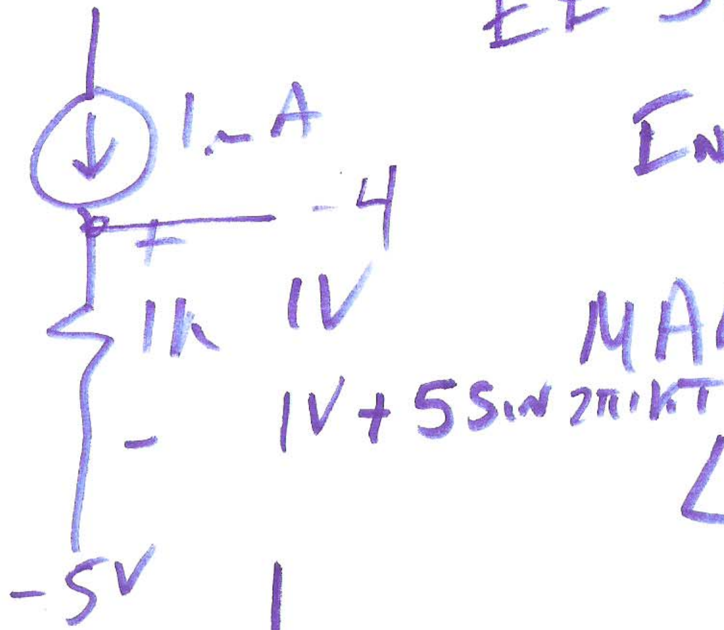
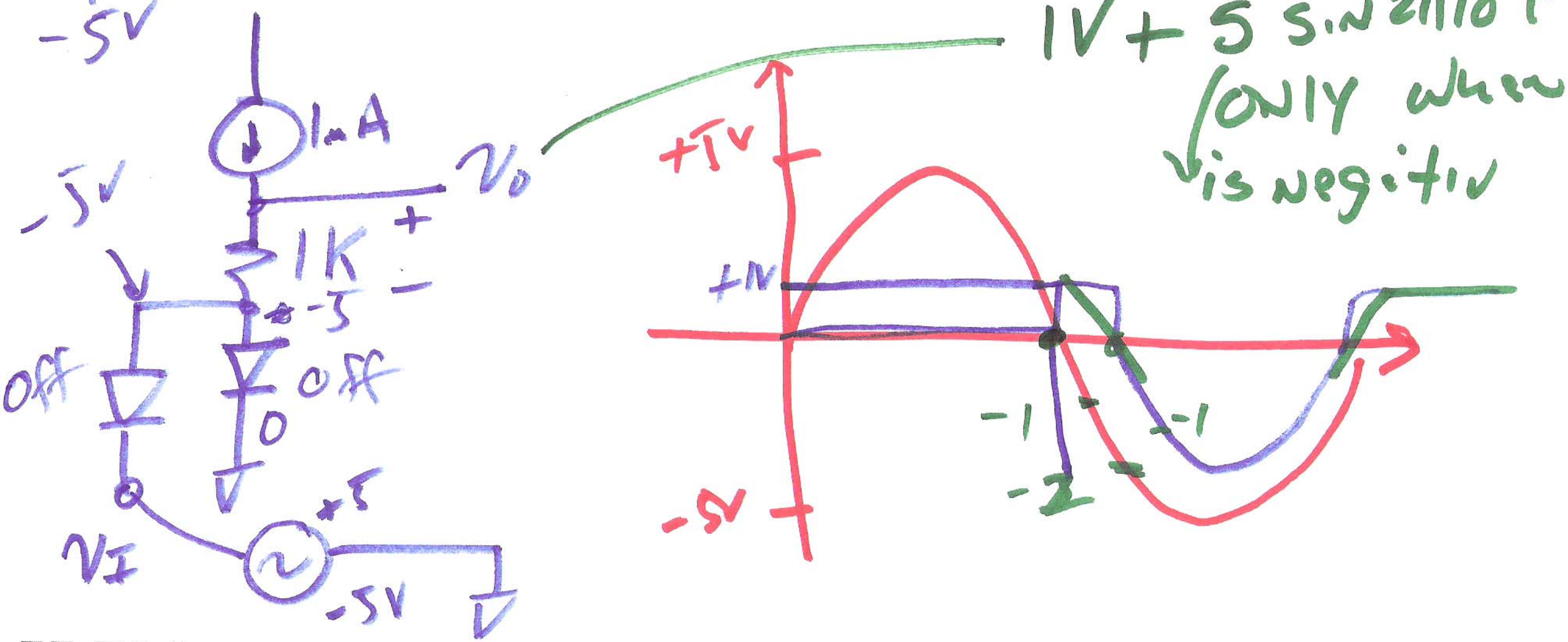
EE 320

