Question 1/18 (3 p.) Answer is mandatory

Consider the circuit shown in the Figure. The transistor parameters are:

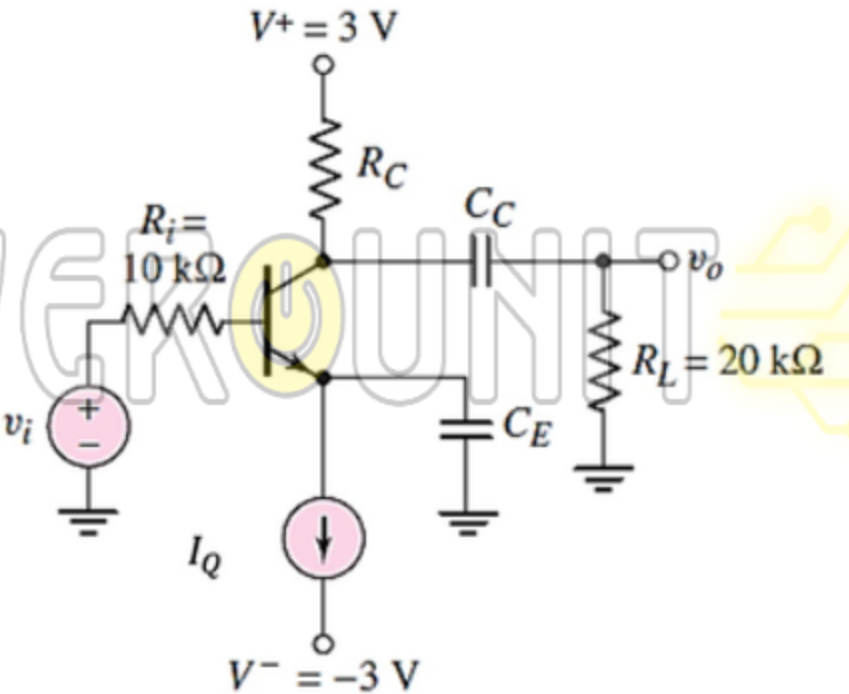
$\beta = 120, V_{BE}(on) = 0.7V$, and $V_A = \infty$.

Assume: $I_Q = 0.4mA$, and $V_T = 0.026V$

If you are given the voltage gain as:

$$A_v(s) = \frac{-g_m r_\pi R_C}{R_i + r_\pi + (1+\beta)\left(\frac{1}{sC_E}\right)}$$

Determine C_E such that the corner frequency associated with is $f_E = 10Hz$.



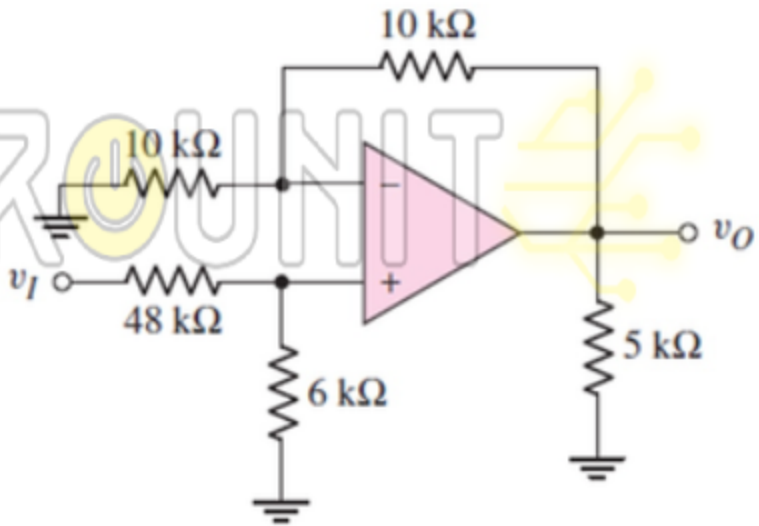
Question 2/18 (2 p.) Answer is mandatory

For any voltage amplifier circuit, if the load resistance R_L happened to become open, then the ac output voltage will:

- ○ Increase
- ○ Equal Zero
- ○ Decrease
- ○ Remain the Same

Question 3/18 (3 p.) Answer is mandatory

Consider the circuit shown in the Figure.
Determine the output voltage for $v_I = 8.5V$.



