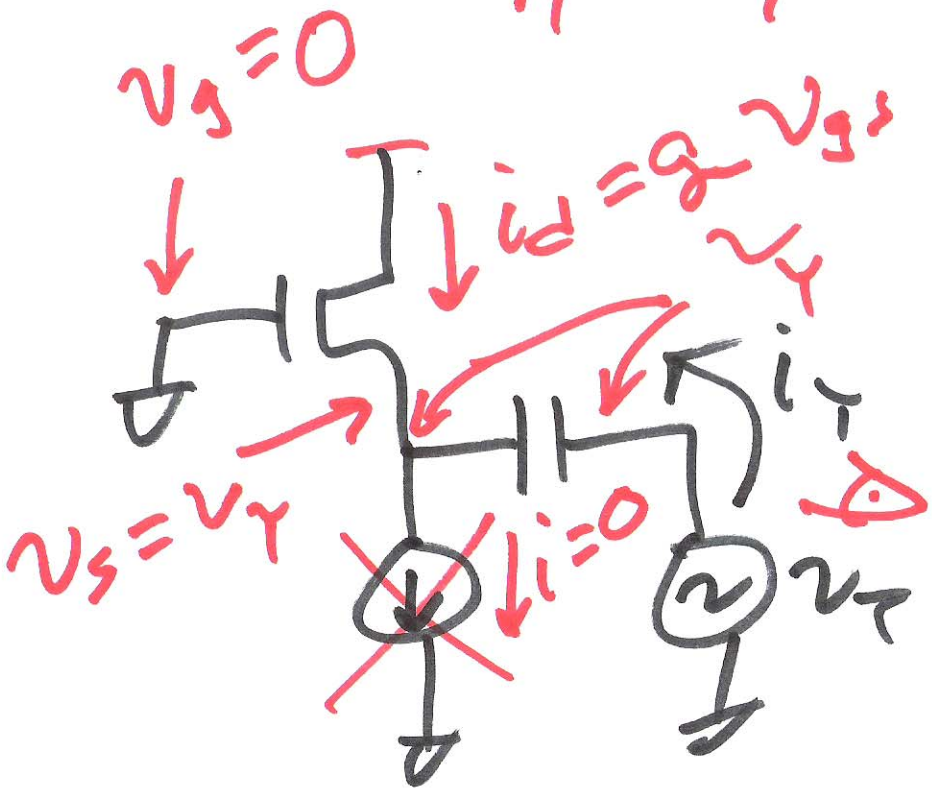
EE 320

Lecture 24

4/28/14 Spring 2014



$$v_{gs} = v_g - v_s$$
$$= -v_T$$

$$i_d = -i_T$$

$$R_{out} = \frac{v_T}{i_T}$$

$$-i_T = g(-v_T)$$

$$i_d = g v_{gs}$$

$$\boxed{R_{out} = \frac{1}{g}}$$

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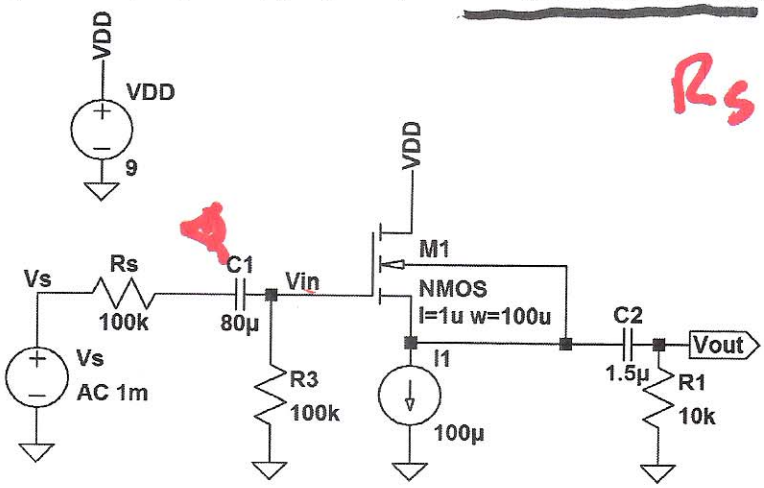
Quiz 12 EE 320 Electronics, Spring 2014 Name:_____

Open book and closed notes.