Engineering Electronics I

MARCH 9, 2015

Lecture 14





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$$I_D = I_S\left(-1 + e^{V_D/nV_T}\right)$$

forward biased

$$I_D \simeq I_S e^{V_D/nV_T}$$

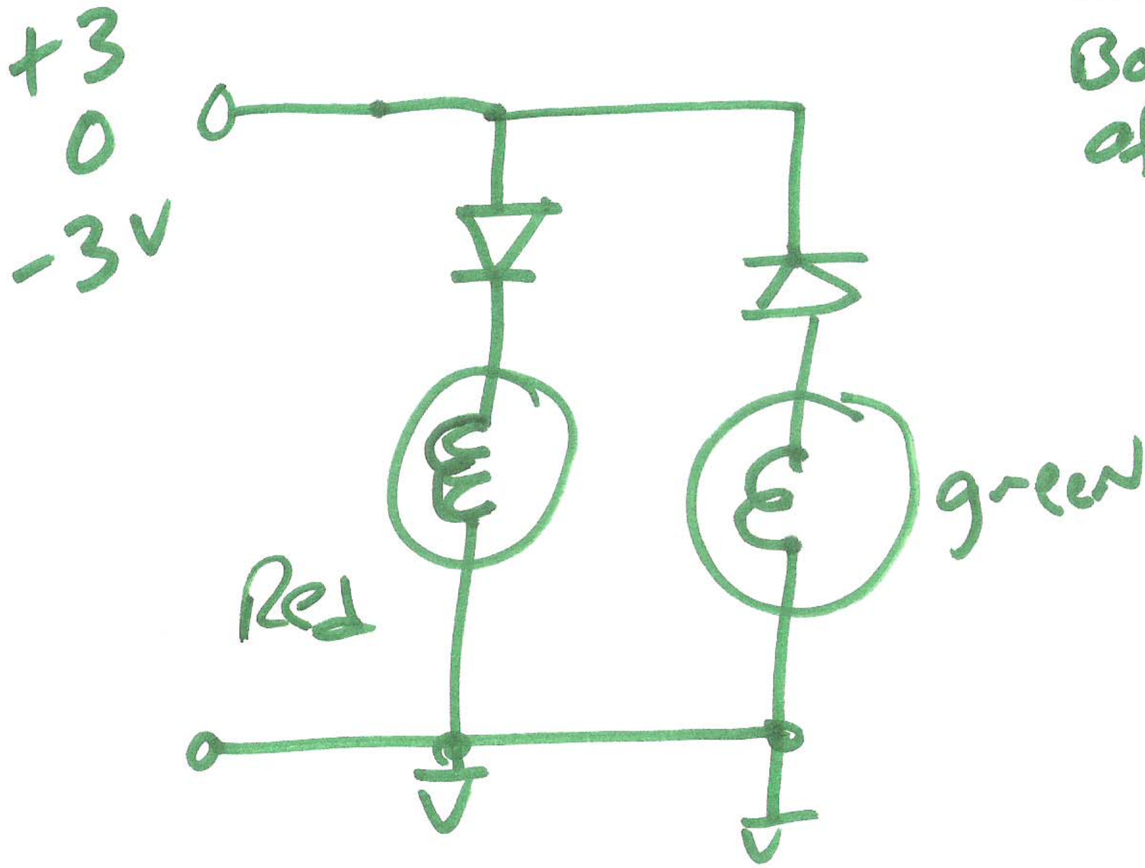
Reverse biased

$$I_D \simeq I_S$$

Forward biased

$$V_D \simeq nV_T \ln \frac{I_D}{I_S}$$

4.16



0	+3	-3
Both off	Red on	Green on

4.19) $V_D = 0.7$ at 1mA

$V_D = 0.5$ what is I

$0.7 = NV_T \ln \frac{10^{-3}}{I_S}$, $10^{-3} = I_S e^{\frac{0.7}{NV_T}}$

