Started on	Thursday, 14 December 2017, 10:59 AM
State	Finished
Completed on	Thursday, 14 December 2017, 12:09 PM
Time taken	1 hour 10 mins
Grade	**52.00** out of 106.00 (**49**%)

Question 1

Correct

Mark 1.00 out of 2.00

Which of the following is true for a PNP BJT operating in the forward-active region ?

Select one:

- a. The collector current consists primarily of holes injected from the collector into the base
- b. The emitter current consists primarily of holes injected from the emitter into the base ✓
- c. Some base current flows to replace holes which are lost as electrons diffusing across the base recombine
- d. All of these
- e. The base current consists primarily of holes injected from the emitter into the base

The correct answer is: The emitter current consists primarily of holes injected from the emitter into the base

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **1.00/2.00**.

Question 2

Correct

Mark 1.00 out of 2.00

Which of the following is true for a PNP BJT ?

Select one:

- a. None of these ✓
- b. Current flows when either Vbe or Vbc are positive voltages
- c. A P-type base is sandwiched between an N-type emitter and an N-type collector
- d. The base current consists of mostly holes
- e. Current flows primarily because of electrons injected into the base

The correct answer is: None of these

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **1.00/2.00**.

Question 3

Correct

Mark 1.00 out of 2.00

A BJT with it's base-emitter junction reverse biased and it's base-collector junction reverse biased is in :

Select one:

- a. Reverse-Active
- b. Forward-Active
- c. Saturation
- d. Cutoff ✓
- e. None of these

The correct answer is: Cutoff

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **1.00/2.00**.

Question 4

Correct

Mark 2.00 out of 2.00

A BJT with it's base-emitter junction forward biased and it's base-collector junction forward biased is in :

Select one:

- a. Reverse-Active
- b. None of these
- c. Saturation ✓
- d. Cutoff
- e. Forward-Active

The correct answer is: Saturation

Correct

Marks for this submission: 2.00/2.00.

Question 5

Correct

Mark 1.00 out of 2.00

As |Vce| increases for a BJT in the forward active region, "base-width modulation" causes :

Select one:

- a. The width of the base-collector depletion region to decrease
- b. All of these
- c. The output resistance, ro , to increase
- d. The collector current for the BJT to increase ✓
- e. The width of the base to increase

The correct answer is: The collector current for the BJT to increase

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **1.00/2.00**.

Question 6

Correct

Mark 2.00 out of 2.00

If an NPN BJT at 300°K with a constant collector current of 10μA has a Vbe voltage of 620mV, then what will Vbe be for this same BJT if the collector current is increased to 1mA?

Select one:

- a. 740mV ✓
- b. None of these
- c. 680mV
- d. 800mV
- e. 560mV

The correct answer is: 740mV

Correct

Marks for this submission: 2.00/2.00.

Question 7

Correct

Mark 1.00 out of 2.00

Considering the typical input and output resistances, a BJT common-collector is well suited to be which of the following types of amplifiers ?

Select one:

- a. Voltage amplifier ✓
- b. Transconductance amplifier
- c. None of these
- d. Current amplifier
- e. Transresistance amplifier

The correct answer is: Voltage amplifier

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **1.00/2.00**.

Question 8

Correct

Mark 1.00 out of 2.00

For a BJT common-collector amplifier, which of the following is true ?

Select one:

- a. The input resistance is typically low
- b. The output resistance is typically low ✓
- c. The voltage gain is negative
- d. All of these
- e. The voltage gain is typically high

The correct answer is: The output resistance is typically low

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **1.00/2.00**.

Question 9

Correct

Mark 1.00 out of 2.00

Considering the typical input and output resistances, which of the following MOS amplifier types is well suited to be used as a transresistance amplifier ?

Select one:

- a. Common-source
- b. Common-drain
- c. Source-follower
- d. None of these ✓
- e. Common-gate

The correct answer is: None of these

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **1.00/2.00**.

Question 10

Correct

Mark 1.00 out of 2.00

For a MOS common-source amplifier, which of the following is true ?

Select one:

- a. The voltage gain is typically high ✓
- b. The output resistance is typically low
- c. The input resistance is typically low
- d. The voltage gain is positive
- e. None of these

The correct answer is: The voltage gain is typically high

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **1.00/2.00**.

Question 11

Correct

Mark 2.00 out of 2.00

In the forward-active region, current flows out of the base of a PNP BJT.