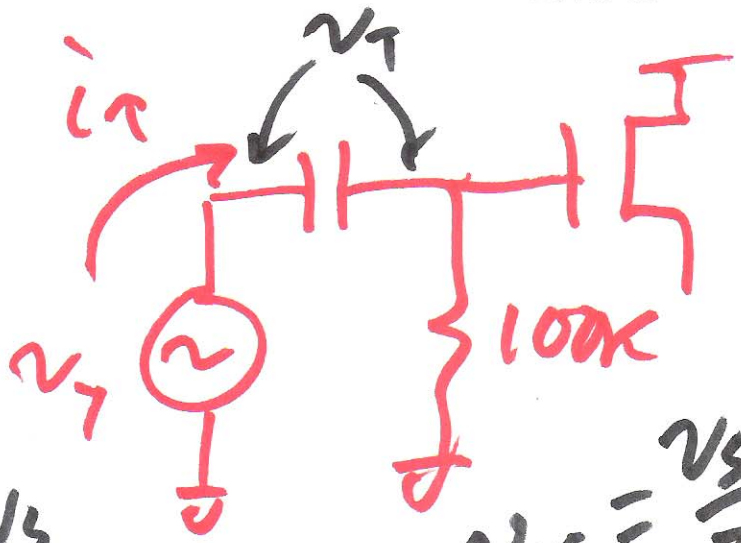
1. For the following SF amplifier what is: a) the amplifier's input resistance? b) output resistance? c) gain, Vout/Vin, and d) gain, Vout/Vs. Show your work for credit.