$0.5 = NV_T \ln \frac{I_D}{I_S}$, $I_D = I_S e^{\frac{0.5}{NV_T}}$

$$\frac{0.7}{0.5} = \frac{\cancel{NV_T} \ln \frac{10^{-3}}{I_S}}{\cancel{NV_T} \ln \frac{I_D}{I_S}}$$

wrong

$\ln \frac{A}{B} = \ln A - \ln B$

$= \ln \frac{10^{-3}}{I_D}$

F in algebra!

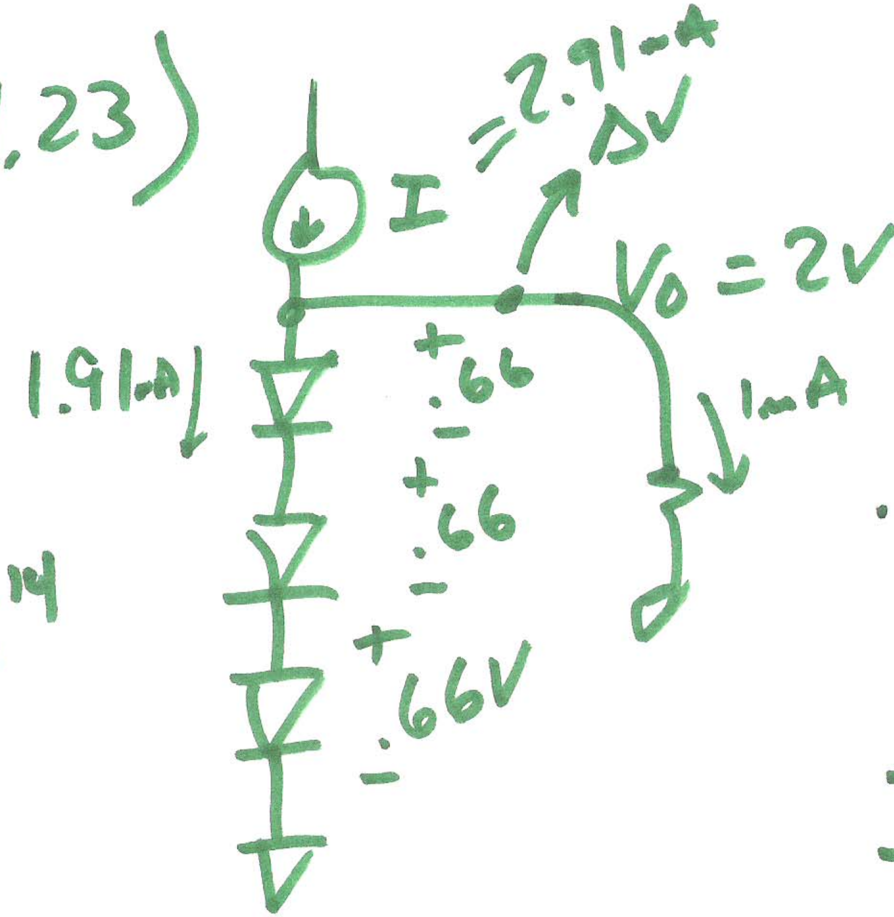
$$\frac{0.7}{0.5} = \ln 10^{-3} - \ln I_D$$

$$\frac{10^{-3}}{I_D} = \frac{\cancel{I_S}\, e^{0.7/nV_T}}{\cancel{I_S}\, e^{0.5/nV_T}}$$

$$\frac{10^{-3}}{I_D} = e^{0.2/nV_T}$$

$n \rightarrow 1$ $\quad$ $V_T \rightarrow 0025$

4.23)



