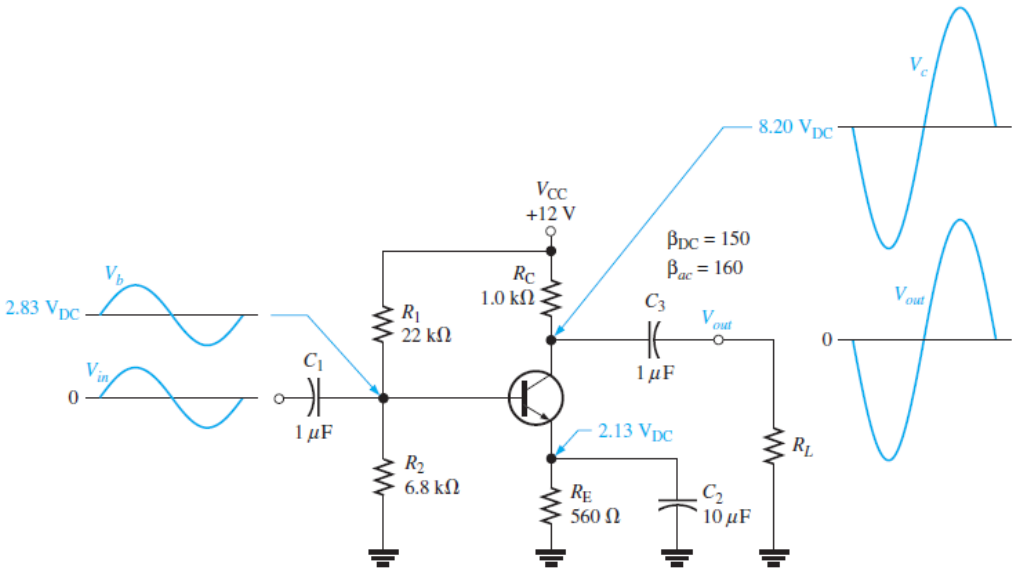
Electronic Circuits II - Tutorial 07

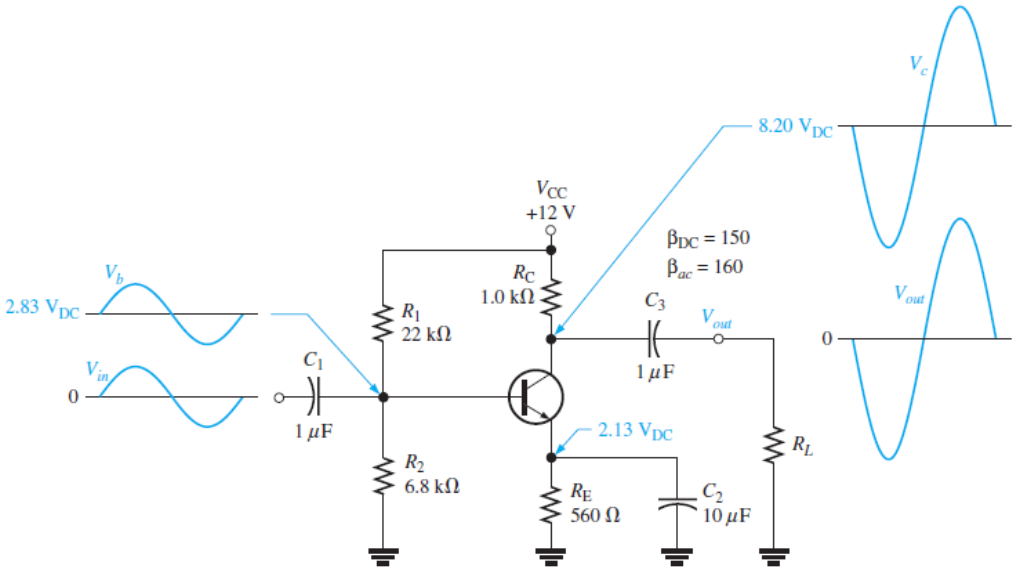
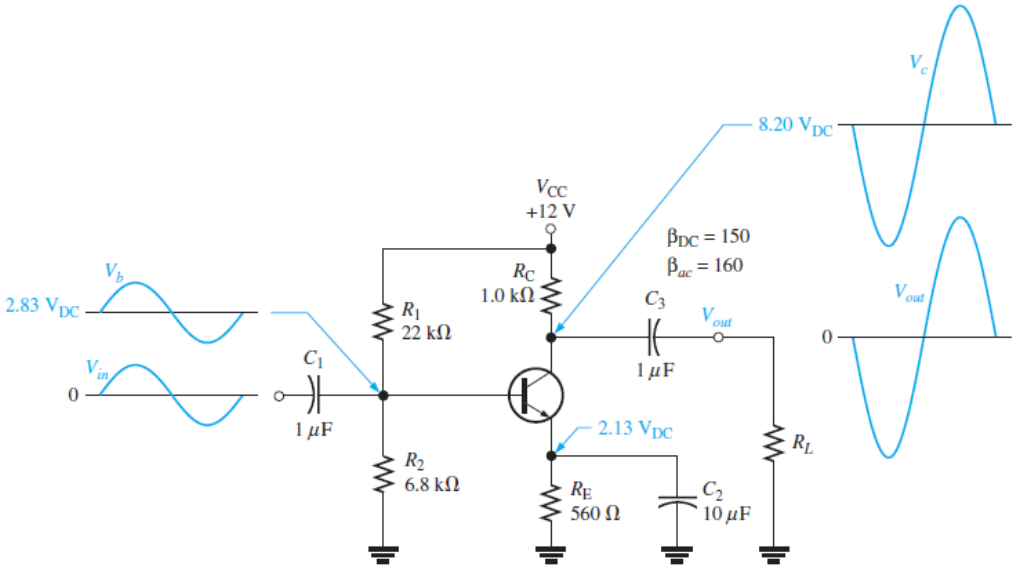
BJT Amplifiers 2