.model NMOS NMOS KP=120u VT0=0.8

$R_s = 100K$

$R_L = 10K$

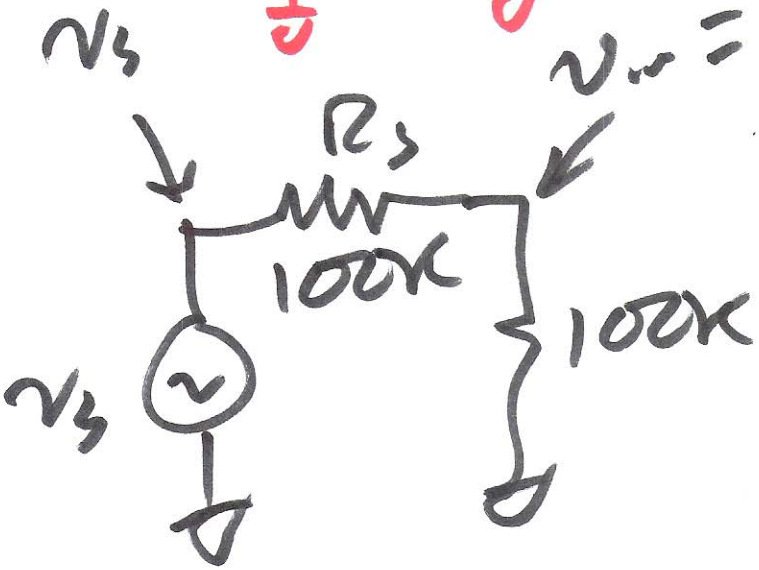


$$i_T = \frac{v_T}{100K}$$

$$R_{in} = \frac{v_T}{i_T}$$

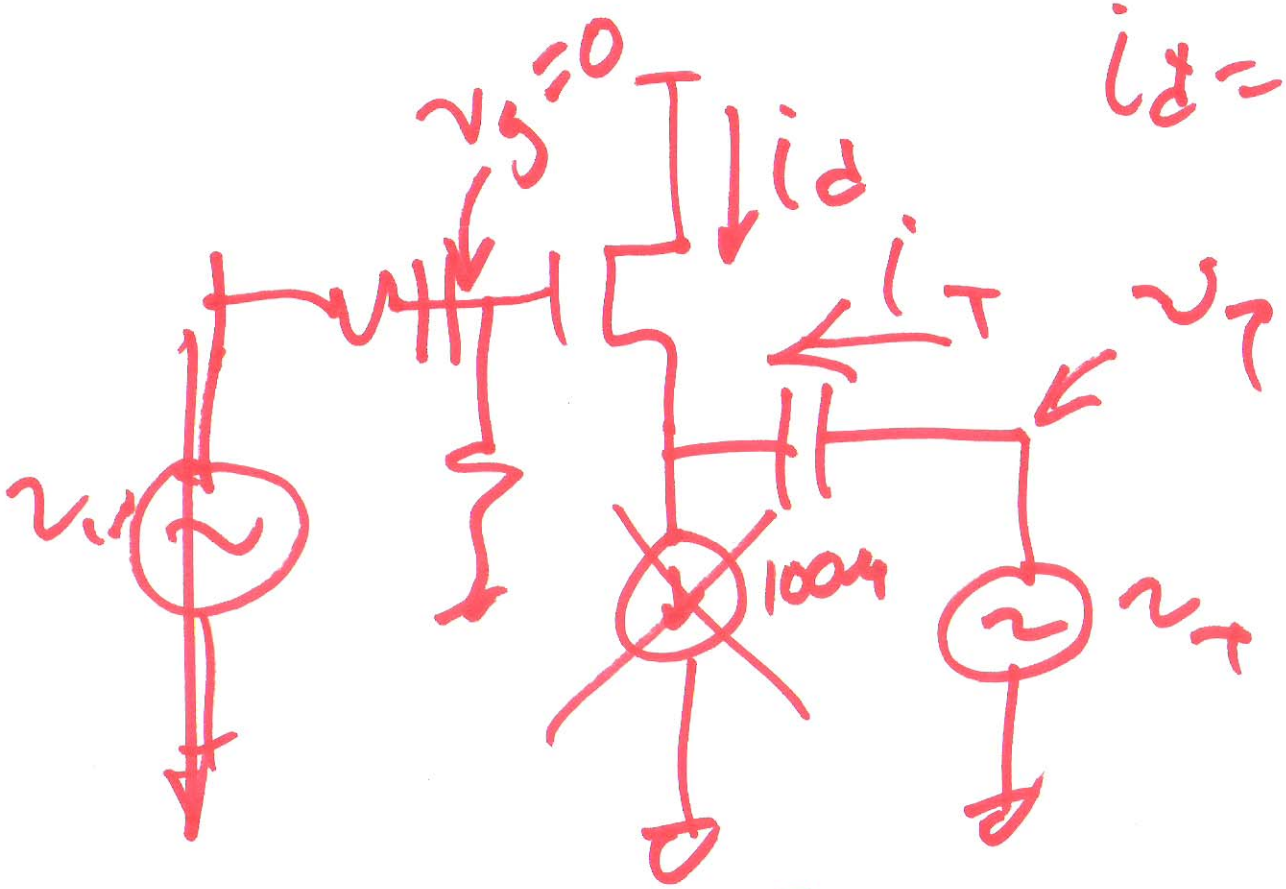
$$v_{in} = \frac{v_s}{2}$$

$$\boxed{R_{in} = 100K}$$



$$\frac{v_{in}}{v_s} = \frac{1}{2}$$

2)



$i_d = -i_T$

$R_{OUT} = \frac{v_T}{i_T}$

$v_T = v_s$

$v_{gs} = 0 - v_T$

$g_m = \sqrt{2K_n' \frac{W}{L} \cdot 100\mu A}$

$= \sqrt{2 \cdot 120\mu \cdot \frac{100}{1} \cdot 100\mu}$

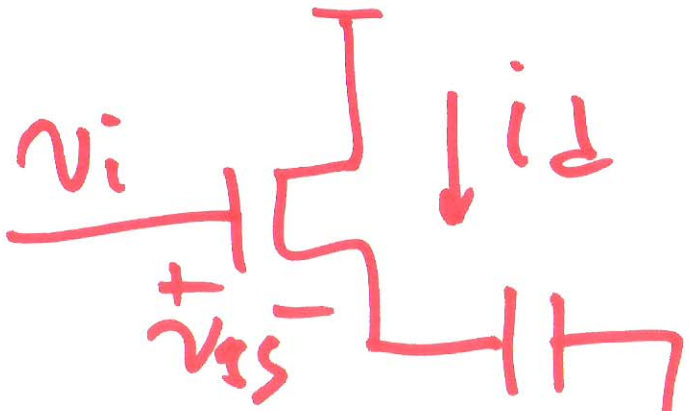
$R_{OUT} = \frac{v_T}{i_T} = \frac{-v_T}{-i_d} = \frac{1}{g_m}$

