

Elect 1151 HyBot Take Home Quiz

- ◇ Problem 2-40, Parts a, b, c and d
- ◇ Problem 3-36, Parts a, b, c, d and e
Also, show the waveforms at points 1, 2 and 3
- ◇ Problem 4-56
- ◇ Problem 4-58
- ◇ Problem 5-50
- ◇ Problem 5-52
- ◇ Problem 6-18
- ◇ Problem 6-34
- ◇ Problem 6-54

* Show all work!

This will be due April ~~6th~~^{9th} by end of day.

Determine the peak forward current through each diode in **Figure 2-104**.

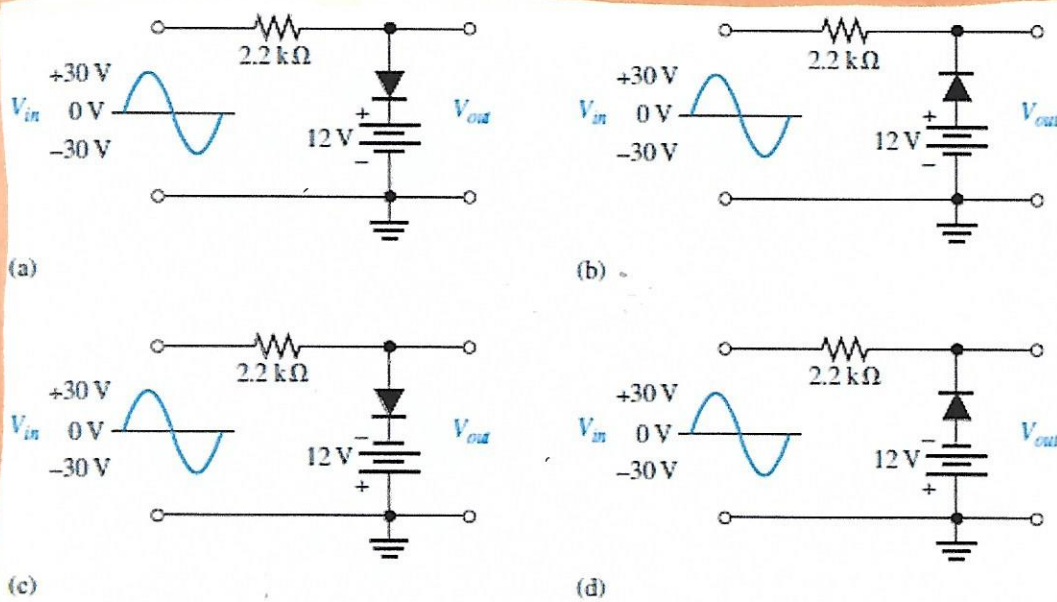


Figure 2-104

4) Determine the output voltage waveform for each circuit in **Figure 2-104**.

Describe the output waveform of each circuit in **Figure 2-105**. Assume the RC time constant is much greater than the period of the input.

36. For each set of measured voltages at the points (1, 2, and 3) indicated in **Figure 3-83**, determine if they are correct and if not, identify the most likely fault(s). State what you would do to correct the problem once it is isolated. The zener is rated at 12 V.

- $V_1 = 120 \text{ V rms}$, $V_2 = 30 \text{ V dc}$, $V_3 = 12 \text{ V dc}$
- $V_1 = 120 \text{ V rms}$, $V_2 = 30 \text{ V dc}$, $V_3 = 30 \text{ V dc}$
- $V_1 = 0 \text{ V}$, $V_2 = 0 \text{ V}$, $V_3 = 0 \text{ V}$
- $V_1 = 120 \text{ V rms}$, $V_2 = 30 \text{ V peak full-wave } 120 \text{ Hz}$, $V_3 = 12 \text{ V, } 120 \text{ Hz pulsating voltage}$
- $V_1 = 120 \text{ V rms}$, $V_2 = 9 \text{ V}$, $V_3 = 0 \text{ V}$