Select one:

- True ✓
- False

The correct answer is 'True'.

Correct

Marks for this submission: 2.00/2.00.

Question 12

Correct

Mark 2.00 out of 2.00

When the base-emitter and base-collector junctions in a BJT are reverse biased, zero current will flow.

Select one:

- True
- False ✓

The correct answer is 'False'.

Correct

Marks for this submission: 2.00/2.00.

Question 13

Correct

Mark 2.00 out of 2.00

If the base-emitter junction of a BJT is reverse biased and the base-collector junction is forward biased, then the BJT is operating in the saturation region of operation.

Select one:

- True
- False ✓

The correct answer is 'False'.

Correct

Marks for this submission: 2.00/2.00.

Question 14

Correct

Mark 2.00 out of 2.00

As the reverse bias across the base-collector junction in a BJT increases, the width of the base increases which causes the collector current to increase.

Select one:

- True
- False ✓

The correct answer is 'False'.

Correct

Marks for this submission: 2.00/2.00.

Question 15

Correct

Mark 0.00 out of 2.00

The output resistance in a transresistance amplifier model is used to determine the signal lost due to the current division between the load resistance and the output resistance of the amplifier.

Select one:

- True
- False ✓

The correct answer is 'False'.

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **0.00/2.00**.

Question 16

Correct

Mark 0.00 out of 2.00

Since most amplifiers are intentionally designed to be bidirectional, the two-port model for an amplifier needs to include a term to model the gain from the output back to the input.

Select one:

- True
- False ✓

The correct answer is 'False'.

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **0.00/2.00**.

Question 17

Correct

Mark 0.00 out of 2.00

The base resistance in the BJT hybrid-pi model, r_π , increases as the collector current increases.

Select one:

- True
- False ✓

The correct answer is 'False'.

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **0.00/2.00**.

Question 18

Correct

Mark 0.00 out of 2.00

The output resistance for a common-collector amplifier is the same as the input resistance for a common-base amplifier.

Select one:

- True ✓
- False

The correct answer is 'True'.

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **0.00/2.00**.

Question 19

Correct

Mark 0.00 out of 2.00

Since current normally flows into the source of a PMOS FET, the source is usually drawn pointing up towards the positive power supply.

Select one:

- (•) True ✓
- ( ) False

The correct answer is 'True'.

Correct

Marks for this submission: 2.00/2.00. Accounting for previous tries, this gives **0.00/2.00**.

Question 20

Correct

Mark 2.00 out of 2.00

All three MOS amplifier types (CS, CG, CD) are identical when the input and output are applied.

Select one:

- ( ) True
- (•) False ✓

The correct answer is 'False'.

Correct

Marks for this submission: 2.00/2.00.

Question 21

Correct

Mark 6.00 out of 6.00

What is the base-to-emitter resistance, r_π, in kΩ for an PNP BJT operating in the forward-active region at 27° C with Ic = 417μA? Use: β = 24 and Vt = kT/q = 26mV.

Answer: 1.496 ✓

The correct answer is: 1.50

Correct

Marks for this submission: 6.00/6.00.

Question 22

Correct

Mark 6.00 out of 6.00

What is the open-circuit voltage gain, μf, in V/V for an NMOS FET operating in saturation with Id = 967μA and Von = Vgs-Vt = 245mV ? Use: λ = 0.11

Answer: 74.211

The correct answer is: 74.21

Correct

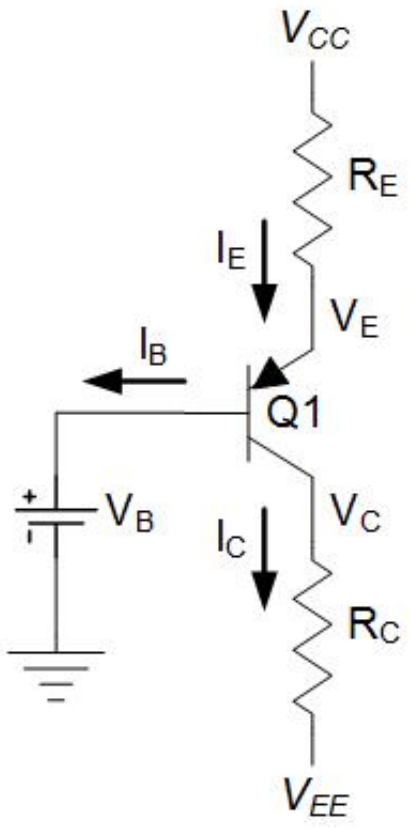
Marks for this submission: 6.00/6.00.