$I_s = 10^{-14}$

$N = 1$

$V_T = 25mV$

$$.66 = \cancel{N}\underbrace{\cancel{V_T}}_{.025} \ln \frac{I}{10^{-14}}$$

Solve for I

$$I = 10^{-14} e^{\frac{.66}{.025}}$$

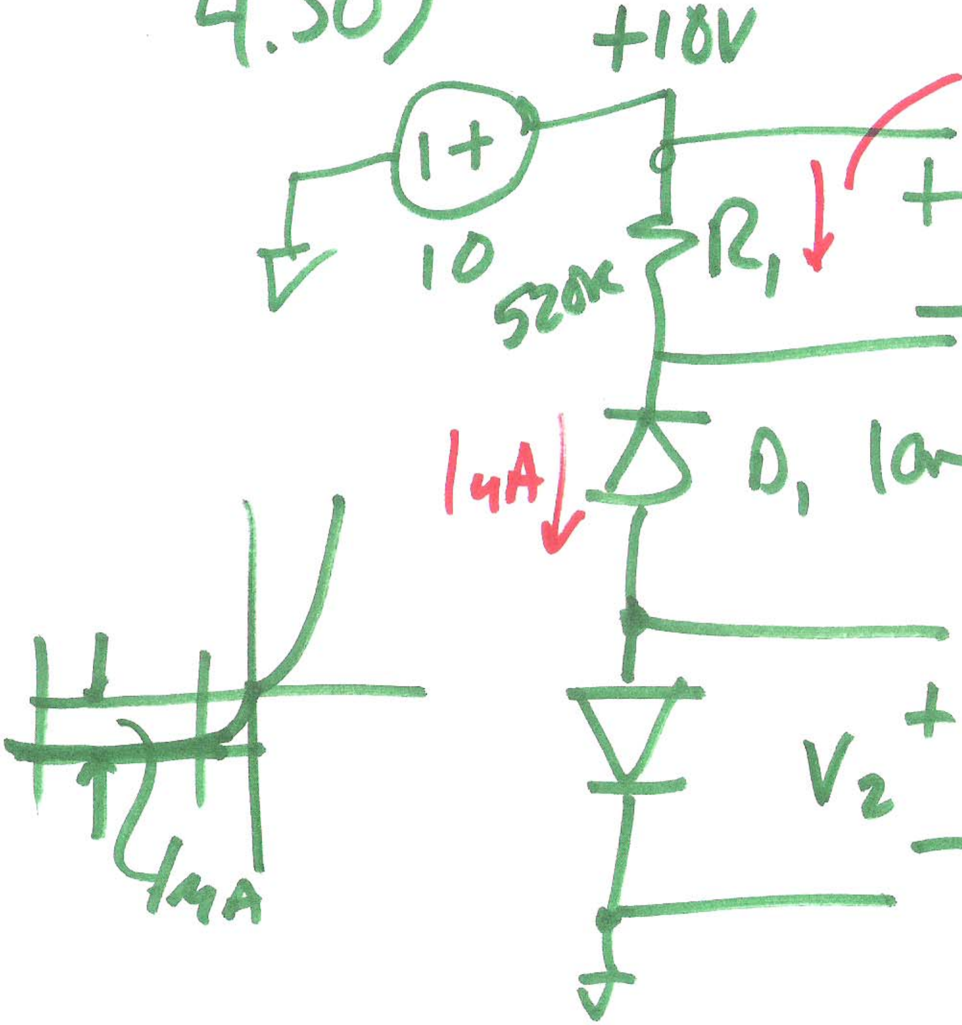
$$= \underline{\underline{2.91mA}}$$

$$V_D = .025 \ln \frac{1.91mA}{10^{-14}}$$

$$= 0.65$$

$$\Delta V = 2 - 3 \cdot .65 \simeq \underline{\underline{5mV}}$$

4.30)



