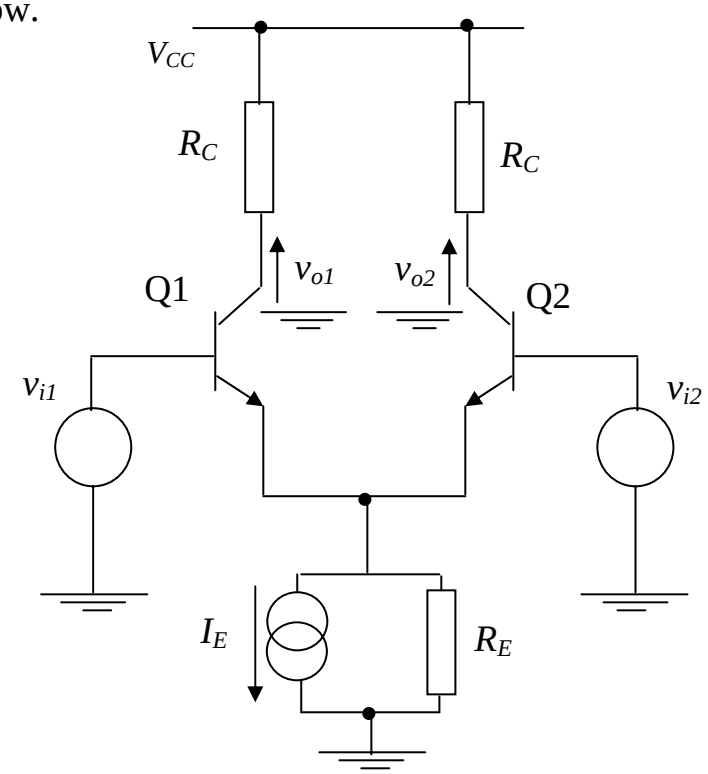
EEE 331 – Tutorial Sheet 2

Bookwork questions

1) State the current gain of the Darlington pair and cascode connection.

2) State two applications of a cascode circuit.

3) State how the input and output voltages are defined for the circuit below.

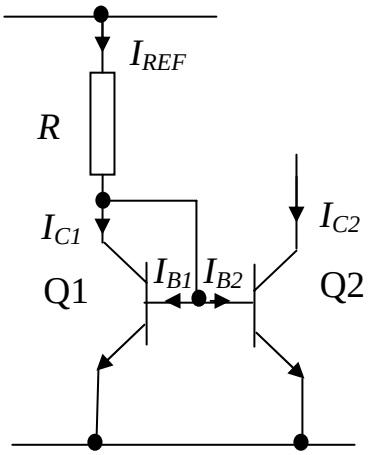


4) Draw the differential mode and common mode half circuits of a simple difference amplifier shown above, the associated gains and the CMRR.

5) Sketch the following circuits, and state one advantage each has over the standard current mirror topology.

- Emitter degenerated current source
- Wilson current source
- Wildar current source

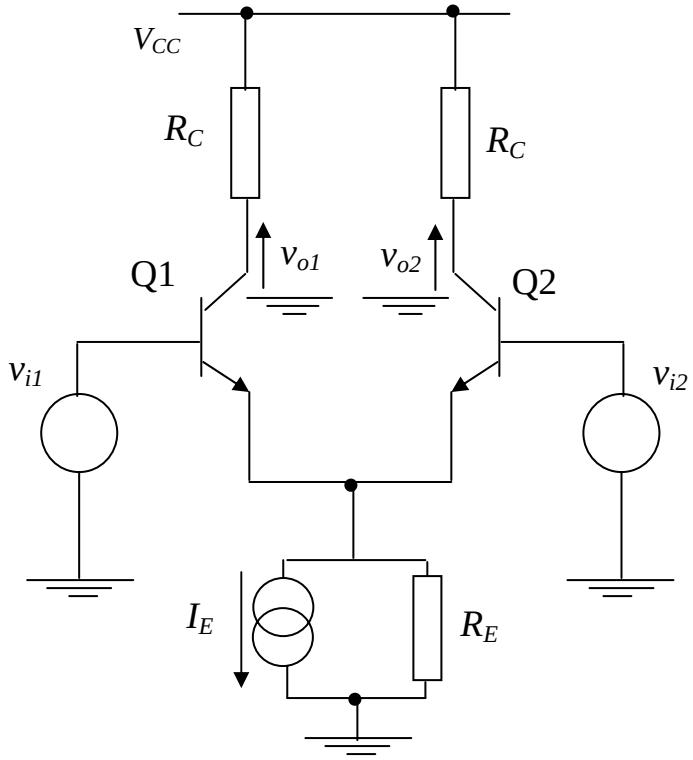
6) State the relationship between I_{C2} and I_{REF} for the circuit shown across.