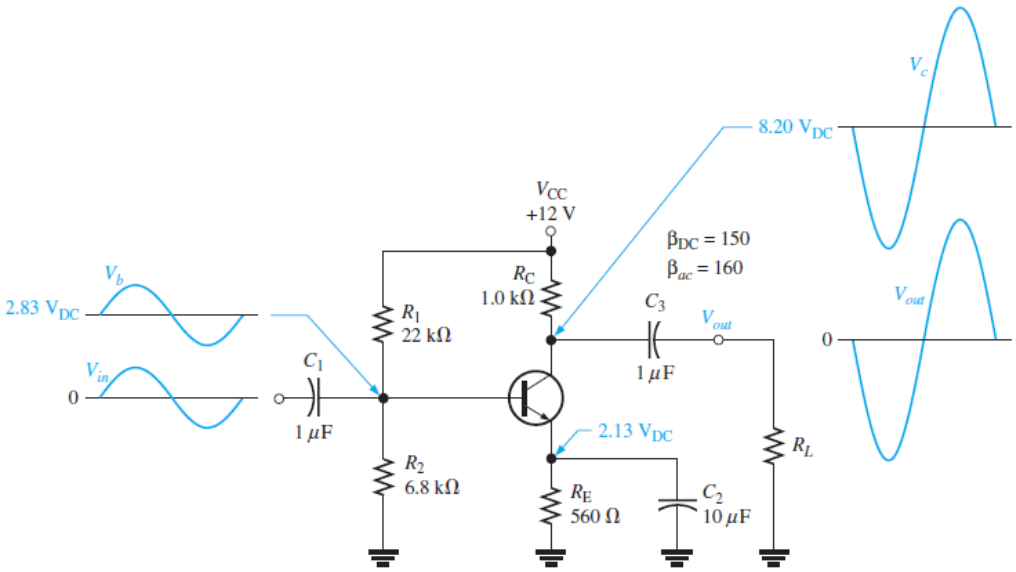
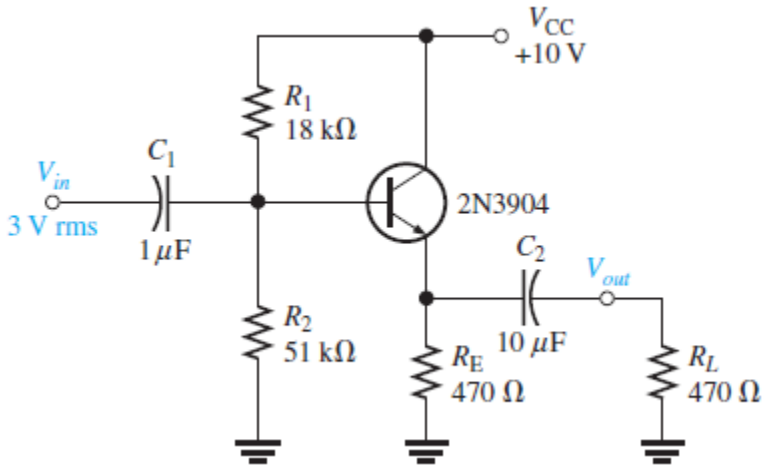
T & F

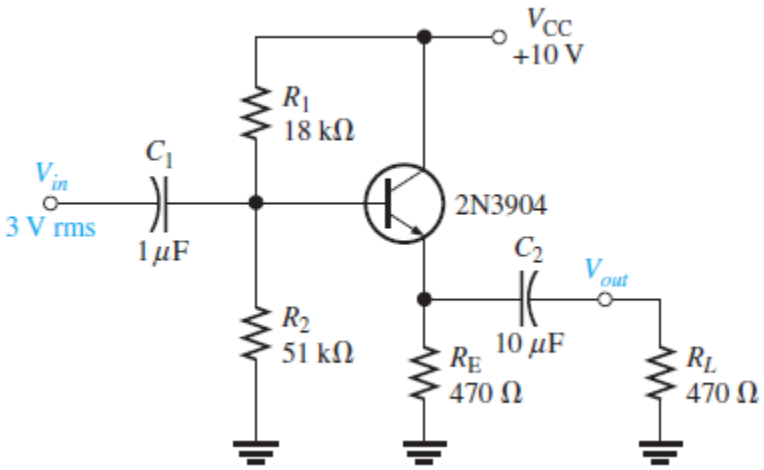
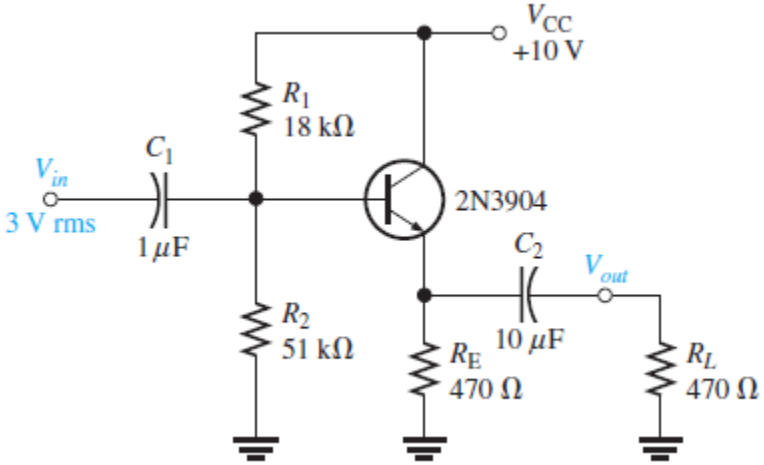
#		
1	In an amplifier, a coupling capacitor should appear ideally as a short to the signal.	T
2	r parameters include	T
3	h parameters are never specified on a datasheet.	F
4	The r parameter is the same as the h parameter hfe.	T
5	A bypass capacitor in a CE amplifier decreases the voltage gain.	F
6	If RC in a CE amplifier is increased, the voltage gain is reduced.	F
7	The load is the amount of current drawn from the output of an amplifier.	T
8	In a CE amplifier, the gain can be stabilized by using a swamping resistor.	T
9	An emitter-follower is a CC amplifier.	T
10	A CC amplifier has high voltage gain.	F
11	A Darlington pair consists essentially of two CC amplifiers.	T
12	A CB amplifier has high current gain.	F
13	The overall voltage gain of a multistage amplifier is the product of the gains of each stage.	T
14	A differential amplifier amplifies the difference of two input signals.	T
15	CMRR is the common-mode resistance ratio.	F