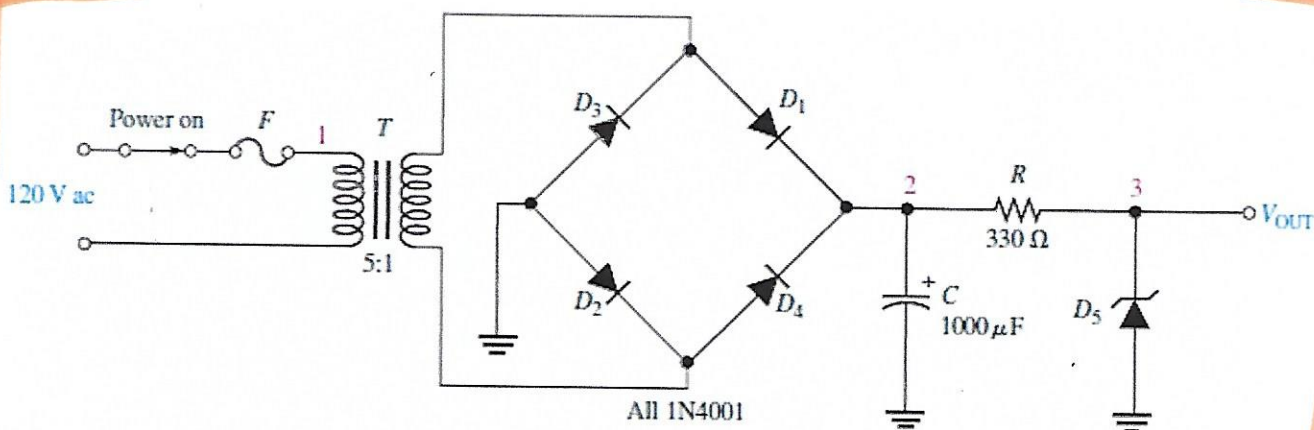


Figure 3-83

37. What is the output voltage in **Figure 3-83** for each of the following faults?

- D_5 open
- R open
- C leaky
- C open
- D_3 open
- D_2 open
- T open
- F open

4-56, 4-58

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For each of the circuits in **Figure 4-70**, determine if there is a problem based on the datasheet information in **Figure 4-69**. Use the maximum specified h_{FE} .

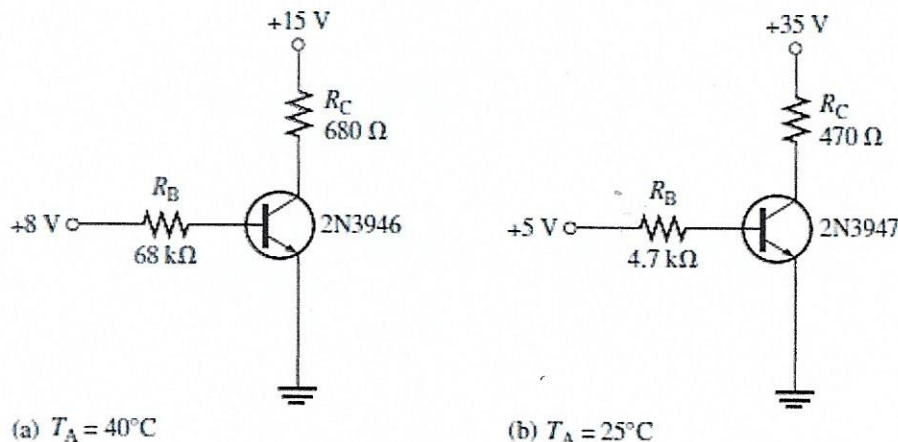


Figure 4-70

Advanced Problems

54. Derive a formula for α_{DC} in terms of β_{DC} .
55. A certain 2N3904 dc bias circuit with the following values is in saturation. $I_B = 500 \mu A$, $V_{CC} = 10 V$, and $R_C = 180 \Omega$, $h_{FE} = 150$. If you increase V_{CC} to 15 V, does the transistor come out of saturation? If so, what is the collector-to-emitter voltage and the collector current?
56. Design a dc bias circuit for a 2N3904 operating from a collector supply voltage of 9 V and a base-bias voltage of 3 V that will supply 150 mA to a resistive load that acts as the collector resistor. The circuit must not be in saturation. Assume the minimum specified β_{DC} from the datasheet. *100n BDC 100*
57. Modify the design in **Problem 56** to use a single 9 V dc source rather than two different sources. Other requirements remain the same.
58. Design a dc bias circuit for an amplifier in which the voltage gain is to be a minimum of 50 and the output signal voltage is to be "riding" on a dc level of 5 V. The maximum input signal voltage at the base is 10 mV rms. $V_{CC} = 12 V$, and $V_{BB} = 4 V$. Assume $r'_e = 8 \Omega$.

