BIRZEIT UNIVERSITY

Phys 112
Quiz

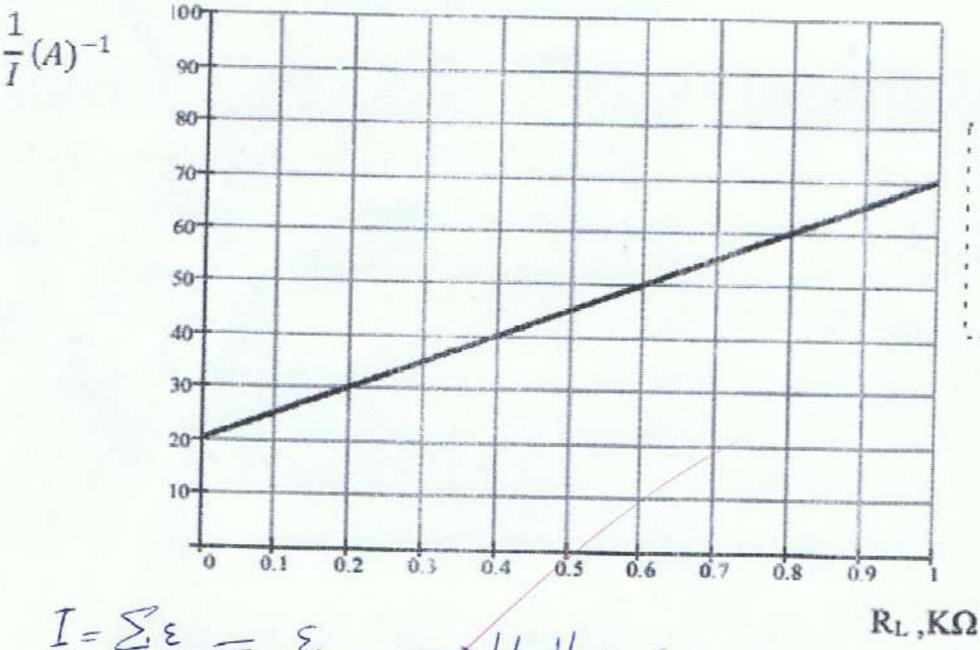
6

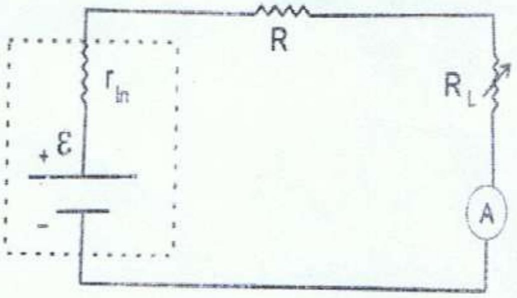
Student name:. [redacted]

Student number:. [redacted]

If one take the reading of the ammeter while changing the value of R_L. Then plot 1/I versus R_L data as shown in the graph below.

1. Find the electromotive force of the battery $\mathcal{E}$?
2. Find $(r_{in} + R)$?
3. Find the maximum power transfer between the battery and the load resistance?





$$I = \frac{\sum \mathcal{E}}{\sum R} = \frac{\mathcal{E}}{r_{in} + R + R_L} \Longrightarrow \text{take the inverse} \Rightarrow \frac{1}{I} = \frac{r_{in} + R + R_L}{\mathcal{E}}$$

point
(0.2,30) (0.8,60)

$$\underset{y}{\frac{1}{I}} = \underset{slop}{\frac{1}{\mathcal{E}}} \underset{x}{R_L} + \underset{y\text{-intersection}}{\frac{R + r_{in}}{\mathcal{E}}}$$

From the first graph I^{-1} vs $R_L \Rightarrow$ slop $= \frac{\Delta y}{\Delta x} = \frac{\Delta I^{-1}}{\Delta R_L}$

$$= \frac{60-30}{(0.8-0.2)} = \frac{30}{0.6 k\Omega A} = \text{slop}$$

$$\mathcal{E} = \frac{1}{\text{slop}} = \frac{1}{\frac{30}{0.6 k\Omega A}} = \frac{0.6 k\Omega A}{30} = \boxed{20 \text{ volt}}$$

1. ε

$$y\text{-intercept} = \frac{R + r_{in}}{\varepsilon} \Longrightarrow 20\,A' = \frac{R + r_{in}}{20\ \text{volt}} \Rightarrow R + r_{in} = \boxed{400\ \Omega}$$

2. $r_{in} + R$

$$I = \frac{\Sigma \varepsilon}{\Sigma R} = \frac{\varepsilon}{R + r_{in} + R_L}$$

at the maximum power transfere $\frac{dP}{dR_L} = 0$

this implies $R_L = r_{in} + R$

by sublitution $\Longrightarrow I = \frac{\varepsilon}{R + R_{in} + R + r_{in}} = \frac{20}{400 + 400} = \boxed{25\ mA}$

$$Power = I^2 R_l = (25 \times 10^{-3})^2 \times 400 = \boxed{0.25\ Joul}$$

3. max power