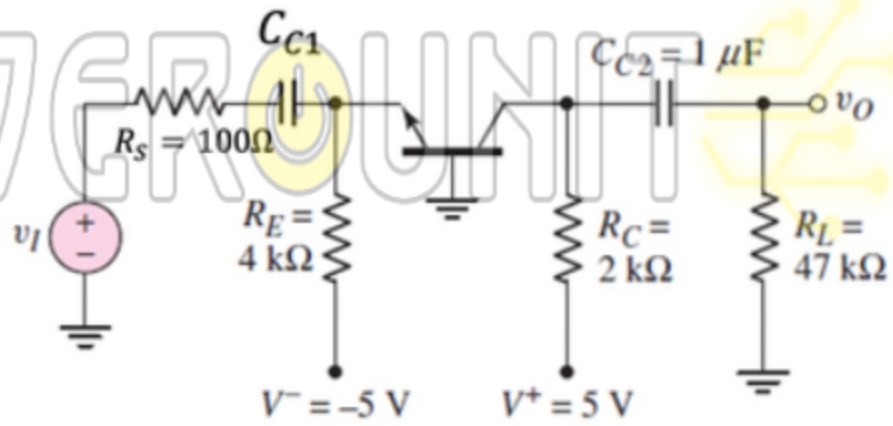
Question 4/18 (4 p.) Answer is mandatory

The parameters of the transistor in the circuit shown in the Figure are:

$V_{BE}(on) = 0.7V, \beta = 120$, and $V_A = \infty$.

Use $V_T = 0.026V$.

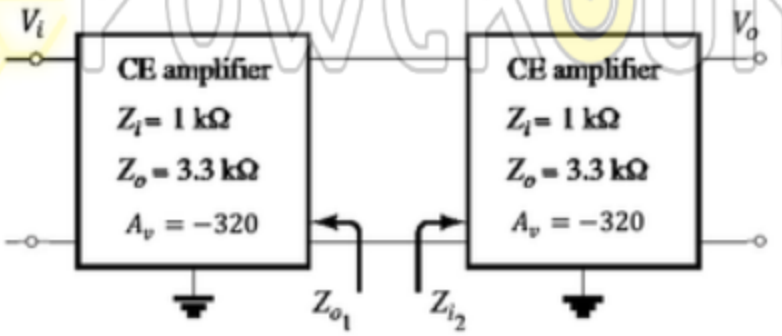
Find the −3 dB frequency associated with $C_{C1} = 9.6\mu F$.



Question 5/18 (4 p.) Answer is mandatory

For the cascaded system shown in the Figure with **two identical stages** each has the same A_v, determine:

The total voltage gain $A_{vT} = \frac{V_o}{V_i}$.



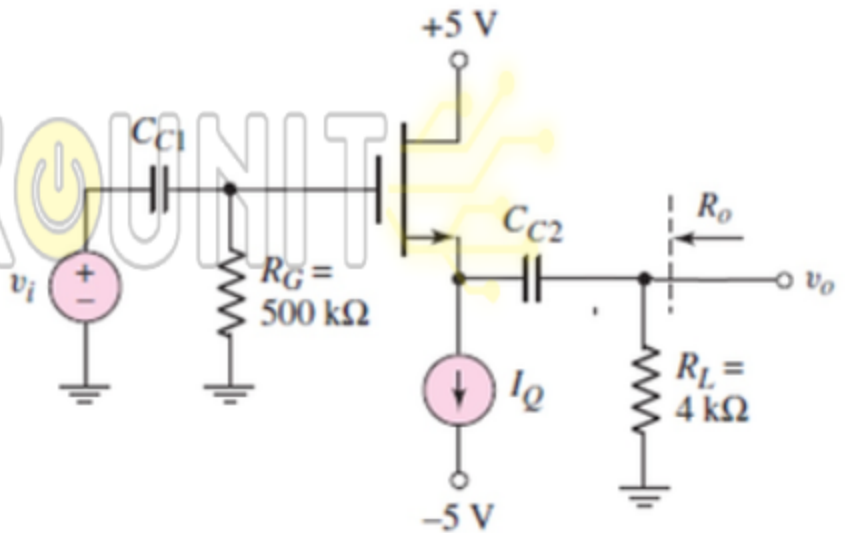
Question 6/18 (3 p.) Answer is mandatory

Consider the source follower circuit in the Figure with transistor parameters:

$V_{TN} = 0.8V$, $k_n' = 100\mu A/V^2$, $W/L = 20$, and $\lambda = 0.02V^{-1}$.

Let $I_Q = 3mA$.

Find the small signal output resistance R_o in the Mid-band frequency.