5-50, 5-52

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Advanced Problems

49. Design a circuit using base bias that operates from a 15 V dc voltage and draws a maximum current from the dc source ($I_{CC(max)}$) of 10 mA. The Q-point values are to be $I_C = 5$ mA and $V_{CE} = 5$ V. The transistor is a 2N3904. Assume a midpoint value for β_{DC} .
50. Design a circuit using emitter bias that operates from dc voltages of +12 V and -12 V. The maximum I_{CC} is to be 20 mA and the Q-point is at 10 mA and 4 V. The transistor is a 2N3904.
51. Design a circuit using voltage-divider bias for the following specifications: $V_{CC} = 9$ V, $I_{CC(max)} = 5$ mA, $I_C = 1.5$ mA, and $V_{CE} = 3$ V. The transistor is a 2N3904.
52. Design a collector-feedback circuit using a 2N2222A with $V_{CC} = 5$ V, $I_C = 10$ mA, and $V_{CE} = 1.5$ V.
53. Can you replace the 2N3904 in **Figure 5-47** with a 2N2222A and maintain the same range of output voltage over a temperature range from 45°C to 55°C?
54. Refer to the datasheet graph in **Figure 5-50** and the partial datasheet in **Figure 5-49**. Determine the minimum dc current gain for a 2N2222A at -55°C, 25°C, and 175°C for $V_{CE} = 1$ V.

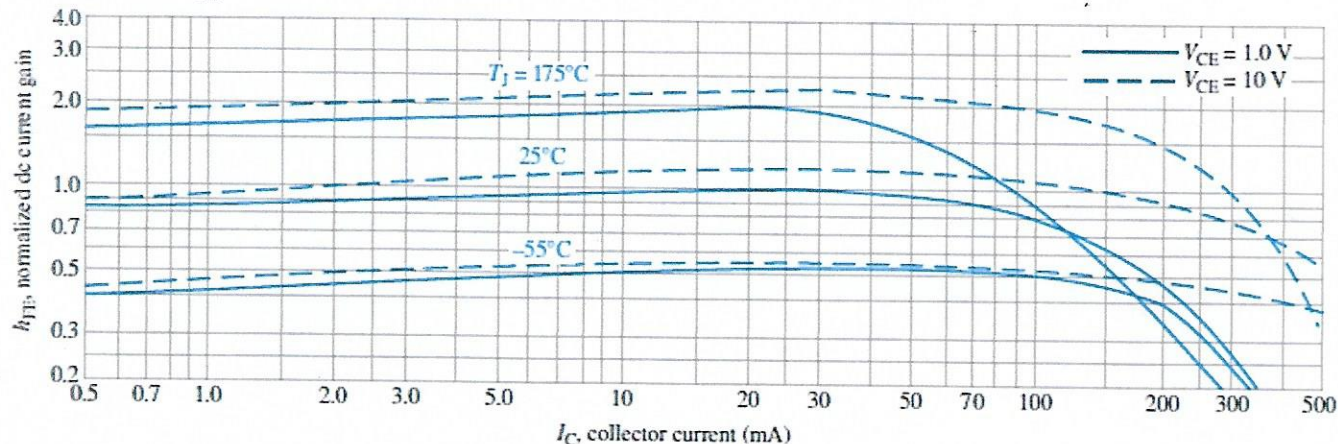


Figure 5-50

55. A design change is required in the valve interface circuit of the temperature-control system shown in **Figure 5-28**. The new design will have a valve interface input resistance of 10 k Ω . Determine the effect this change has on the temperature-to-voltage conversion circuit.
56. Investigate the feasibility of redesigning the temperature-to-voltage conversion circuit in **Figure 5-29** to operate from a dc supply voltage of 5.1 V and produce the same

6-18

- c. V_B
- d. I_C
- e. V_C
- f. V_{CE}

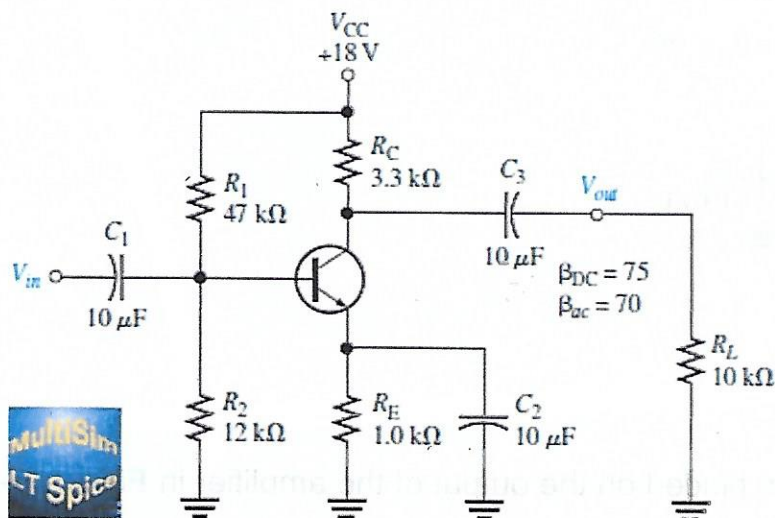


Figure 6-53

16. Determine the following ac values for the amplifier in **Figure 6-53**

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

17. Assume that a $600\ \Omega$ $12\ \mu V_{rms}$ voltage source is driving the amplifier in **Figure 6-53**. 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?