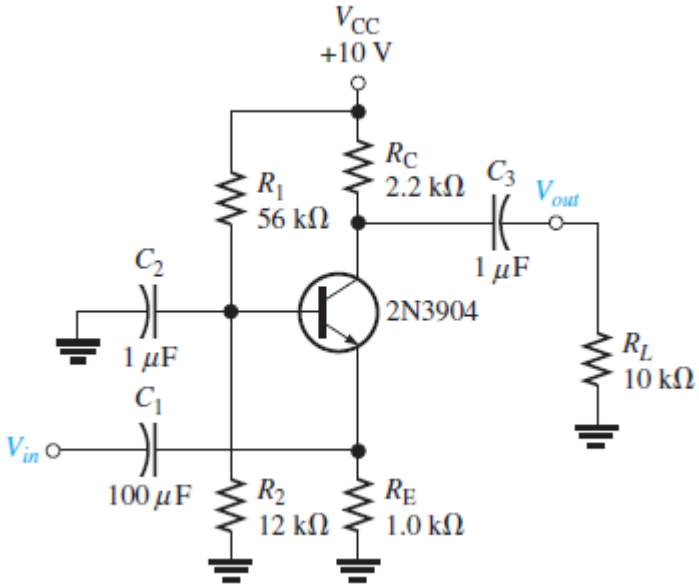
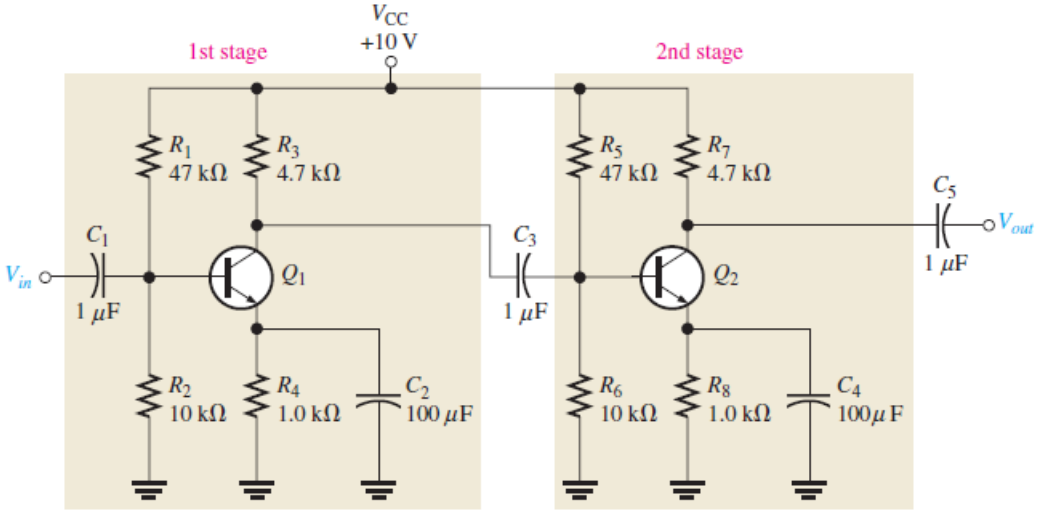
MCQ

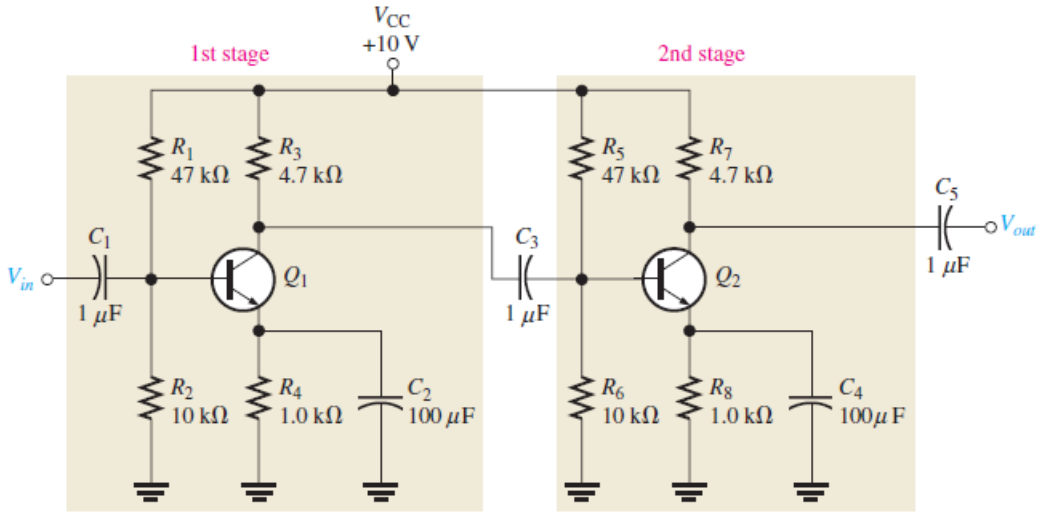
#	Question	Answer
1	 If the transistor in Figure is exchanged for one with higher betas, Vout will	a

