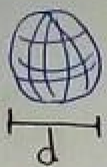
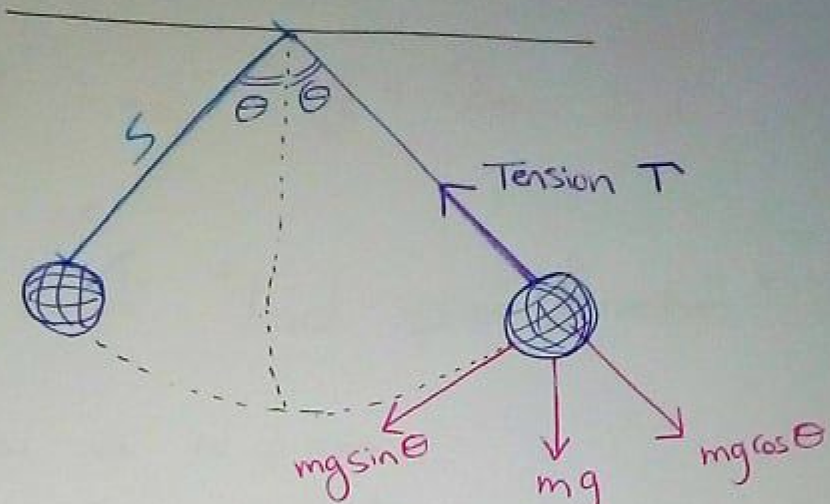
Experiment 7: Measuring of g at BZU

- Simple pendulum

$\boxed{\theta \leq 15^\circ}$





$$L = S + \frac{d}{2}$$

$$F_c = T - mg\cos\theta = \frac{m v^2}{L}$$

$$\text{Period} \equiv T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{L}{g}}$$

$$\boxed{T = 2\pi\sqrt{\frac{L}{g}}} \qquad T^2 = \frac{4\pi^2}{g} L$$

Experiment

10 periods

$T = t_{avg}/2$

S (cm)	L (cm)	t_1 (sec)	t_2 (sec)	t_{avg} (sec)	T (sec)	T^2 (sec^2)
39.0	40.0	—	—			
50.5	51.5	—	—			

T^2 vs. L $\Rightarrow$ A straight line with slope $= \frac{4\pi^2}{g}$

$$g_{exp} = \frac{4\pi^2}{\text{slope}}$$

$$\frac{\Delta g}{g_{exp}} = \frac{\Delta\text{slope}}{\text{slope}} \Rightarrow \Delta g = g_{exp} \frac{\Delta\text{slope}}{\text{slope}}$$

By using Excel "Least square fit method"

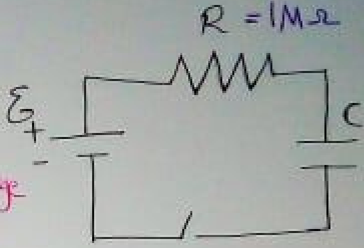
slope $m \Rightarrow m \pm \Delta m$

Y-intercept $b \Rightarrow b \pm \Delta b$

Experiment 9: RC circuit

- Capacitor $Q = CV$; $[C] = F$

- Charging the capacitor



at $t = 0$, $Q = 0$, $V_c = 0$

at $t \to \infty$, $Q = Q_0 = C\varepsilon$ = max. charge

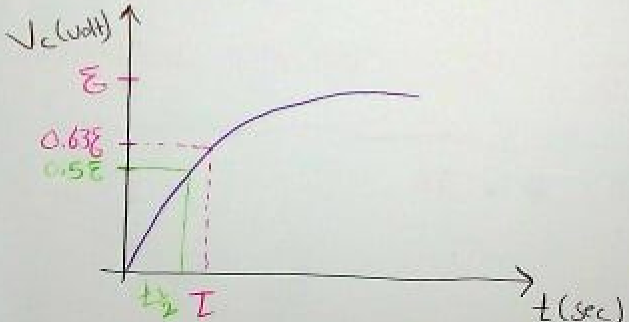
$V_c = \varepsilon$

$$V_c(t) = \varepsilon\left(1 - e^{-t/\tau}\right)$$

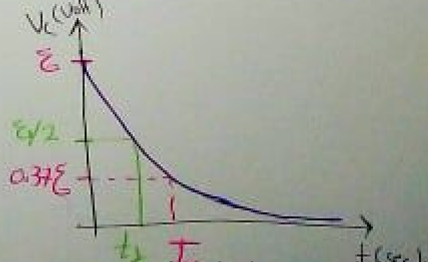
$$Q(t) = C\varepsilon\left(1 - e^{-t/\tau}\right)$$

