CHAPITRE 12 - AMPLIS DE PUISSANCE

PROBLEMS

**Note:* Asterisks indicate more difficult problems.

12.2 Series-Fed Class A Amplifier

1. Calculate the input and output power for the circuit of Fig. 12.35. The input signal results in a base current of 5 mA rms.

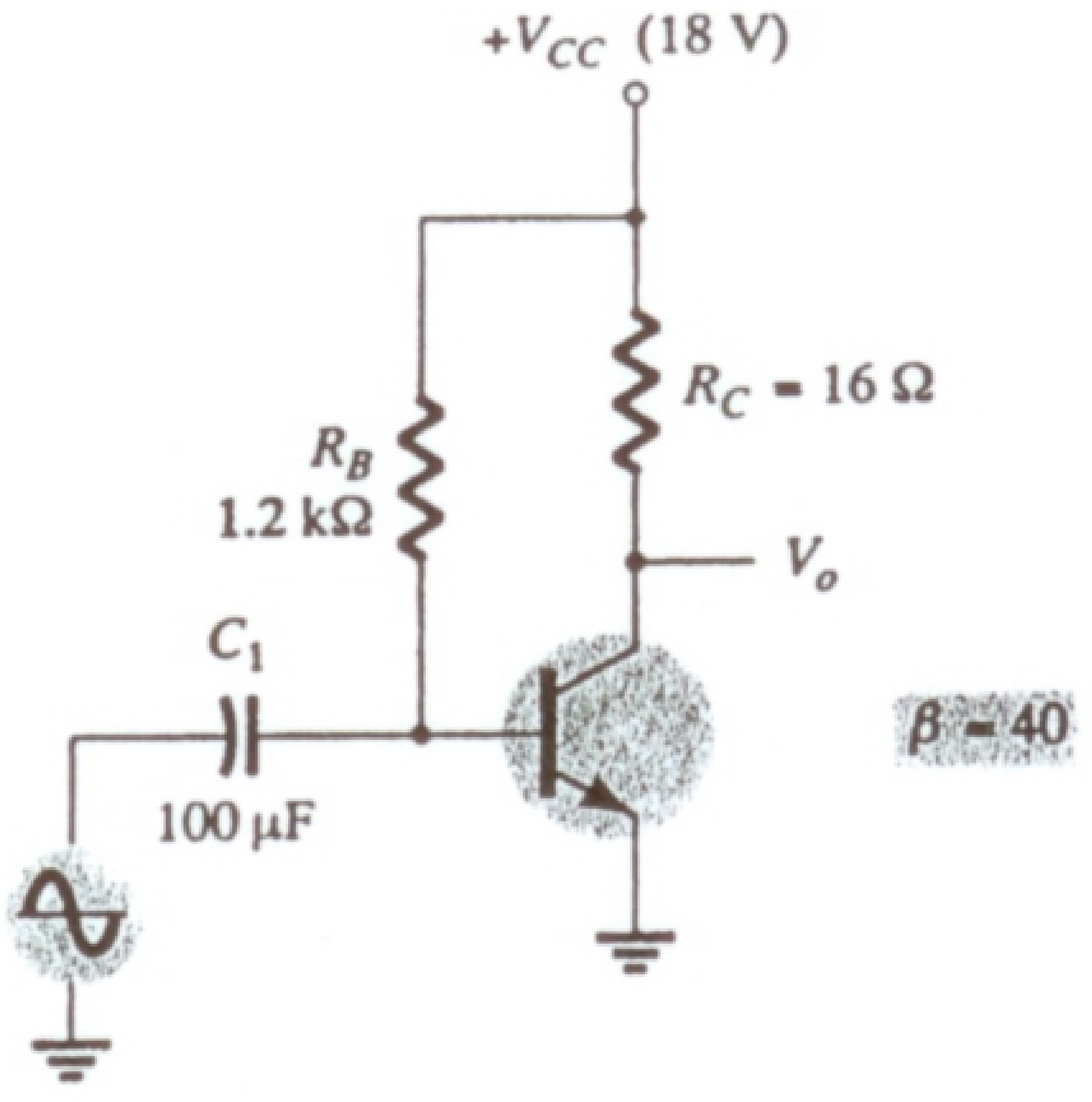

FIG. 12.35
Problems 1 to 4 and 26.