Question 23

Not answered

Mark 0.00 out of 6.00

For the BJT bias circuit shown, what is the base current, Ib, in microamps? Use Vcc = 7V, Vee = -8V, Vb = 2.9V, Rc = 1.8kΩ, and Re = 6.8kΩ. Assume that the transistor is in the forward-active region, with β = 46 and |Vbe(on)| = 0.7V. Neglect the effects of base-width modulation.



Answer:

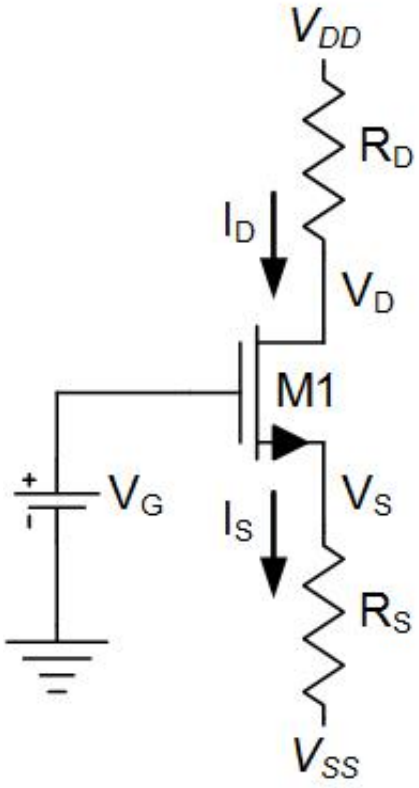
The correct answer is: 10.6

Question 24

Not answered

Mark 0.00 out of 6.00

For the MOSFET bias circuit shown, what value of Rd in kilohms is needed to allow the maximum possible peak-to-peak signal swing on the drain without clipping? Use: Vdd = 8V, Vss = -7V, Vg = -0.6V, Rs = 4.8kΩ, Vt = 0.5V, and Von = 0.15. (Remember that Von = Vov = Vgs-Vt) Neglect the effect of channel-length modulation and body effect. (Hint: Be sure to keep the MOSFET in saturation!)



Answer:

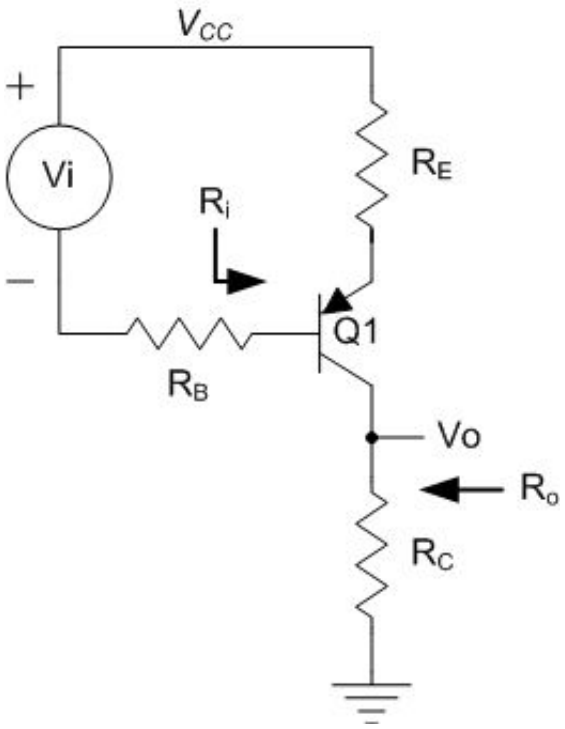
The correct answer is: 3.8

Question 25

Incorrect

Mark 0.00 out of 6.00

What is the low frequency voltage gain for the amplifier shown at 27° C with Rc = 36.6kΩ, Re = 0.1kΩ and Rb = 1.0kΩ ? Use: Ic = 971μA, β = 44, and Vt = kT/q = 26mV. Neglect the effect of base-width modulation.