$g_m = 1.55mA$

$R_{OUT} = 645$

3)

$$\frac{v_{in}}{v_s} = \frac{1}{2}$$



$$v_{out} = i_d \cdot 10K$$

$$v_i = v_{gs} + v_{out}$$

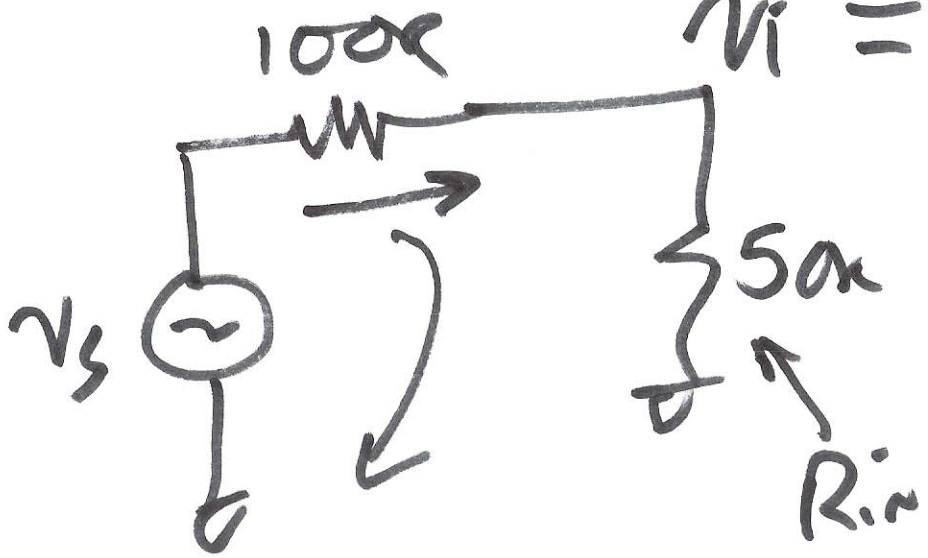
$$= i_d\left(\frac{1}{g_m} + 10K\right)$$

$$.94 = \frac{v_{out}}{v_i} = \frac{10K}{\frac{1}{g_m} + 10K}$$

$$.94 = \frac{10K}{10645}$$

$$.47 = \frac{v_{out}}{v_s} = \frac{1}{2}\,\frac{10K}{\frac{1}{g_m} + 10K}$$

4)



$$V_i = V_s \cdot \frac{50K}{100K + 50K}$$

$$\frac{V_i}{V_s} = \frac{1}{3}$$

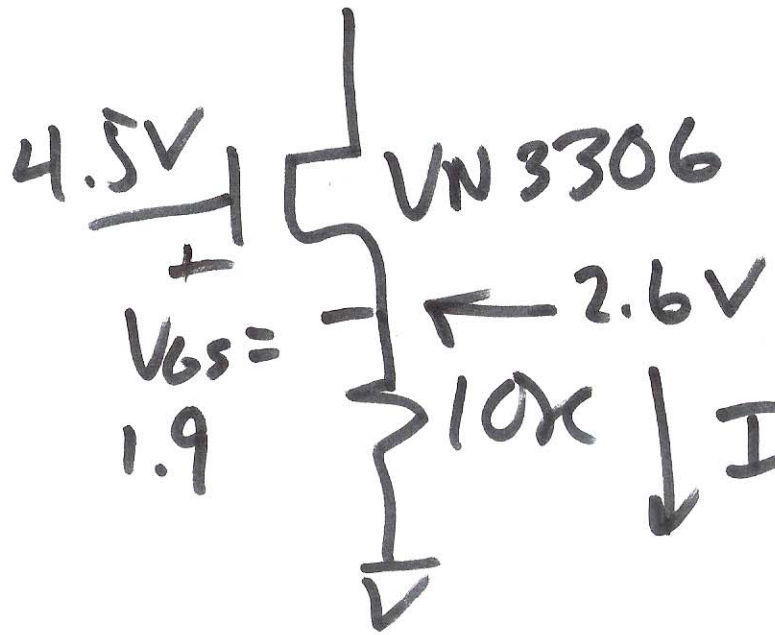
$$\frac{V_s - V_i}{100K} = \frac{\frac{2}{3}V_s}{100K}$$