	(a) increase (b) decrease (c) not change	
2	 If C2 is removed from the circuit in Figure, Vout will (a) increase (b) decrease (c) not change	b
3	 If the value of RC in Figure is increased, Vout will (a) increase (b) decrease (c) not change	a

4	 If the amplitude of Vin in Figure is decreased, Vout will (a) increase (b) decrease (c) not change	b
5	 If C2 in Figure is shorted, the average value of the output voltage will (a) increase (b) decrease (c) not change	a

6	 If the value of RE in Figure is increased, the voltage gain will (a) increase (b) decrease (c) not change	c
7	 If the value of C1 in Figure is increased, Vout will (a) increase (b) decrease (c) not change	c

8	 If the value of RC in Figure is increased, the current gain will (a) increase (b) decrease (c) not change	c
9	 $\beta_{DC} = \beta_{ac} = 150$ for Q_1 and Q_2 If C2 and C4 in Figure are increased in value, Vout will (a) increase (b) decrease (c) not change	c

10	 $\beta_{DC} = \beta_{ac} = 150$ for Q_1 and Q_2 If the value of R4 in Figure is reduced, the overall voltage gain will (a) increase (b) decrease (c) not change	C
11	**1.** A small-signal amplifier **(a)** uses only a small portion of its load line **(b)** always has an output signal in the mV range **(c)** goes into saturation once on each input cycle **(d)** is always a common-emitter amplifier	a
12	The parameter h_{fe} corresponds to (a) β_{DC} (b) β_{ac} (c) r'_e (d) r'_c	b
13	If the dc emitter current in a certain transistor amplifier is 3 mA, the approximate value of r'_e is (a) 3 kΩ (b) 3 Ω (c) 8.33 Ω (d) 0.33 kΩ	c
14	A certain common-emitter amplifier has a voltage gain of 100. If the emitter bypass capacitor is removed, **(a)** the circuit will become unstable **(b)** the voltage gain will decrease **(c)** the voltage gain will increase **(d)** the Q-point will shift	b
15	For a common-emitter amplifier, $R_C = 1.0\,k\Omega$, $R_E = 390\,\Omega$, $r'_e = 15\,\Omega$, and $\beta_{ac} = 75$. Assuming that R_E is completely bypassed at the operating frequency, the voltage gain is (a) 66.7 (b) 2.56 (c) 2.47 (d) 75	a
16	For a common-emitter amplifier, $R_C = 1.0\,k\Omega$, $R_E = 390\,\Omega$, $r'_e = 15\,\Omega$, and $\beta_{ac} = 75$. , if the frequency is reduced to the point where $X_{C(bypass)} = R_E$, the voltage gain (a) remains the same (b) is less (c) is greater	b
17	In a common-emitter amplifier with voltage-divider bias, $R_{in(base)} = 68\,k\Omega$, $R_1 = 33\,k\Omega$, and $R_2 = 15\,k\Omega$. The total ac input resistance is (a) 68 kΩ (b) 8.95 kΩ (c) 22.2 kΩ (d) 12.3 kΩ	b
18	A CE amplifier is driving a 10 kΩ load. If $R_C = 2.2\,k\Omega$ and $r'_e = 10\,\Omega$, the voltage gain is approximately (a) 220 (b) 1000 (c) 10 (d) 180	d

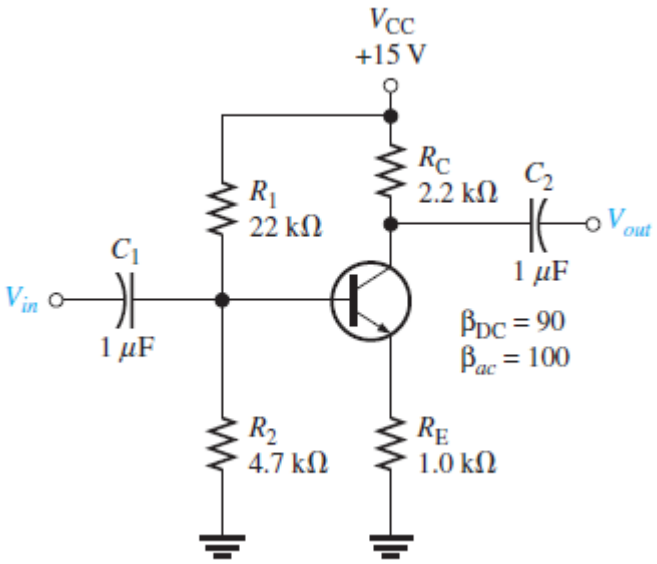
19	For a common-collector amplifier, $R_E = 100\ \Omega$, $r'_e = 10\ \Omega$, and $\beta_{ac} = 150$. The ac input resistance at the base is (a) 1500 Ω (b) 15 kΩ (c) 110 Ω (d) 16.5 kΩ	d
20	For a common-collector amplifier, $R_E = 100\ \Omega$, $r'_e = 10\ \Omega$, and $\beta_{ac} = 150$. If a 10 mV signal is applied to the base of the emitter-follower circuit , the output signal is approximately (a) 100 mV (b) 150 mV (c) 1.5 V (d) 10 mV	d
21	In a certain emitter-follower circuit, the current gain is 50. The power gain is approximately (a) $50A_v$ (b) 50 (c) 1 (d) answers (a) and (b)	d
22	In a Darlington pair configuration, each transistor has an ac beta of 125. If R_E is 560 Ω, the input resistance is (a) 560 Ω (b) 70 kΩ (c) 8.75 MΩ (d) 140 kΩ	c
23	The input resistance of a common-base amplifier is (a) very low (b) very high (c) the same as a CE (d) the same as a CC	a
24	Each stage of a four-stage amplifier has a voltage gain of 15. The overall voltage gain is (a) 60 (b) 15 (c) 50,625 (d) 3078	c
25	The overall gain found in Question 14 can be expressed in decibels as (a) 94.1 dB (b) 47.0 dB (c) 35.6 dB (d) 69.8 dB	a
26	A differential amplifier (a) is used in op-amps (b) has one input and one output (c) has two outputs (d) answers (a) and (c)	d
27	When a differential amplifier is operated single-ended, (a) the output is grounded (b) one input is grounded and a signal is applied to the other (c) both inputs are connected together (d) the output is not inverted	b
28	In the double-ended differential mode, (a) opposite polarity signals are applied to the inputs (b) the gain is 1 (c) the outputs are different amplitudes (d) only one supply voltage is used	a