Answer: 246.62 ✗

The correct answer is: -241.14

Incorrect

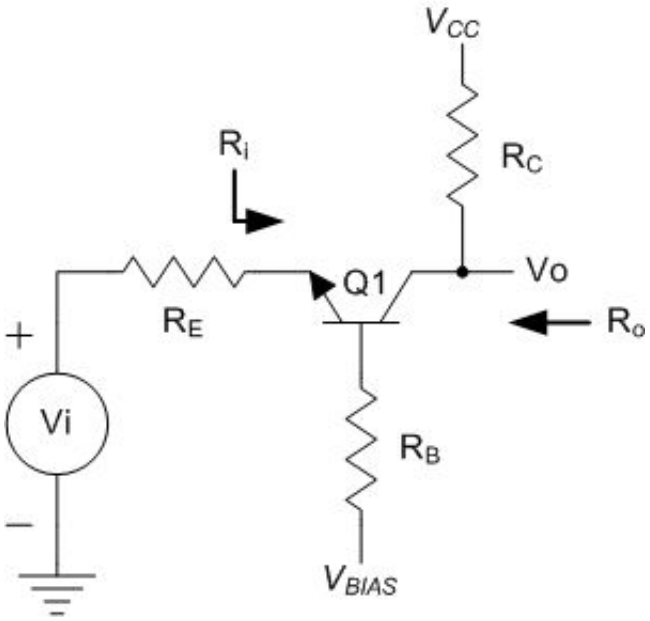
Marks for this submission: 0.00/6.00.

Question 26

Incorrect

Mark 0.00 out of 6.00

What is the low frequency voltage gain for the amplifier shown at 27° C with Rc = 40.6kΩ, Re = 0.1kΩ and Rb = 0.5kΩ ? Use: Ic = 48μA, β = 197, and Vt = kT/q = 26mV. Neglect the effect of base-width modulation.



Answer: -29.936

The correct answer is: 62.97

Incorrect

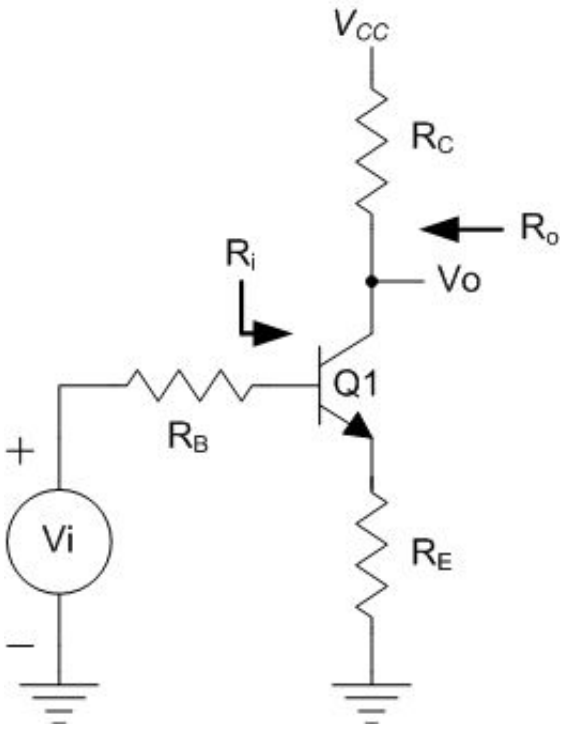
Marks for this submission: 0.00/6.00.

Question 27

Correct

Mark 6.00 out of 6.00

What is the low frequency input resistance, Ri, in kΩ for the amplifier shown at 27° C with Rc = 10.1kΩ, Re = 0.2kΩ and Rb = 0.8kΩ ? Use: Ic = 427μA, β = 146, and Vt = kT/q = 26mV. Neglect the effect of base-width modulation.



