{max} * \frac{-t}{RC}$



$\text{slope} = \frac{-1}{RC} = \frac{-1}{T}$

$\bar{T} \pm \sigma_m$,

* $C = \frac{\bar{T}}{R}$

$\frac{\Delta C}{C} = \frac{\Delta \bar{t}}{\bar{t}} + \frac{\Delta R}{R}$

, $\Delta R = 0.01$ mΩ
, $R = 1$ mΩ

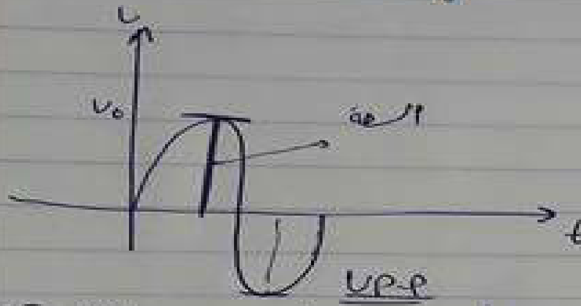
Experiment 10 : Oscilloscope.

A.C

D.C

$V = V_{max} \cos(\omega t)$

$\omega = 2\pi f$



(السعة) V_p = Amplitued

$V_p = \frac{1}{2} V_{p-p}$

الزمن الدوري Period (T) $\Longrightarrow$ $\frac{1}{T} = F$ (التردد) $Hz \equiv \frac{1}{sec}$

من قمة لقمة او من قاع الى قاع او من بداية لبداية

$f \equiv Hz$ $1\ KHz = 10^3\ Hz$

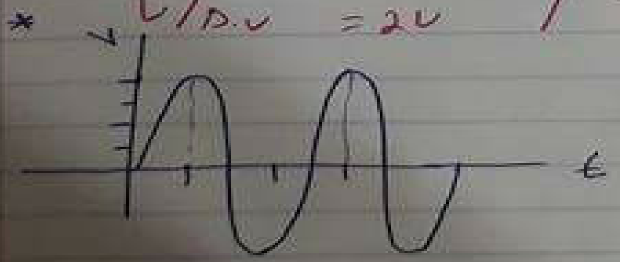
$MHz = 10^9\ Hz$

* $V_{p-p} = 2V$

$V_p = 1V$

*مثال :-

* $V/D.V = 2V$ / $T/D.V = 100$ msec



$V_{p-p} = 16$ volt

$T = 4 * 100 * 10^{-3}$

$V_p = 8$ volt