29	In the common mode, (a) both inputs are grounded (b) the outputs are connected together (c) an identical signal appears on both inputs (d) the output signals are in-phase	c

Problems

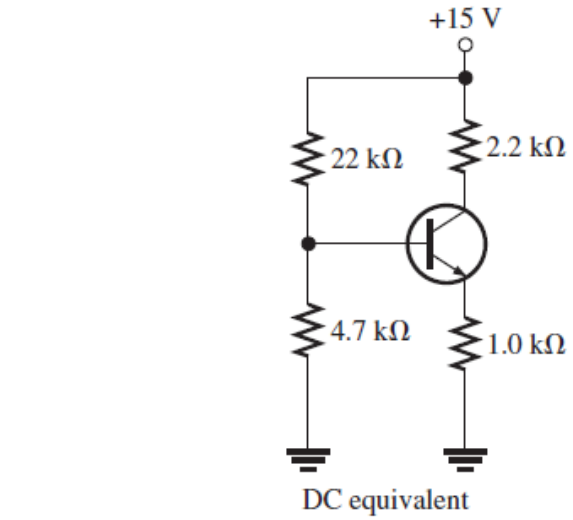
Q1	At the dc bias point of a certain transistor circuit, $I_B = 15\ \mu A$ and $I_C = 2$ mA. Also, a variation in I_B of $3\ \mu A$ about the Q-point produces a variation in I_C of 0.35 mA about the Q-point. Determine β_{DC} and β_{ac}.
Sol 1	.....

Q2

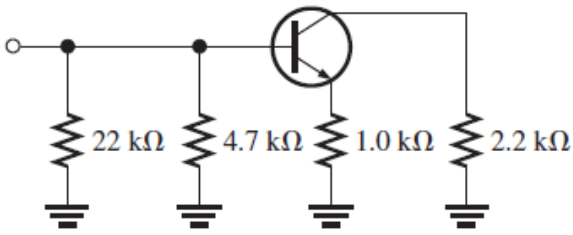


Draw the dc equivalent circuit and the ac equivalent circuit for the unloaded amplifier in Figure

Sol 2

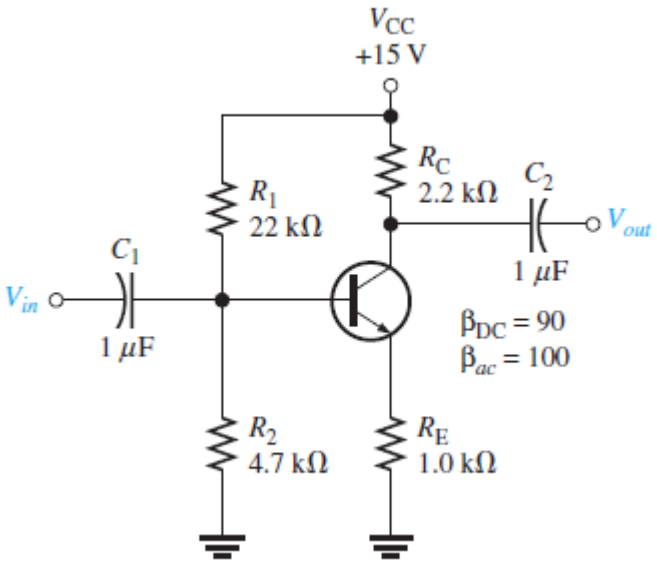


DC equivalent



AC equivalent

Q3



Determine the following dc values for the amplifier in Figure

(a) V_B (b) V_E (c) I_E (d) I_C (e) V_C

Sol 3

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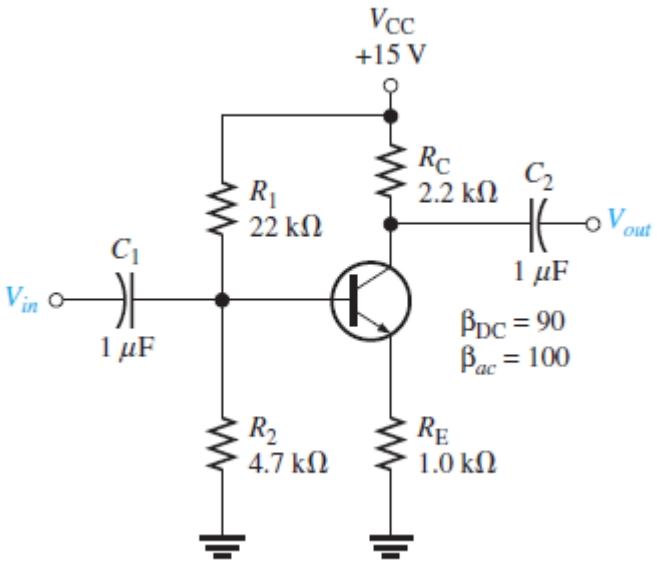
Q4