2. Calculate the input power dissipated by the circuit of Fig. 12.35 if R_B is changed to 1.5 kΩ.
3. What maximum output power can be delivered by the circuit of Fig. 12.35 if R_B is changed to 1.5 kΩ?
4. If the circuit of Fig. 12.35 is biased at its center voltage and center collector operating point, what is the input power for a maximum output power of 1.5 W?

12.3 Transformer-Coupled Class A Amplifier

5. A class A transformer-coupled amplifier uses a 25:1 transformer to drive a 4-Ω load. Calculate the effective ac load (seen by the transistor connected to the larger turns side of the transformer).
6. What turns ratio transformer is needed to couple to an 8-Ω load so that it appears as an 8-kΩ effective load?
7. Calculate the transformer turns ratio required to connect four parallel 16-Ω speakers so that they appear as an 8-kΩ effective load.

*8. A transformer-coupled class A amplifier drives a 16-Ω speaker through a 3.87:1 transformer. Using a power supply of $V_{CC} = 36$ V, the circuit delivers 2 W to the load. Calculate:
   a. $P(\text{ac})$ across transformer primary.
   b. $V_L(\text{ac})$.
   c. $V(\text{ac})$ at transformer primary.
   d. The rms values of load and primary current.

9. Calculate the efficiency of the circuit of Problem 8 if the bias current is $I_{C_Q} = 150$ mA.
10. Draw the circuit diagram of a class A transformer-coupled amplifier using an *npn* transistor.

12.4 Class B Amplifier Operation

11. Draw the circuit diagram of a class B *npn* push–pull power amplifier using transformer-coupled input.
12. For a class B amplifier providing a 22-V peak signal to an 8-Ω load and a power supply of $V_{CC} = 25$ V, determine:
    a. Input power.
    b. Output power.
    c. Circuit efficiency.
13. For a class B amplifier with $V_{CC} = 25$ V driving an 8-Ω load, determine:
    a. Maximum input power.
    b. Maximum output power.
    c. Maximum circuit efficiency.

*14. Calculate the efficiency of a class B amplifier for a supply voltage of $V_{CC} = 22$ V driving a 4-Ω load with peak output voltages of:
a. $V_L(\text{p}) = 20$ V.
b. $V_L(\text{p}) = 4$ V.

12.5 Class B Amplifier Circuits

15. Sketch the circuit diagram of a quasi-complementary amplifier, showing voltage waveforms in the circuit.

16. For the class B power amplifier of Fig. 12.36, calculate:
a. Maximum $P_o(\text{ac})$.
b. Maximum $P_i(\text{dc})$.
c. Maximum $\%\eta$.
d. Maximum power dissipated by both transistors.