Answer: 38.1

The correct answer is: 38.3

Correct

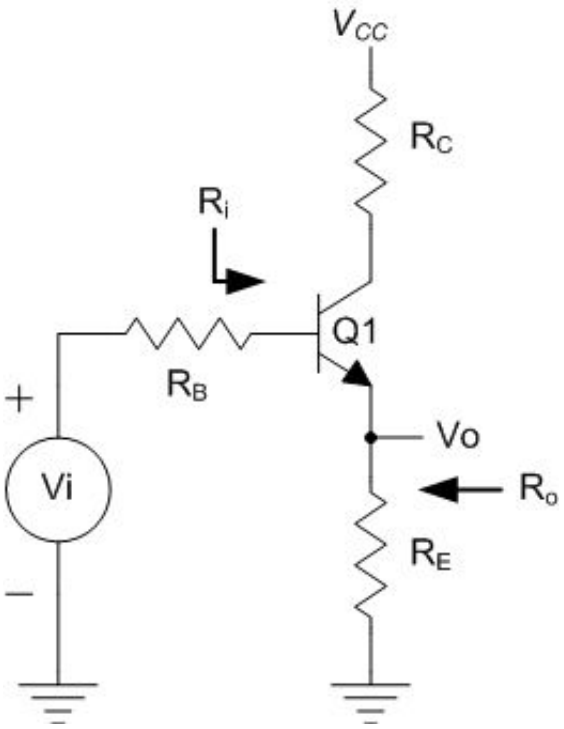
Marks for this submission: 6.00/6.00.

Question 28

Correct

Mark 6.00 out of 6.00

What is the low frequency input resistance, Ri, in kΩ for the amplifier shown at 27° C with Rc = 13.9kΩ, Re = 0.4kΩ and Rb = 1.0kΩ ? Use: Ic = 50μA, β = 98, and Vt = kT/q = 26mV. Neglect the effect of base-width modulation.



Answer: 90.16

The correct answer is: 90.6

Correct

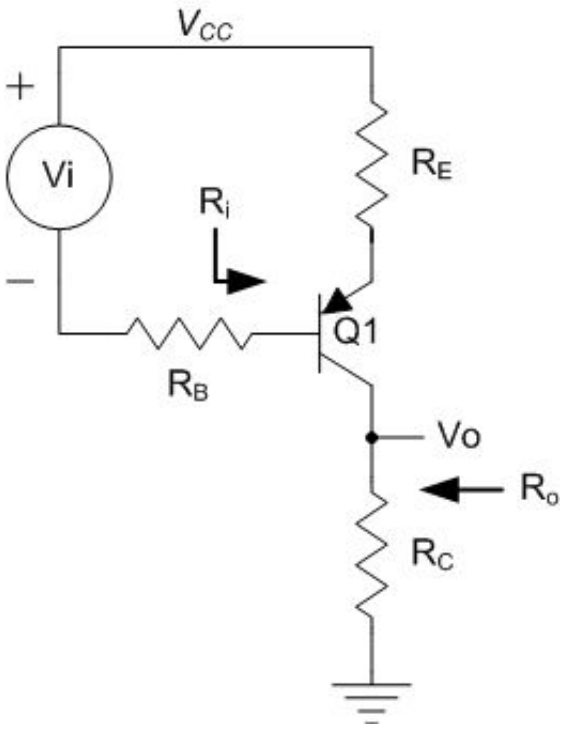
Marks for this submission: 6.00/6.00.

Question 29

Incorrect

Mark 0.00 out of 6.00

What is the low frequency output resistance, Ro, in kΩ for the amplifier shown at 27° C with Rc = 62.3kΩ, Re = 0.9kΩ and Rb = 0.9kΩ ? Use: Ic = 28μA, β = 22, VA = 10V, and Vt = kT/q = 26mV. Use the "short-cut approach" discussed in class.



Answer: 0.456 ✗

The correct answer is: 57.2

Incorrect

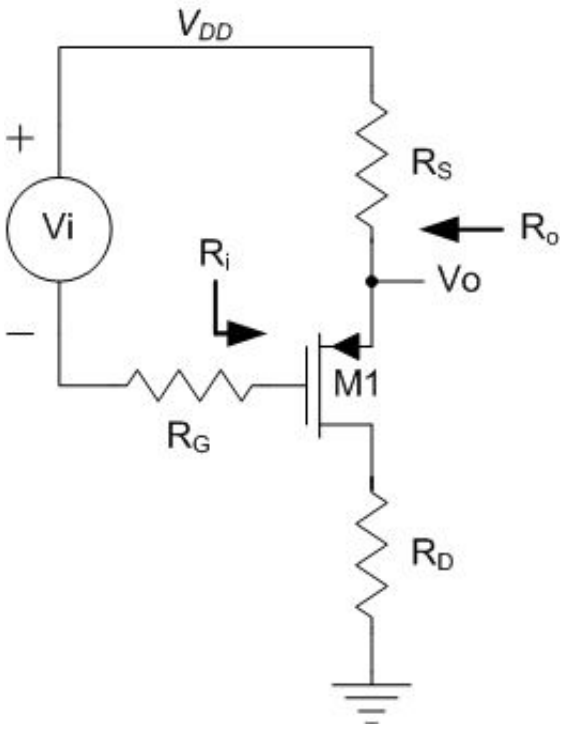
Marks for this submission: 0.00/6.00.