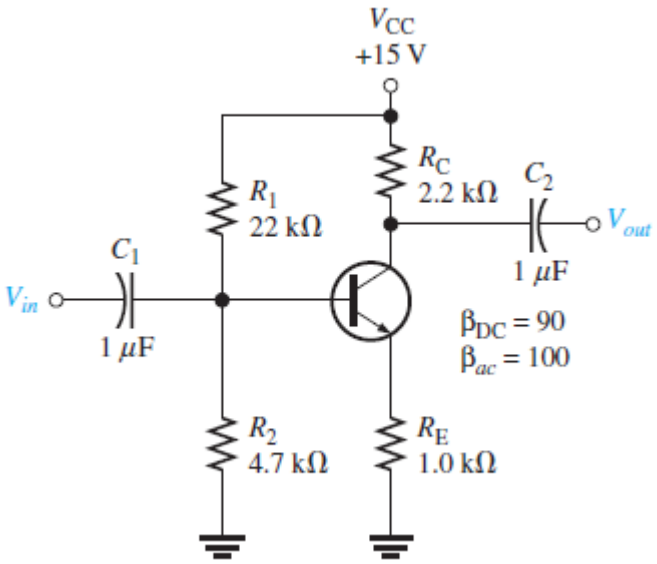


Calculate the quiescent power dissipation in Figure

Sol 4

37.5 mW

Q5

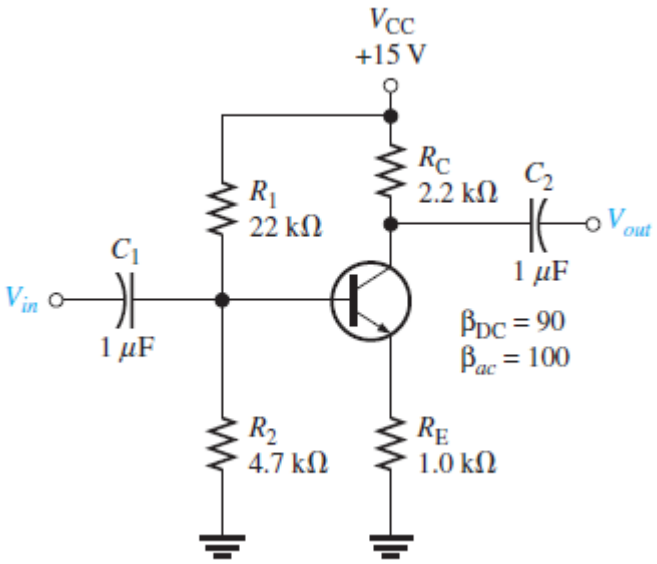


Determine the following dc values for the amplifier in Figure

(a) V_B (b) V_E (c) I_E (d) I_C (e) V_C

Sol 5

Q6



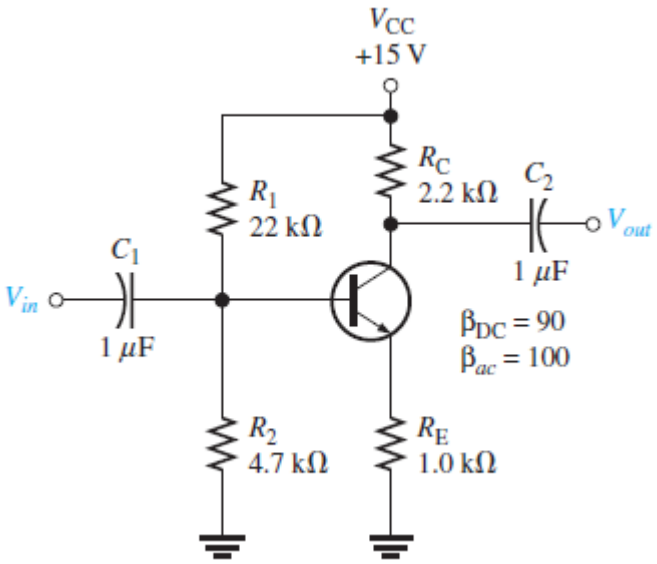
Connect a bypass capacitor across R_E in Figure , and repeat

(a) $R_{in(base)}$ (b) $R_{in(tot)}$ (c) A_v

Sol 6

(a) 1.29 kΩ (b) 968 Ω (c) 171

Q7



Connect a 10 kΩ load resistor to the output in Figure

Connect a bypass capacitor across R_E in Figure , and repeat

(a) $R_{in(base)}$ (b) $R_{in(tot)}$ (c) A_v

Sol 7

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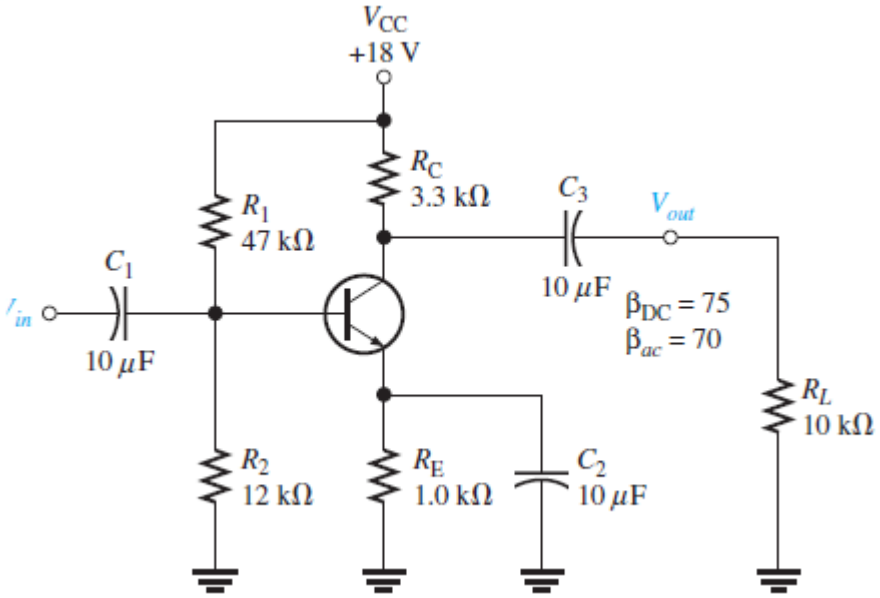
Q8