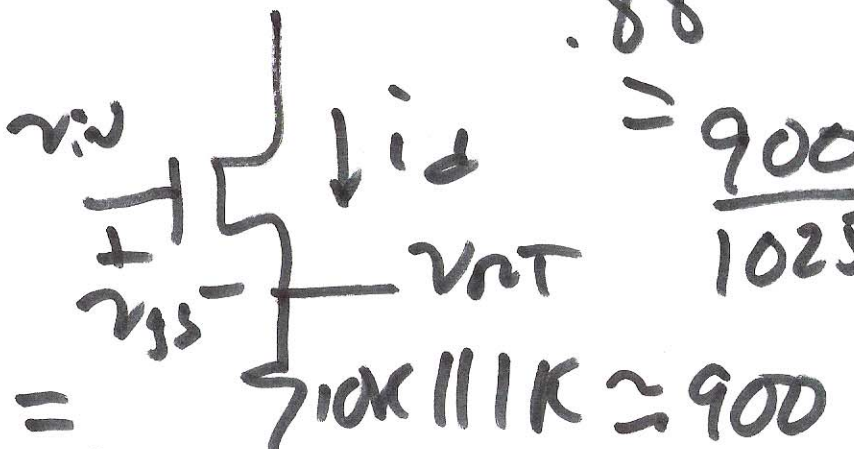
$$\frac{V_o}{V_s} = \frac{V_i}{V_s} \cdot \frac{V_o}{V_i} = .293$$

$\frac{1}{3}$ $\quad .88$

$g_m = 8\frac{mA}{V} = 8\,mS$

$= 8_m \mathcal{V}$





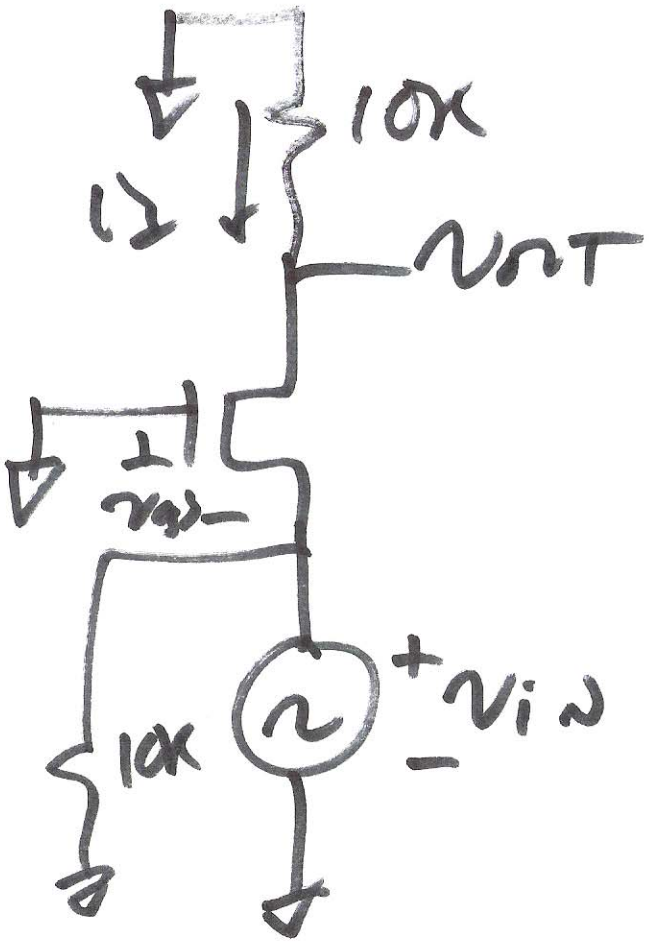
$.88 \simeq \frac{900}{1025} = \frac{v_{out}}{v_{in}} = \frac{i_d \cdot 900}{i_d\left(\frac{1}{g_m} + 900\right)}$