Question 30

Incorrect

Mark 0.00 out of 6.00

What is the low frequency output resistance, Ro, in Ω for the amplifier shown at 27° C with Rd = 35.2kΩ, Rs = 0.6kΩ and Rg = 9.5kΩ. Use: W/L = 67, Id = 156μA, VTP = -0.5V, k'p = 40μA/V^2, λ = 0 Neglect body effect.



Answer: 35200 ✗

The correct answer is: 387.4

Incorrect

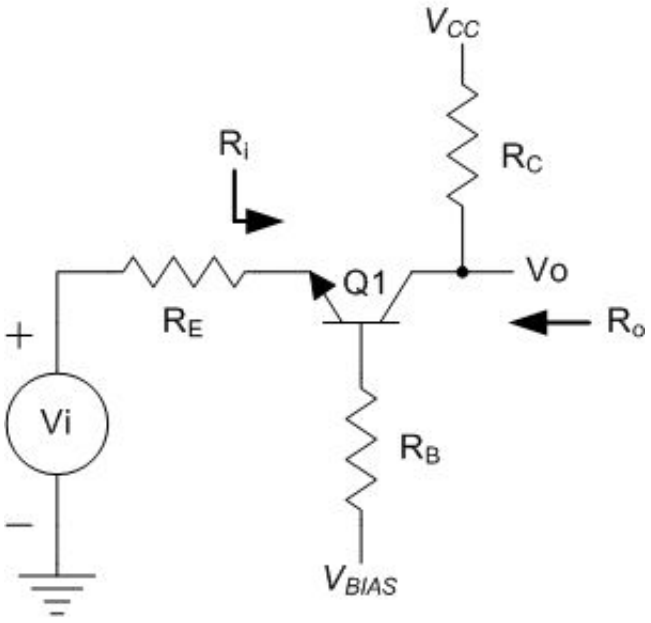
Marks for this submission: 0.00/6.00.

Question 31

Correct

Mark 6.00 out of 6.00

Estimate the maximum low frequency voltage gain for the amplifier shown if the bias voltage across Rc is 1693mV and the bias voltage across Re is 364mV.



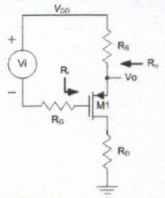
Answer: 4.65

The correct answer is: 4.65

Correct

Marks for this submission: 6.00/6.00.

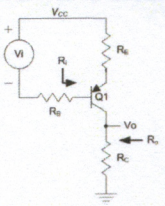
30. What is the low frequency output resistance, Ro, in Ω for the amplifier shown at 27° C with Rd = 35.2kΩ, Rs = 0.6kΩ and Rg = 9.5kΩ. Use: W/L = 67, Id = 156μA, VTP = -0.5V, k'p = 40μA/V^2, λ = 0 Neglect body effect.



$g_m = \sqrt{2 \cdot k'p \cdot \left(\frac{W}{L}\right) \cdot I_d} = \sqrt{2 \cdot (40\times10^{-6})(67)(156\times10^{-6})} = 0.0009144$

$R_o = R_s \,||\, 1/g_m \approx \frac{1}{600} + 0.0009144 = \frac{1}{0.002581085} = \boxed{387.4\,\Omega}$

29. What is the low frequency output resistance, Ro, in kΩ for the amplifier shown at 27° C with Rc = 62.3kΩ, Re = 0.9kΩ and Rb = 0.9kΩ ? Use: Ic = 28μA, β = 22, VA = 10V, and Vt = kT/q = 26mV. Use the "short-cut approach" discussed in class.