Determine the following dc values for the amplifier in Figure

(a) I_E (b) V_E (c) V_B (d) I_C (e) V_C (f) V_{CE}

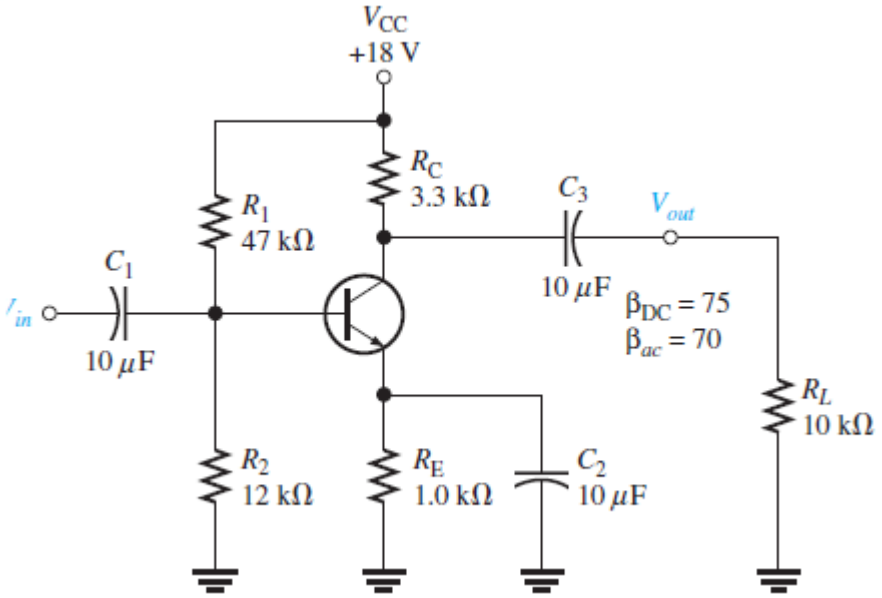
Sol 8

... (a) $I_E = 2.63$ mA (b) $V_E = 2.63$ V .....

... (c) $V_B = 3.76$ V (d) $I_C \cong 2.63$ mA .....

... (e) $V_C = 9.32$ V (f) $V_{CE} = 6.69$ V .....

Q9



Determine the following ac values for the amplifier in Figure

(a) $R_{in(base)}$ (b) R_{in} (c) A_v (d) A_i (e) A_p

Sol 9

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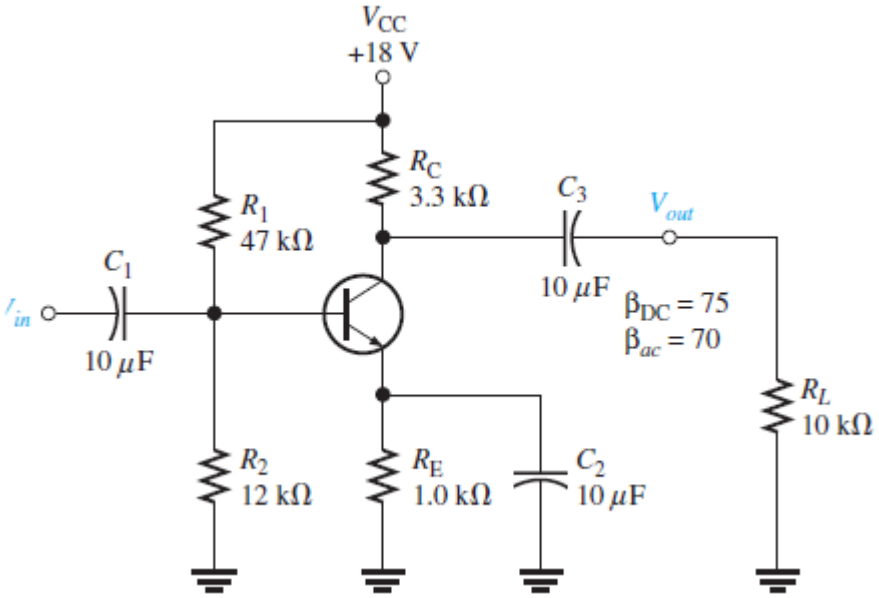
Q10



Assume that a 600 Ω, 12 μV rms voltage source is driving the amplifier in Figure
Determine the overall voltage gain by taking into account the attenuation in the base circuit, and find the *total* output voltage (ac and dc). What is the phase relationship of the collector signal voltage to the base signal voltage?

Sol 10

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$A'_v = 131; \theta = 180°$ .....

