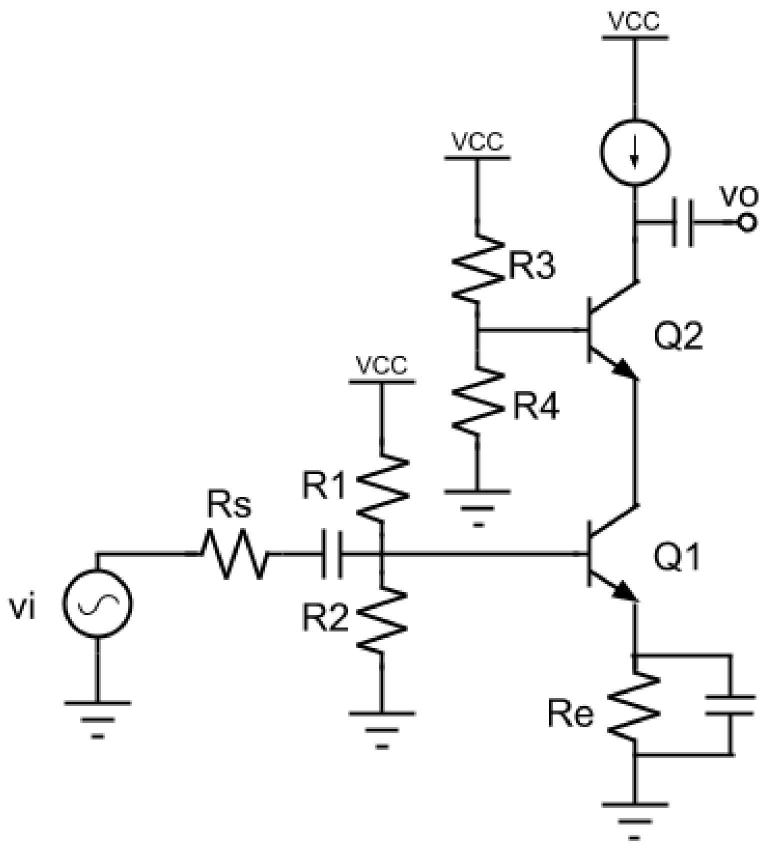

Figure 1: A sample design for a cascode amplifier.

1 Warm-Up Problems Due Week 1

1. Find the r_{out} of an emitter degenerated common emitter amplifier if r_o is included in the calculations. Assume it is biased by a resistor divider. (Optional: If you're feeling bold or want extra practice, also find r_{in} and a_v.)
2. Find the output voltage swing of an emitter follower which is biased with a large signal voltage source on its base in series with the signal source (the "impractical" biasing we often use in lecture). The base bias voltage is V_B, the BJT has a saturation voltage of $V_{CE,SAT}$, and the power supply is V_{CC}. Report V_{OMIN} and V_{OMAX} as part of your answer.

2 Warm-Up Problems Due Week 2

1. Find r_{in}, r_{out} and a_v of the amplifier pictured in Figure 1.
2. Add one capacitor to the amplifier in Figure 1 to improve its performance.

3 Design Project Introduction

The learning goals for this project are:

- Master the use of common single stage amplifiers and multistage loading calculations
- Apply all of the techniques that we have studied up to this point to a single design
- Experience trading off parameters in a large analog system

4 Design Project 1

Design an amplifier over the next 1.5 weeks which meets the following specifications

- $r_{in} > 20\text{k}\Omega$
- $r_{out} < 50\Omega$
- $a_v = 1000 \pm 5\%$
- $V_{SW} > 5$V.
- $THD < 5\%$ when $V_{sw} = 5$V.
- $f_{low} < 2$kHz
- Use only one 10 V power supply. (This constraint does not apply to your attenuator.)
- Input signal source has a source impedance of 50 Ω and may not have any DC offset.
- Use four or fewer transistors, up to two 2N3906s and up to two 2N3904s.
- Optimize for minimum power consumption and minimum component count.

Design the amplifier on paper, simulate it, build it, and experimentally verify its performance. You may need to build an attenuator to make your input signal small enough that your output does not exceed your output swing because of the high gain of the amplifier. Figure 2 depicts an attenuator design that can easily achieve 60dB or more of attenuation. Applying Thevenin analysis makes it much easier to design your attenuator.

Required Data: Calculated, simulated and measured gain, input resistance, output resistance and power consumption of the amplifier. Designs for each stage including the collector current (comparing calculated, measured and simulated values). Traces showing the amplifier operating normally and at maximum swing. Discussion of testing of each specification. Discussion of design process. Discussion of discrepancies between measured, simulated and calculated results.

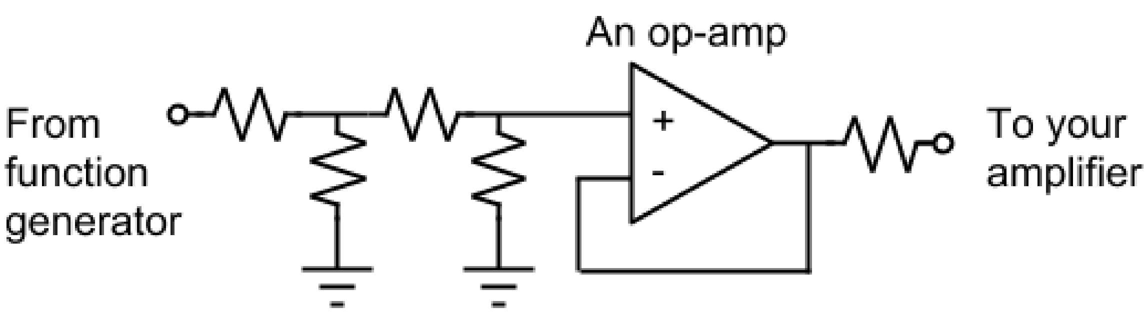

Figure 2: A sample design for an attenuator.