18. The amplifier in **Figure 6-54** has a variable gain control, using a $100\ \Omega$ 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.

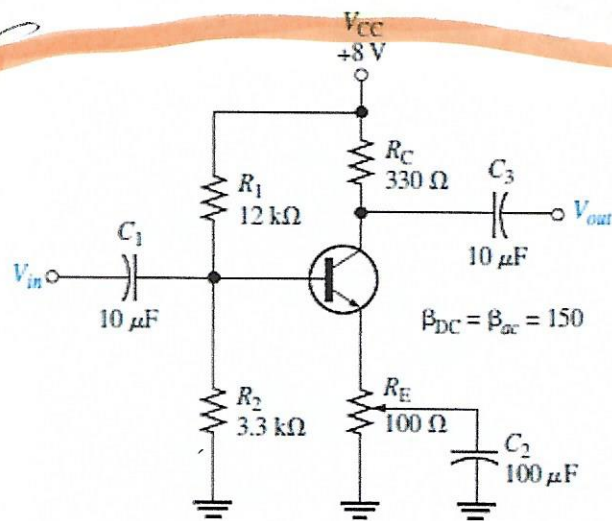


Figure 6-54

19. If a load resistance of $600\ \Omega$ is placed on the output of the amplifier in **Figure 6-54**, what are the maximum and minimum gains?

31. Each of two cascaded amplifier stages has an $A_v = 20$. What is the overall gain?
32. Each of three cascaded amplifier stages has a dB voltage gain of 10 dB. What is the overall voltage gain in dB? What is the actual overall voltage gain?
33. For the two-stage, capacitively coupled amplifier in **Figure 6-58**, find the following values:

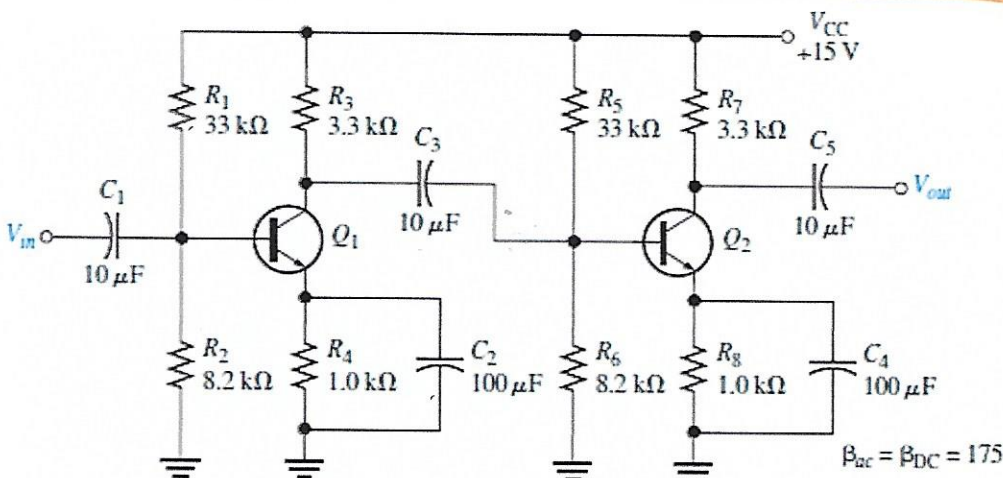


Figure 6-58

- voltage gain of each stage
 - overall voltage gain
 - Express the gains found in (a) and (b) in dB.
34. If the multistage amplifier in **Figure 6-58** is driven by a $75\ \Omega$, $50\ \mu\text{V}$ source and the second stage is loaded with an $R_L = 18\ \text{k}\Omega$, determine
- voltage gain of each stage
 - overall voltage gain
 - Express the gains found in (a) and (b) in dB.