$g_m = \sqrt{\quad}$

$v_{in} = v_{gs} + v_{out} = i_d\left(\frac{1}{g_m} + 900\right)$

$1/g_m = 1252$

6)



$$v_{gs} = -v_{in}$$

$$i_d = g_m v_{gs}$$

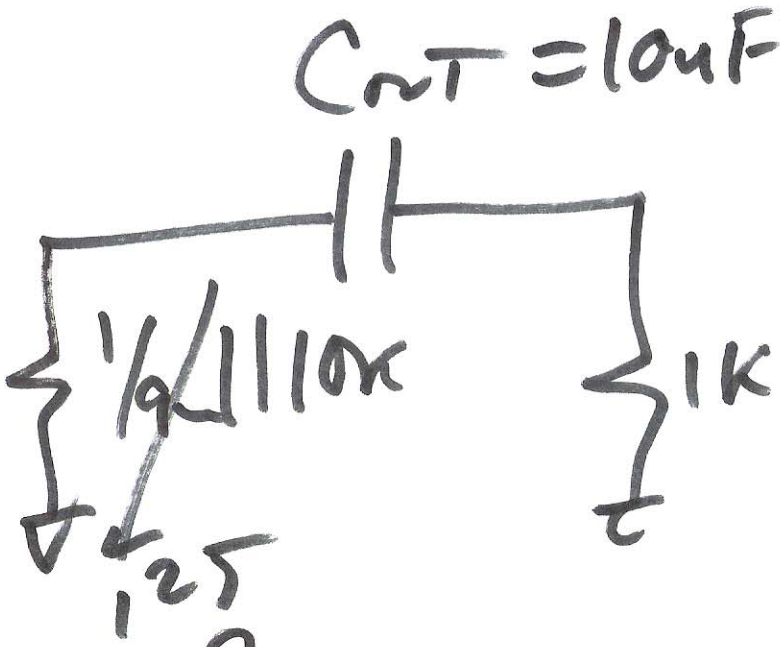
$$= -g v_{in}$$

$$v_{out} = -i_d \cdot 10k$$

$$\frac{v_{out}}{v_{in}} = +g\,10k$$

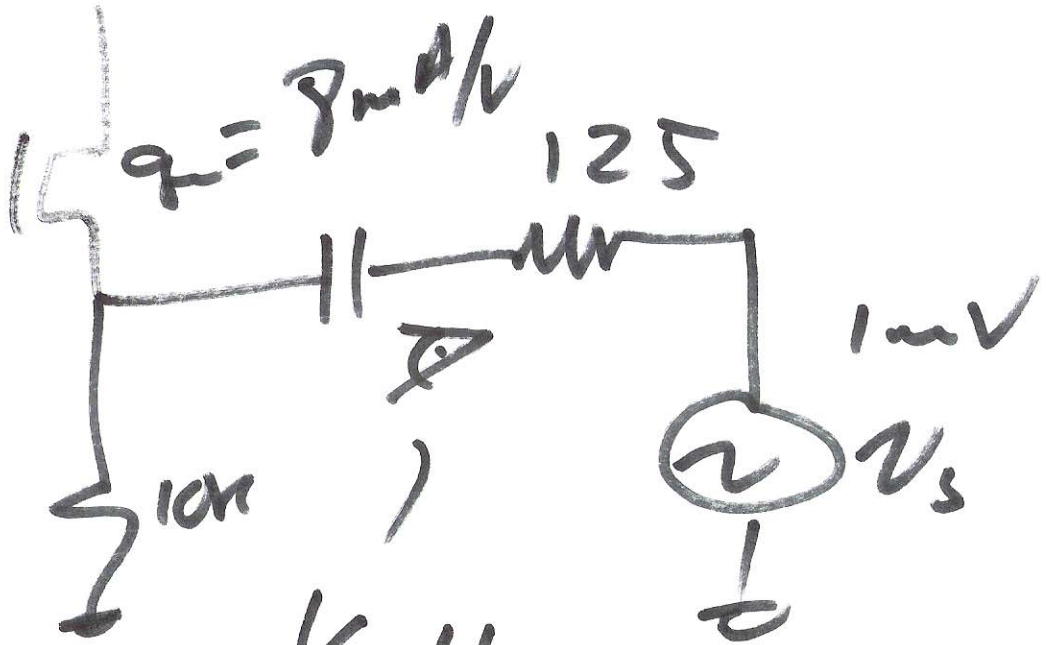
$$= 8mA \cdot 10k$$

$$= 80 \frac{V}{V}$$



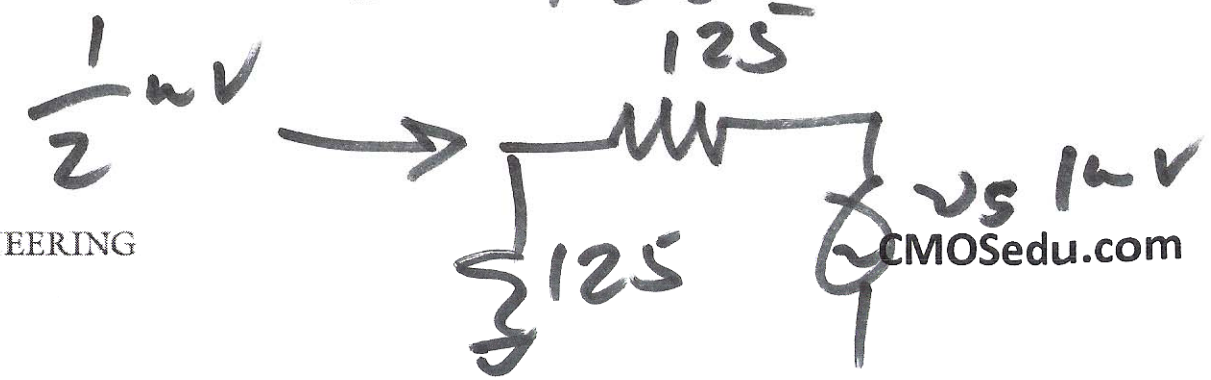