7) What factors might we have to consider when designing an output stage?

Application questions

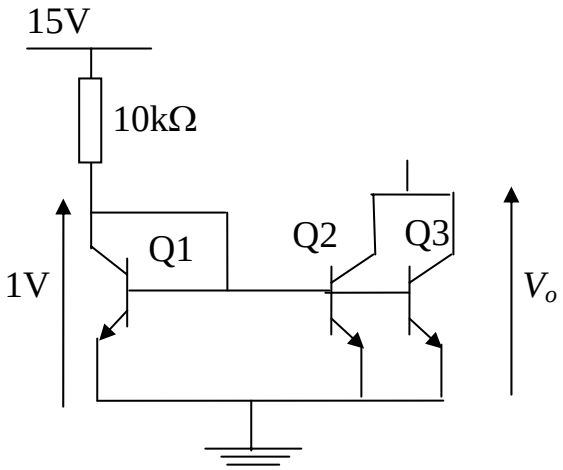
8) For the circuit below, determine the differential mode gain, common mode gain and CMRR assuming that I_E = 20μA, R_E = 10MΩ, R_c = 100kΩ, g_m = 1000, β=100 and V_{CC} = 10V. You may neglect r_{bb}, r_{ce} and r_{cb}.



9) Design a current source to provide 1mA from a 5V supply. You have available to you high β BJTs with $V_{CE\ ON}$ = 1V and V_A = 100V

and resistors. The required output impedance is 50kΩ and the output voltage swing must be at least 3.5V.

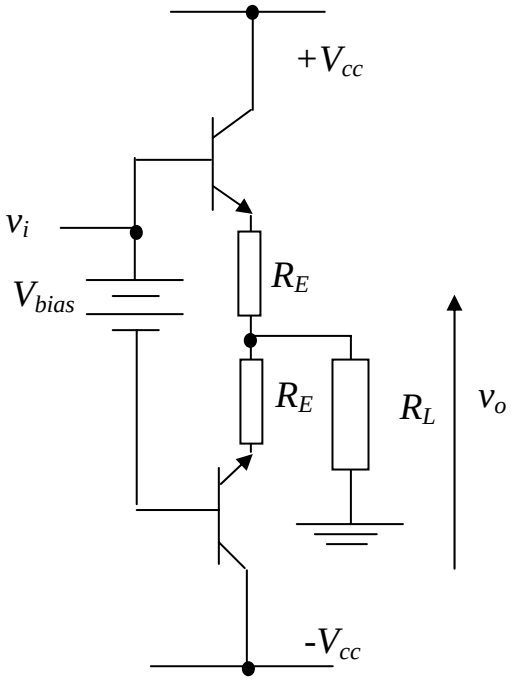
10) Using the same BJTs as in question 9, the following current source is constructed. What is the output impedance of this circuit? What will the output current be when V_o = 1V, 3V and 5V?



11) Determine the temperature of two power BJTs which are mounted on a 1°C/W heatsink, with the use of a epoxy resin of thermal resistance Q_{epoxy} = 1.8°C/W. Both BJTs are dissipating 4W of power and the ambient air temperature is 25°C.

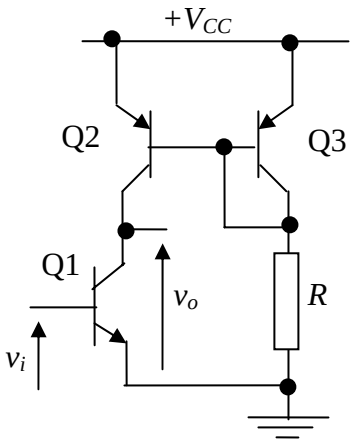
Difficult questions

12) For the circuit shown, define the range of V_{bias} which may be used for class A operation. Explain your answer.



13) Sketch the output characteristic and load line of the circuit below assuming identical transistors having V_A = 100V.

If the current mirror were replaced with a resistor, what value of resistance and what supply voltage would be required to give equivalent behaviour?



14) The circuit across below shows the top half of a push-pull output stage with short circuit protection. Given that the circuit has the minimum supply voltage required to dissipate 5W of sinusoidal drive into the load resistor and that $V_{ce\ on}$ = 1V, calculate an appropriate value of R_E to provide short circuit protection.