Question 7/18 (2 p.) Answer is mandatory

In an amplifier circuit, the average power dissipated in the transistor decreases when:

- ○ V_{CC} is increased
- ◉ AC signal is applied
- ○ AC signal is not applied
- ○ R_C is decreased

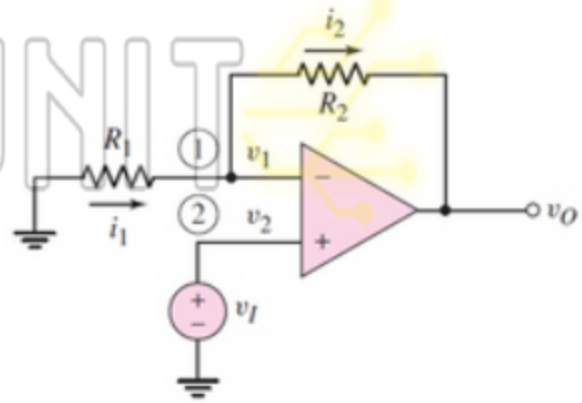
Question 8/18 (2 p.) Answer is mandatory

For an op-amp circuit, if it has only a positive supply voltage V_{CC}, then its output cannot:

- (●) Be Zero
- ( ) Be ac coupled
- ( ) Be negative
- ( ) Saturate

Question 9/18 (3 p.) Answer is mandatory

An ideal non-inverting op-amp circuit is to be designed with a closed-loop voltage gain of $A_v = 55$. The largest resistor value to be used is 4 $k\Omega$.
If the simple two-resistor design shown in the Figure is used, what is the value of R_1?



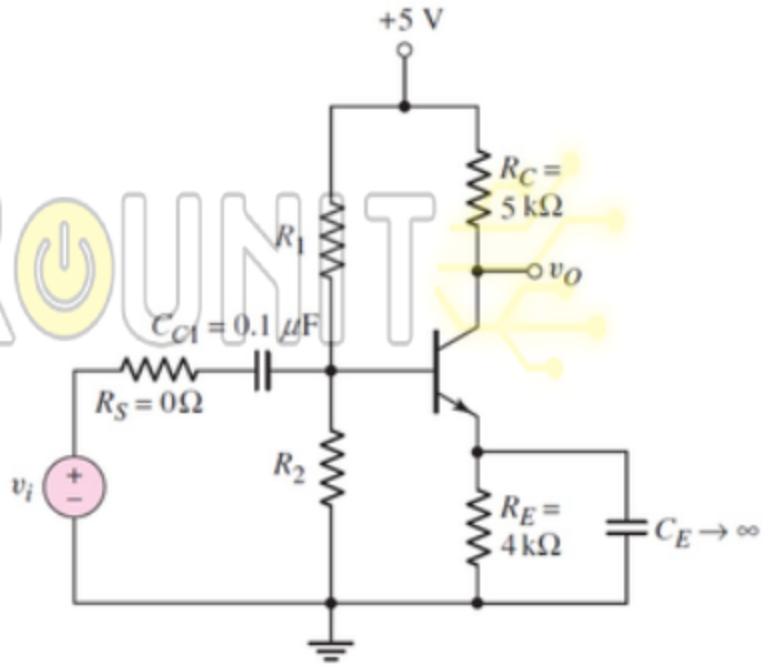
Question 10/18 (3 p.) Answer is mandatory

The parameters of the circuit shown in the Figure are:

$R_1 = 60\ k\Omega$ and $R_2 = 28\ k\Omega$.

The transistor parameters are:
$V_{BE}(on) = 0.7V, \beta = 100$, and $C_\mu = 0.45\ pF$.
Use $V_T = 0.026V$.

Determine the **Miller** capacitance C_M.

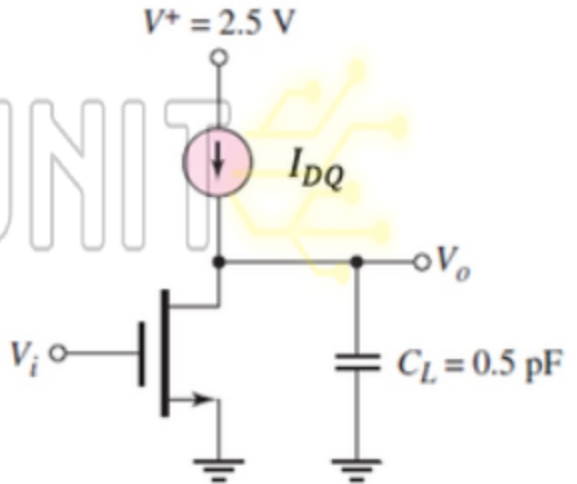


Question 11/18 (3 p.) Answer is mandatory

The transistor in the circuit shown in the Figure is biased by $I_{DQ} = 2mA$, and has the following parameters:

$V_{TN} = 0.4V$, $K_n = 50\mu A/V^2$, and $\lambda = 0.05V^{-1}$.

Approximately, what is the bandwidth of the frequency response for the amplifier circuit shown?



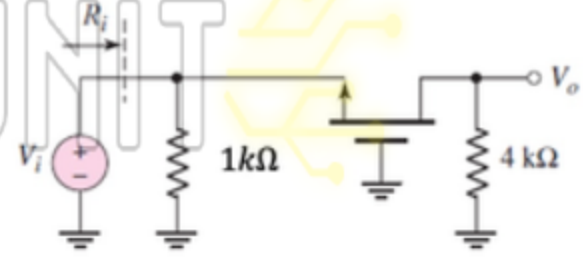
Question 12/18 (3 p.) Answer is mandatory

The small-signal parameters of the NMOS transistor in the **ac equivalent** common-gate circuit shown in the Figure are:

$V_{TN} = 0.6\,V$, $K_n = 4mA/V^2$, and $\lambda = 0$.