τ = time constant $\boxed{\tau = RC}$

at $t = \tau \Rightarrow V_c = 0.63\varepsilon$, $Q = 0.63\,C\varepsilon = 0.63Q_0$



- Discharging the capacitor



at $t = 0$, $Q = Q_0 = \varepsilon C$, $V = \varepsilon$

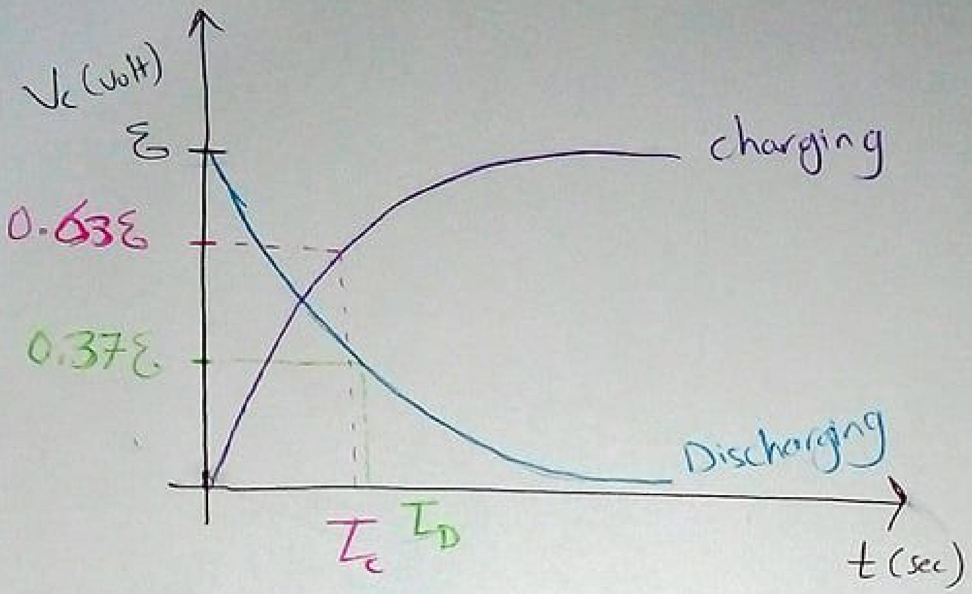
$t \to \infty$, $Q = V = 0$

$$V_c(t) = \varepsilon\, e^{-t/\tau}$$

$$Q = C\varepsilon\, e^{-t/\tau}$$

at $t = \tau \Rightarrow V_c = 0.37\varepsilon$, $Q = 0.37Q_0$

- $t_{\frac{1}{2}} \equiv$ Half time $\boxed{t_{\frac{1}{2}} = \tau \ln 2}$ at $t = t_{\frac{1}{2}} \Rightarrow V_c = \frac{\varepsilon}{2}$



$\Rightarrow$ Discharging $V_c = \varepsilon e^{-t/\tau}$

$$\underbrace{\ln V_c}_{\text{Y-axis}} = \ln \varepsilon - \frac{t}{\tau} \sim \text{x-axis}$$

$\ln V_c$ Vs. t

straight line with slope $= -\frac{1}{\tau} = -\frac{1}{RC}$ and Y-intercept $= \ln \varepsilon$

$$C_{exp} = \frac{\tau}{R} \qquad \Delta\tau = \sigma_m(\tau)$$

$$\frac{\Delta C}{C_{exp}} = \frac{\Delta \tau}{\tau} + \frac{\Delta R}{R}$$

$$\boxed{C_{exp} \pm \Delta C}$$