Advanced Problems

53. In an amplifier such as the one in **Figure 6-63**, explain the general effect that a leaky coupling capacitor would have on circuit performance.
54. Draw the dc and ac equivalent circuits for the amplifier in **Figure 6-63**.
55. Modify the two-stage amplifier in **Figure 6-63** to drive a load of $10\text{ k}\Omega$ and maintain the same voltage gain.
56. Design a single-stage common-emitter amplifier with a voltage gain of 40 dB that operates from a dc supply voltage of $+12\text{ V}$. Use a 2N2222 transistor, voltage-divider bias, and a $330\text{ }\Omega$ swamping resistor. The maximum input signal is 25 mV rms.
57. Design an emitter-follower with a minimum input resistance of $50\text{ k}\Omega$ using a 2N3904 *npn* transistor with a $\beta_{ac} = 100$.
58. Repeat **Problem 57** using a 2N3906 with a $\beta_{ac} = 100$.
59. Design a single-stage common-base amplifier for a voltage gain of 75. Use a 2N3904 with emitter bias. The dc supply voltages are to be $\pm 6\text{ V}$.
60. Refer to the amplifier in **Figure 6-63** and determine the minimum value of coupling capacitors necessary for the amplifier to produce the same output voltage at 100 Hz that it does at 5000 Hz.
61. Prove that for any unloaded common-emitter amplifier with a collector resistor R_C and R_E bypassed, the voltage gain is $A_v \cong 40 V_{R_C}$.



Multisim Troubleshooting Problems

These file circuits are in the Troubleshooting Problems folder on the website.

62. Open file TPM06-62 and determine the fault.
63. Open file TPM06-63 and determine the fault.
64. Open file TPM06-64 and determine the fault.
65. Open file TPM06-65 and determine the fault.
66. Open file TPM06-66 and determine the fault.
67. Open file TPM06-67 and determine the fault.

46. Refer to the public address system block diagram in **Figure 6-47**. You are asked to repair a system that is not working. After a preliminary check, you find that there is no output signal from the power amplifier or from the preamplifier. Based on this check and assuming that only one of the blocks is faulty, which block can you eliminate as the faulty one? What would you check next?
47. What effect would each of the following faults in the amplifier of **Figure 6-63** have on the output signal?

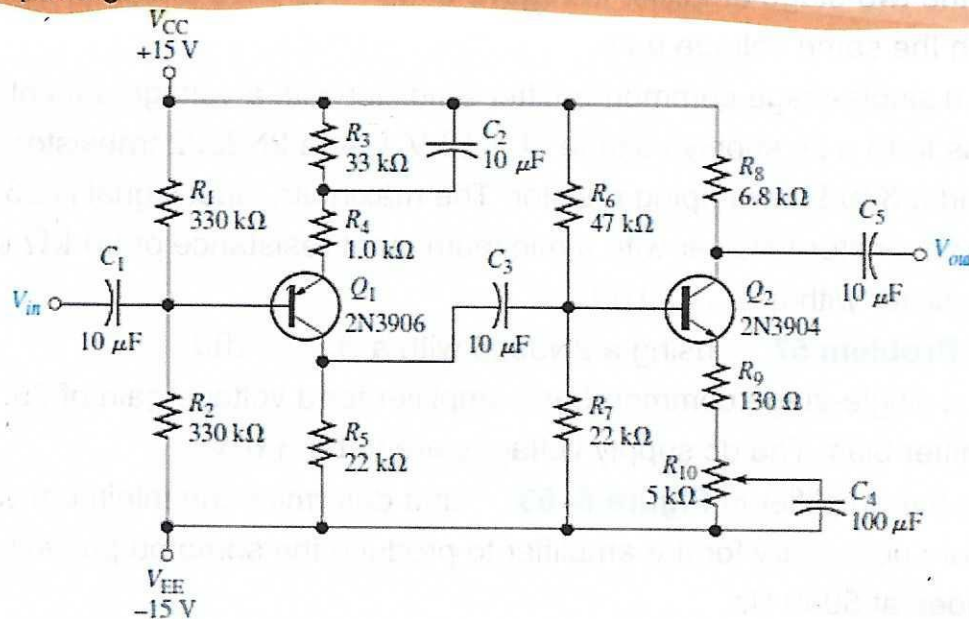


Figure 6-63

- Open C_1
 - Open C_2
 - Open C_3
 - Open C_4
 - Q_1 collector internally open
 - Q_2 emitter shorted to ground
48. Suppose a $220\ \Omega$ resistor is incorrectly installed in the R_7 position of the amplifier in **Figure 6-63**. What effect does this have on the circuit?
49. The connection from R_1 to the supply voltage V_1 in **Figure 6-63** has opened.
- What happens to Q_1 ?
 - What is the dc voltage at the Q_1 collector?
 - What is the dc voltage at the Q_2 collector?