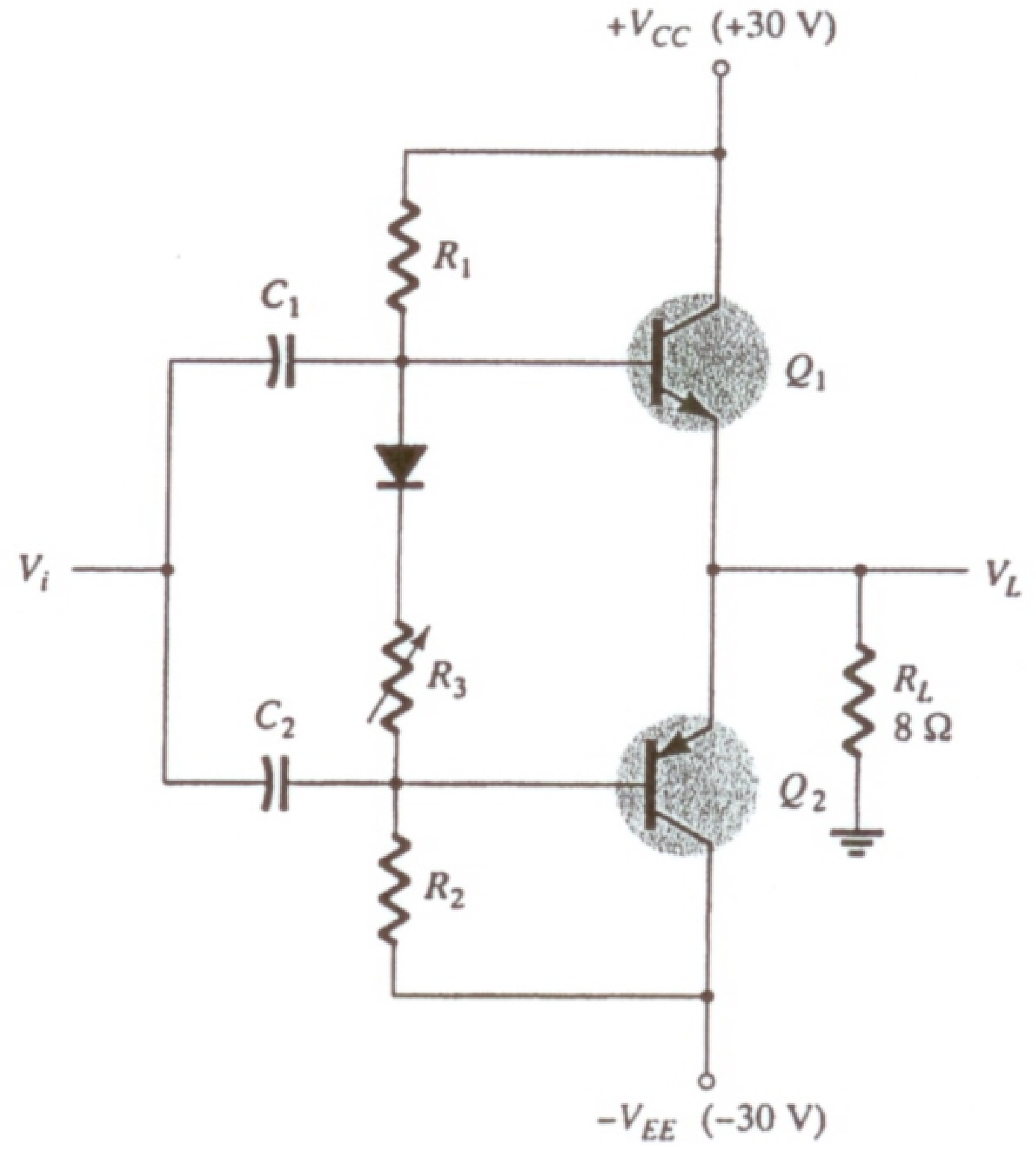

FIG. 12.36
Problems 16, 17, and 27.

*17. If the input voltage to the power amplifier of Fig. 12.36 is 8-V rms, calculate:
a. $P_i(\text{dc})$.
b. $P_o(\text{ac})$.
c. $\%\eta$.
d. Power dissipated by both power output transistors.

*18. For the power amplifier of Fig. 12.37, calculate:
a. $P_o(\text{ac})$.
b. $P_i(\text{dc})$.
c. $\%\eta$.
d. Power dissipated by both output transistors.

12.6 Amplifier Distortion

19. Calculate the harmonic distortion components for an output signal having fundamental amplitude of 2.1 V, second harmonic amplitude of 0.3 V, third harmonic component of 0.1 V, and fourth harmonic component of 0.05 V.

20. Calculate the total harmonic distortion for the amplitude components of Problem 19.

21. Calculate the second harmonic distortion for an output waveform having measured values of $V_{CE_{\text{min}}} = 2.4$ V, $V_{CE_Q} = 10$ V, and $V_{CE_{\text{max}}} = 20$ V.

22. For distortion readings of $D_2 = 0.15$, $D_3 = 0.01$, and $D_4 = 0.05$, with $I_1 = 3.3$ A and $R_C = 4\ \Omega$, calculate the total harmonic distortion fundamental power component and total power.