$$f_{3dB} = \frac{1}{2\pi\, 10\mu F\, (1125)}$$

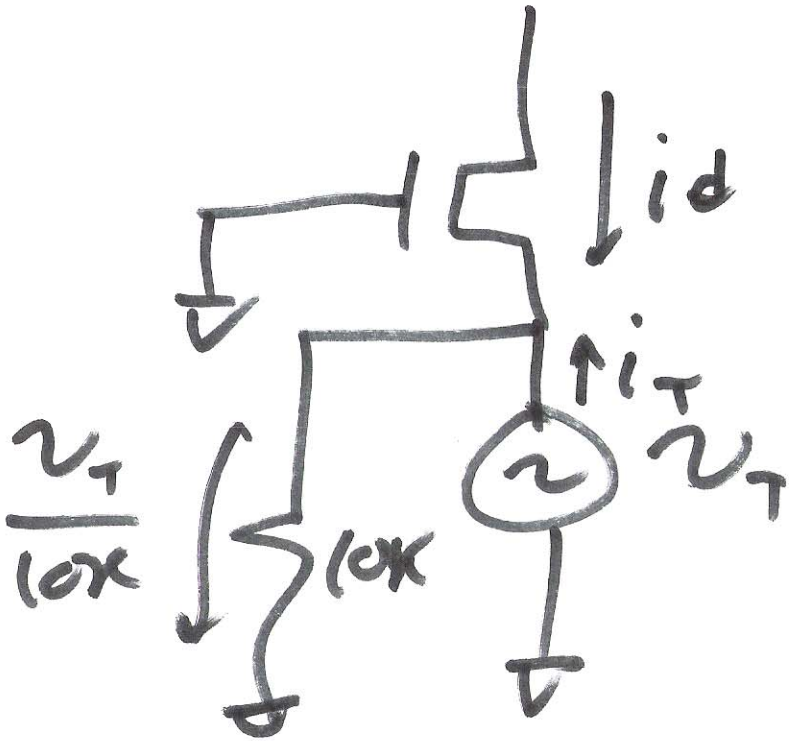
$14\ Hz \Rightarrow 70\frac{m\text{-}s}{T}$



$$\frac{1}{g_m} \parallel 10K$$

$$\simeq 125$$





$$R_{in} = \frac{v_T}{10K} + \frac{v_T}{-i_d}$$

$$v_{gs} = -v_T$$

$$\frac{v_T}{i_T} = \frac{v_{gs}}{-i_T} = \frac{1}{g_m}$$

$$R_{in} = \frac{v_T}{10K} +$$

$$10K \,||\, \frac{v_T}{i_T} = 10K \,||\, 1/g_m$$