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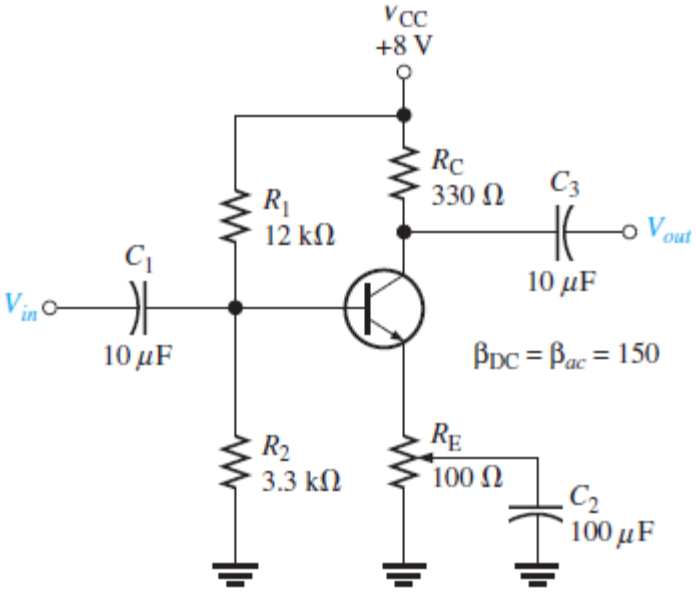
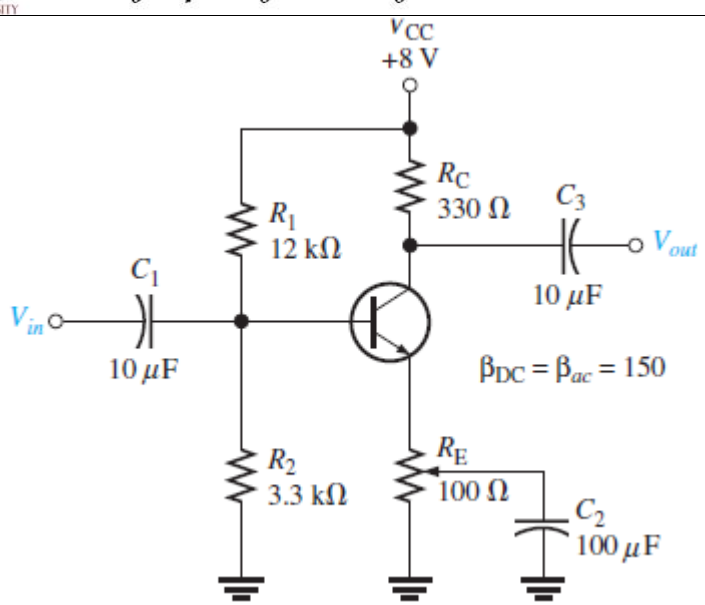
Q11	The amplifier in Figure has a variable gain control, using a 100 Ω potentiometer for R_E with the wiper ac-grounded. As the potentiometer is adjusted, more or less of R_E is bypassed to ground, thus varying the gain. The total R_E remains constant to dc, keeping the bias fixed. Determine the maximum and minimum gains for this unloaded amplifier. 
Sol 11	…… …… …… …… …… …… …… …… …… …… …… …… …… …… ……

Q 12

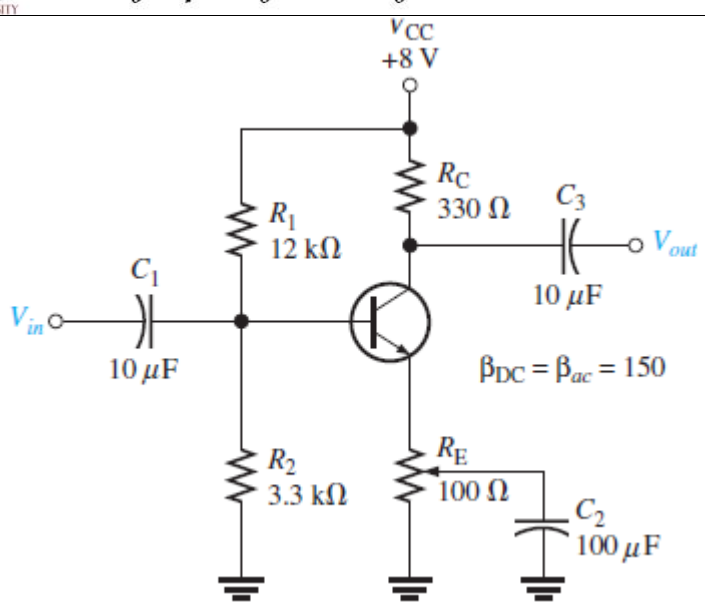


If a load resistance of 600 Ω is placed on the output of the amplifier in Figure , what are the maximum and minimum gains?

Sol 12

$A_{v(max)} = 74.7, A_{v(min)} = 2.07$

Q 13



Find the overall maximum voltage gain for the amplifier in Figure with a 1.0 kΩ load if it is being driven by a 300 kΩ source.

Sol 13

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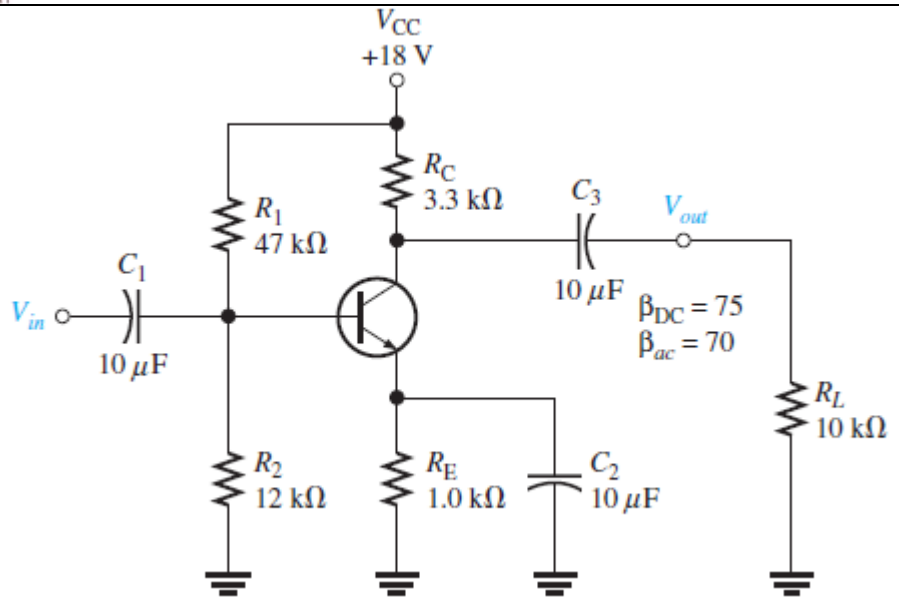
Q 14



Modify the schematic to show how you would "swamp out" the temperature effects of r'_e in Figure by making R_e at least ten times larger than r'_e. Keep the same total R_E. How does this affect the voltage gain?

Sol 14