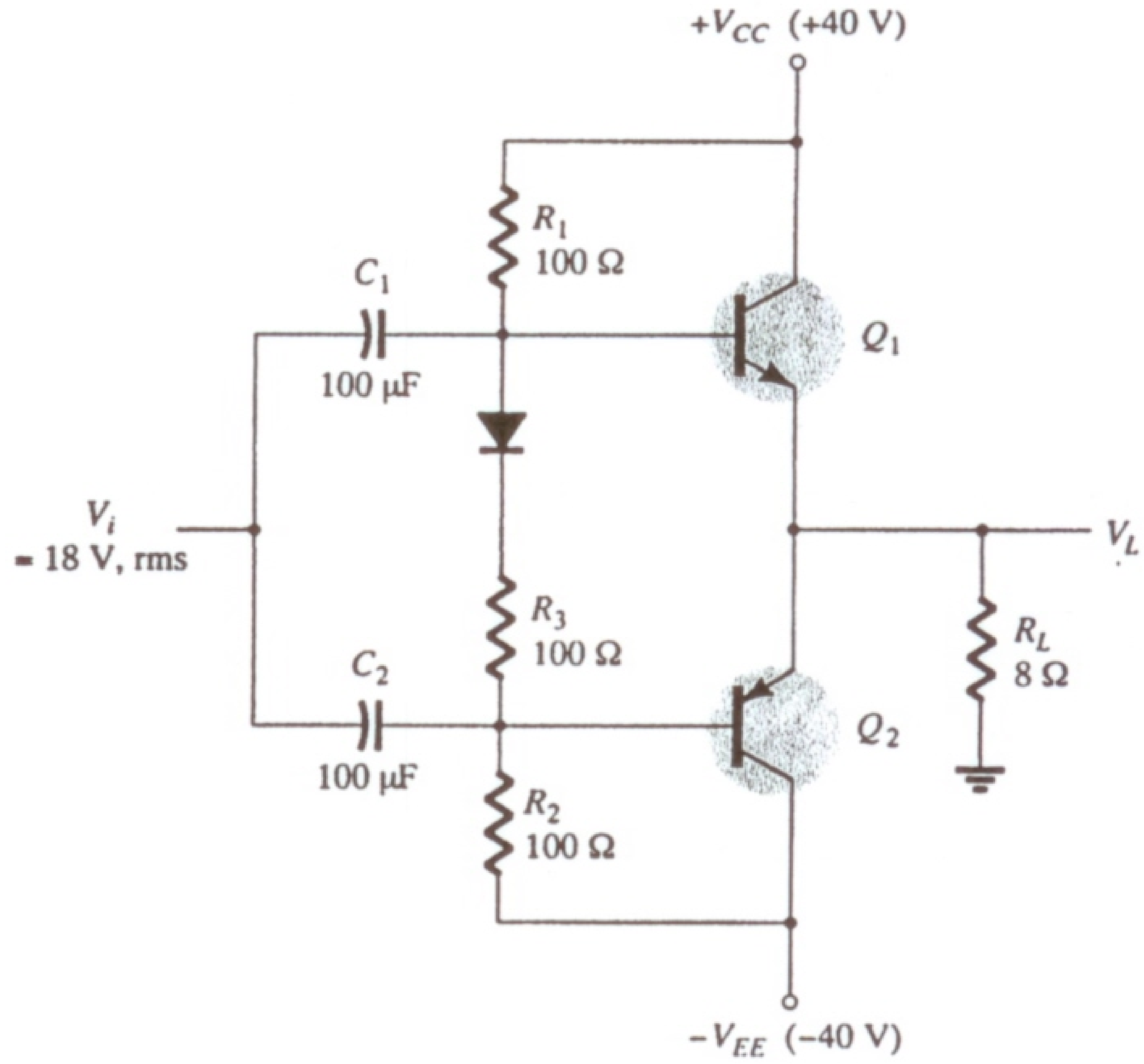

FIG. 12.37
Problem 18.

12.7 Power Transistor Heat Sinking

23. Determine the maximum dissipation allowed for a 100-W silicon transistor (rated at 25°C) for a derating factor of 0.6 W/°C at a case temperature of 150°C.

*24. A 160-W silicon power transistor operated with a heat sink (θ_{SA} = 1.5°C/W) has θ_{JC} = 0.5°C/W and a mounting insulation of θ_{CS} = 0.8°C/W. What maximum power can be handled by the transistor at an ambient temperature of 80°C? (The junction temperature should not exceed 200°C.)

25. What maximum power can a silicon transistor ($T_{J_{max}}$ = 200°C) dissipate into free air at an ambient temperature of 80°C?

12.9 Computer Applications

*26. Use Design Center to draw the schematic of Fig. 12.35 with V_i = 9.1 mV.

*27. Use Design Center to draw the schematic of Fig. 12.36 with V_i = 25 V(p). Determine the circuit efficiency.

*28. Use Multisim to draw the schematic of an op-amp class B amplifier as in Fig. 12.33. Use R_1 = 10 kΩ, R_F = 50 kΩ, and V_i = 2.5 V(p). Determine the circuit efficiency.