The quiescent drain current was found as: $I_{DQ} = 1\,mA$.

Determine the small-signal input resistance R_i.



Question 13/18 (3 p.) Answer is mandatory

The parameters of the transistor in the circuit shown in the Figure are:

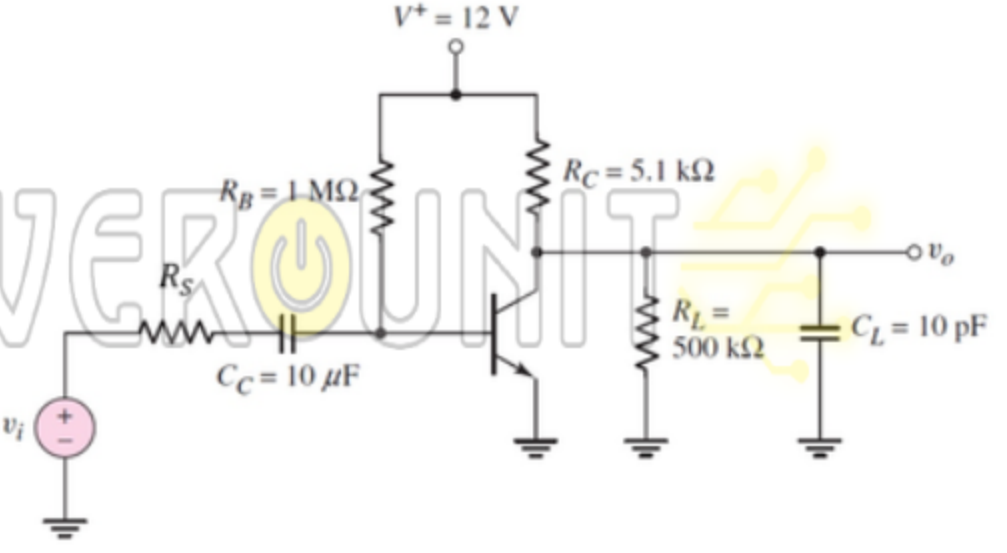
$\beta = 100, V_{BE}(on) = 0.7\,V, V_A = \infty.$
Use $V_T = 0.026V$.

***Hint**: Neglect the capacitance effects of the circuit and the transistor.

When $R_S = 0\Omega$, we calculated:

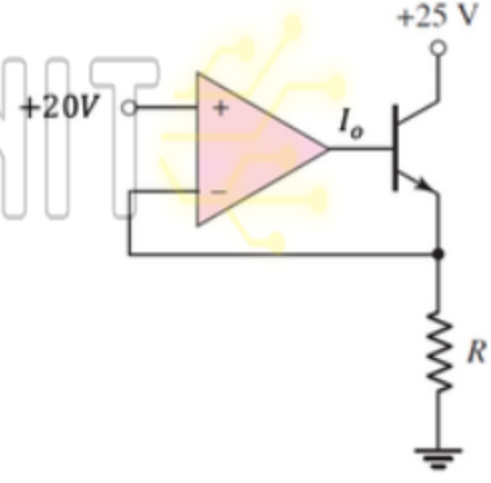
$$A_{mid} = -219.4.$$

If we set $R_S = 1k\Omega$, now determine the new value of $|A_{mid}|_{dB}$:



Question 14/18 (4 p.) Answer is mandatory

The output current of the op-amp shown in the Figure is $I_o = 2.2\ mA$.
Assume the transistor $V_{BE}(on) = 0.7$, and current gain $\beta = 50$.
Determine the resistance value R.



Question 15/18 (2 p.) Answer is mandatory

For a voltage amplifier, if the voltage gain increases by a factor of 14 (e.g. $A_{new}=14*A_{old}$), the decibel (dB) voltage gain increases by:

- ○ A factor of 14
- ◉ 23 dB
- ○ 30 dB
- ○ 14 dB

Question 16/18 (2 p.) Answer is mandatory

The voltage gain of an amplifier decreases 60 dB per decade above the high cut-off frequency f_H=30 kHz.

If the midband voltage gain was 110 dB, what will be the magnitude of the voltage gain A_v at 3MHz?

- -10 dB
- -30 dB
- 10 dB
- 30 dB

Question 18/18 (2 p.) Answer is mandatory

The output resistance of a MOSFET common gate amplifier equals to:

- ○ Base resistor
- ○ Drain resistor
- ○ Gate resistor
- ○ Source resistor