$g_m = \frac{I_c}{V_t} = \frac{(28\times10^{-6})}{(26\times10^{-3})} = 0.001077$

$r_\pi = \frac{\beta}{g_m} = 20428.57$

$r_o = \frac{V_A}{I_c} = \frac{10}{(28\times10^{-6})} = 357142.86$

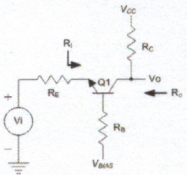
$R_{o1} = r_o\left[1 + \frac{\beta R_E}{R_b + R_E + r_\pi}\right] + \frac{R_E}{1 + \left(\frac{R_E}{r_\pi + R_b}\right)}$

$= 357142.86\left[1 + \frac{22\cdot900}{900+900+20428.57}\right] + \frac{900}{1+\left(\frac{900}{20428.57+900}\right)} = 675266.28 + 863.56 = 676129.84$

$R_o = R_c \,||\, R_{o1} = \frac{1}{62300} + \frac{1}{676129.84} = \frac{1}{0.00001753} = 57043.86\,\Omega = \boxed{57.04\,k\Omega}$

57.2 kΩ (moodle)

26. What is the low frequency voltage gain for the amplifier shown at 27° C with Rc = 40.6kΩ, Re = 0.1kΩ and Rb = 0.5kΩ ? Use: Ic = 48μA, β = 197, and Vt = kT/q = 26mV. Neglect the effect of base-width modulation.



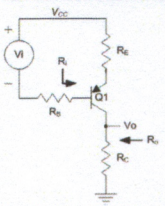
$g_m = \frac{I_c}{V_t} = \frac{(48\times10^{-6})}{(26\times10^{-3})} = 0.001846$

$V_{BE} = -V_i \cdot \frac{1}{1 + g_m\left(\frac{R_B}{(\beta+1)} + R_E\right)}$

$V_o = -g_m V_{BE} R_C \longrightarrow \frac{V_o}{V_i} = g_m R_C\left(\frac{1}{1 + g_m\left(\frac{R_B}{\beta+1} + R_E\right)}\right) \Rightarrow \frac{V_o}{V_i} = \frac{g_m R_C}{1 + \frac{g_m R_B}{\beta+1} + g_m R_E} = \frac{0.001846\cdot40600}{1+\left(\frac{0.001846\cdot500}{197+1}\right)+(0.001846\cdot100)} =$

63.02 (calculated)
62.97 (moodle answer)

25. What is the low frequency voltage gain for the amplifier shown at 27° C with Rc = 36.6kΩ, Re = 0.1kΩ and Rb = 1.0kΩ ? Use: Ic = 971μA, β = 44, and Vt = kT/q = 26mV. Neglect the effect of base-width modulation.

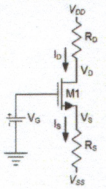


$g_m = \frac{I_c}{V_t} = \frac{(971\times10^{-6})}{(26\times10^{-3})} = 0.037346$

$r_\pi = \frac{\beta}{g_m} = \frac{44}{0.037346} = 1178.167$

$A_V = \frac{-\beta R_C}{R_B + r_\pi + (\beta+1)R_E} = \frac{(-44)(36600)}{1000+1178.167+(45\cdot100)} = \boxed{-241.14}$

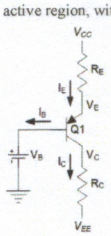
24. For the MOSFET bias circuit shown, what value of Rd in kilohms is needed to allow the maximum possible peak-to-peak signal swing on the drain without clipping? Use: Vdd = 8V, Vss = -7V, Vg = -0.6V, Rs = 4.8kΩ, Vt = 0.5V, and Von = 0.15. (Remember that Von = Vov = Vgs-Vt) Neglect the effect of channel-length modulation and body effect. (Hint: Be sure to keep the MOSFET in saturation!)



$V_{GS} = V_{ON} + V_t = 0.15 + 0.5 = 0.65$

$-V_G + V_{GS} + I_S R_S + V_{SS} = 0 \longrightarrow -(-0.6) + 0.65 + I_S(4800) + 7V = 0 \longrightarrow I_S = \frac{-8.25}{4800} = -0.00172 \qquad I_S = I_D$

23. For the BJT bias circuit shown, what is the base current, Ib, in microamps? Use Vcc = 7V, Vee = -8V, Vb = 2.9V, Rc = 1.8kΩ, and Re = 6.8kΩ. Assume that the transistor is in the forward-active region, with β = 46 and |Vbe(on)| = 0.7V. Neglect the effects of base-width modulation.



$V_E = V_{be} + V_b = 0.7 + 2.9 = 3.4$

$I_E = \frac{V_{CC} - V_E}{R_E} = \frac{7 - 3.4}{6800} = 0.0005$

$I_B = \frac{I_E}{(1+\beta)} = \frac{0.0005}{(1+46)} = 0.0000106638\,A = \boxed{10.6\,\mu A}$