$I = \frac{520\,mV}{520\,k} @ 20° = 1\,\mu A$

$\frac{10^{-3}}{10^{+3}} = 10^{-6}$

$V_{R1} = 520\,mV @ 20°C$

D_1 large AREA

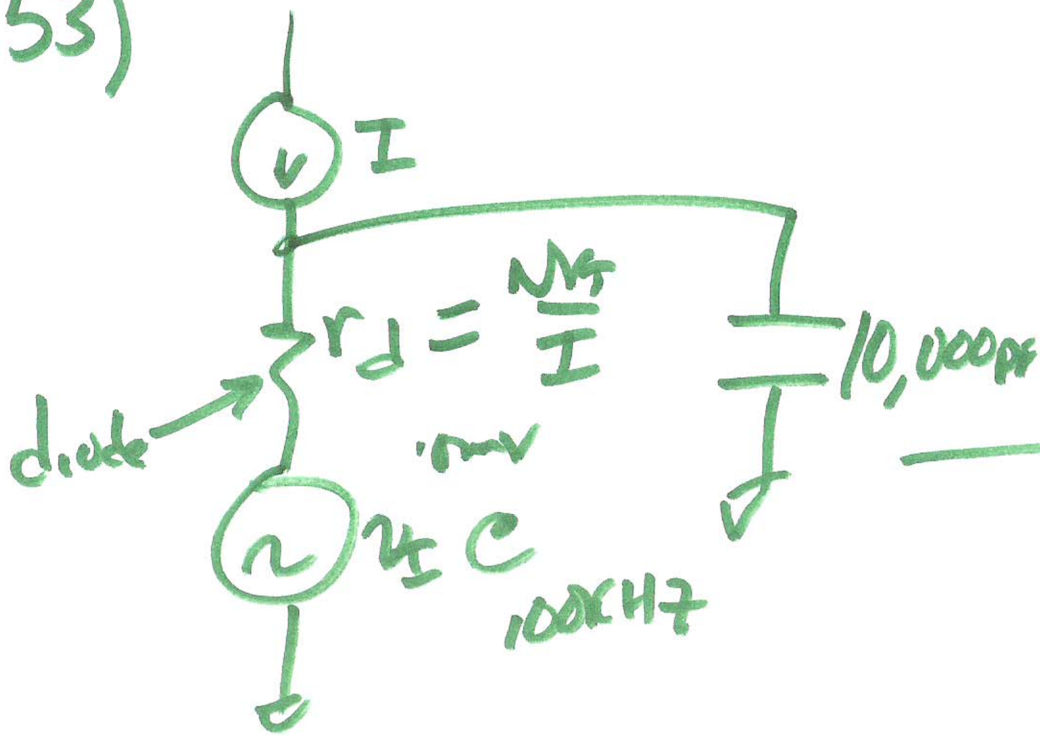
large leakage

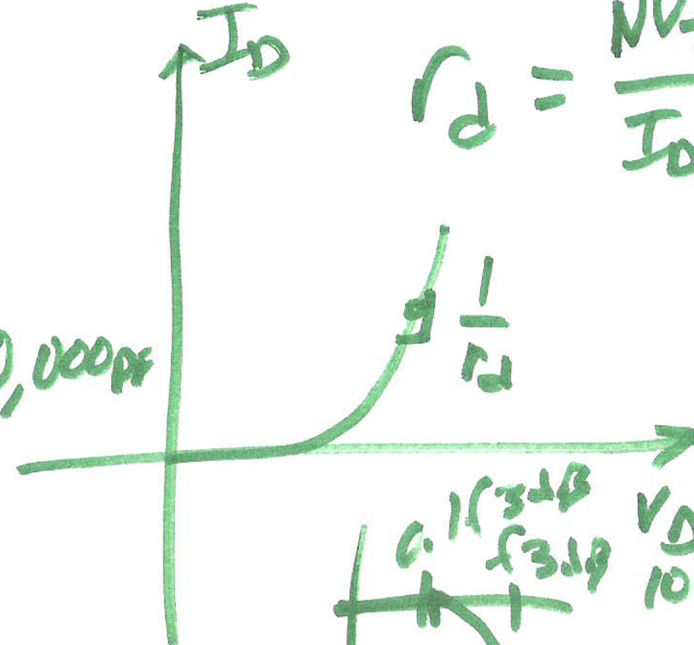
$V_2 = 520\,mV @ 20°C$

$\rightarrow 520\,mV = N\frac{K}{q} \cdot 293 \cdot \ln \frac{10^{-6}}{I_s}$

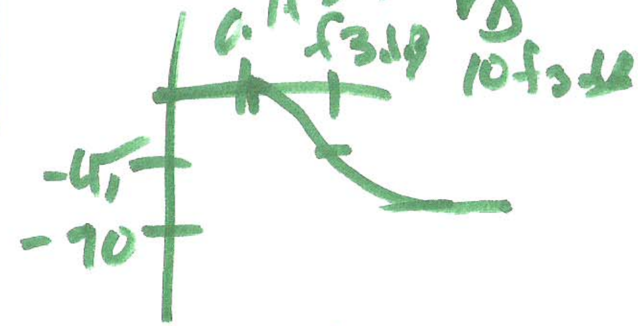
$V_D = \frac{NK}{q}\, 313 \cdot \ln \frac{10^{-6}}{I_s}$

4.53)

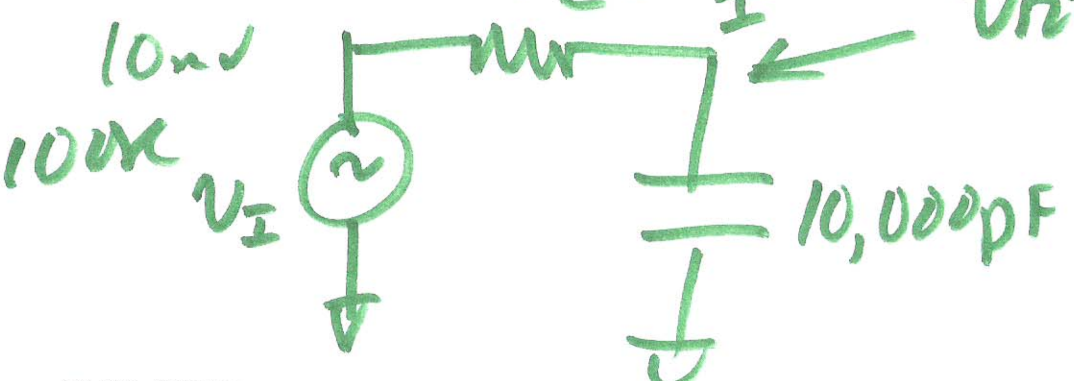




$$r_d = \frac{NV_T}{I_D}$$



AC CKT



$$v_{RT} = 0.01 \cdot \frac{1}{1 + j\,2\pi \cdot 10^5 \cdot r_d \cdot 10^{-8}}$$

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8)

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$$v_{OUT} = v_{IN} \cdot \frac{1}{1 + j\,2\pi f \cdot r_d \cdot 10^{-8}}$$

$10^{-8} \to 10nF$

$$100k = f = \frac{1}{2\pi r_d \cdot 10^{-8}}$$

$$r_d = \frac{NV_T}{I_D} = \frac{1}{2\pi \cdot 10^5 \cdot 10^{-8}} = \frac{1}{2\pi \cdot 10^{-3}}$$

$$= 159$$

$$I_D = \frac{.025}{159} = 157\mu A$$

9)