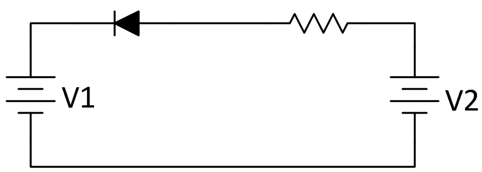
EE351 Test 1 Practice Problems

You have a number of decibel and amplifier problems in the homework. Those are excellent examples of test problems. Be sure you can work all of those in a reasonably short time each.

Diode problems

The only diode problems I give on the test concern being able to determine if a diode is forward or reverse biased and to calculate the diode current given the parameters, IS, n, T, and VD.



V1	V2	Diode
1	2	Forward
0	-1	Reverse
-5	-3	Forward
3	3.1	Forward (although current will be very tiny)
-3	0	Forward
-3	-4	Reverse
12	10	Reverse

Given Is = 10 nA, n=2.2, T=290K, VD=0.6, Find VT, ID, and rd
Answers: VT = 0.025 volts, ID = 544 uA, 101 ohms

Consider: Suppose on the test I turn the diode around. Suppose on the test I re-arrange the circuit or only use 1 voltage source. Do you know the anode from the cathode?

Transistor problems

Use the following circuits. Be able to tell a common-emitter from a common-collector.

Work the following design problems and use the spreadsheet, transistor_designer.xlsx to check your intermediate results and final answers. For analysis only, the spreadsheet, bjt_analyzer.xlsx is more convenient. Both are on the website under transistors.

For all cases use:
VBE@25C = 0.65, dVBE/C = -0.002,
Tmin = 5 C, Tmax = 60 C,
Bmin = 75, Bmax = 250,
KT = KB = 1.2
Other: Use VCBmin = 1, VCEsat = 0.2 as needed depending on the circuit
Use large signal design (Mode = 1 on the design spreadsheet)

Observe that the rounded answers are my rounding – in some cases you might choose a different rounding – that is normal – there are multiple good answers for each. Focus on understanding what you are doing rather than any rounding I have done in the answers.

Things to consider:

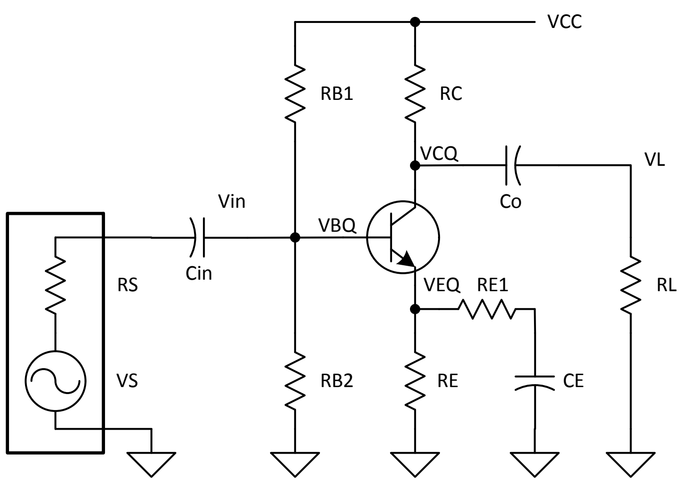
On a test instead of asking you to calculate AVL for a common-emitter amplifier I might give you an input voltage and ask you for the load voltage. You should know that you will need to multiply the input voltage including input voltage division by AVL to get the answer.

Suppose I tell you to design the bias circuit for a collector current I specify and do not tell you a collector resistor. Could you do that? Hint: it is the same thing as knowing VCC, VCQ, and RC.

Instead of asking you to calculate VEQoptimum I might just have you design for a particular VEQ I provide. For example, if I told you to calculate RB1 and RB2 for the 24V case and said to make VEQ be 12.0 volts, could you do that (RB1=68K, RB2=110K)? The design process is identical except that you don't calculate VEQopt (that makes no sense in this case) and just use the VEQ I provide.

Suppose for CE design I tell you what RE to use.

Common-emitter design/analysis



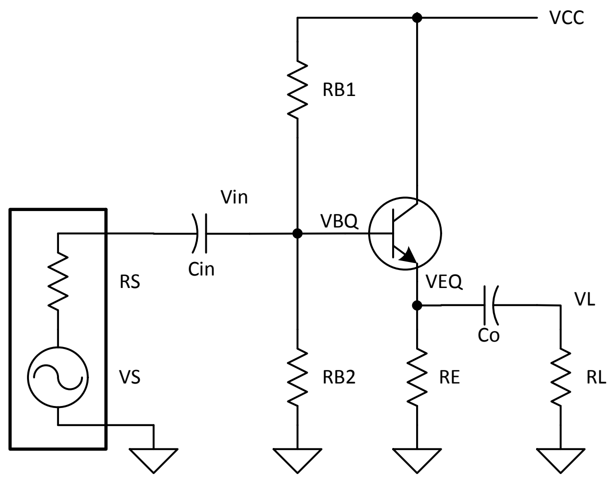
Common-emitter

In the spreadsheet do not worry that the VCQ I have you design to is not the recommended optimum. You are not required to know how to calculate the optimum. All you need to be able to do is calculate to a given condition that I provide – the process is not affected by whether that is the optimum or not.

Design spec.					Answers rounded to standard values			
VCC	**RL**	**RC**	**VCQ**	**AVL**	**RE**	**RB1**	**RB2**	**RE1**
24	5K	10.0K	8	150	330	150K	8.2K	6.2
18	7K	7.5K	7	120	360	120K	9.1K	12
15	6K	4.7K	6	100	270	75K	6.8K	13
12	5K	3.3K	5	100	240	51K	5.6K	7.5
9	2K	1.8K	4	80	180	30K	4.7K	2.4
6	2K	1.0K	3	50	180	20K	5.1K	4.7

Analyze each amplifier for Rin, AV, and AVL. The answers are in the spreadsheet.

Common-collector design/analysis



Common-collector

Do not calculate VBBmin – you will be using much higher in all cases. Do calculate (RB/RE)max and use that.

Design spec. – use VEQopt			Resistors rounded to standard values		
VCC	**RL**	**RE**	**VEQ opt.**	**RB1**	**RB2**
24	1000	1800	17.5	47K	330K
18	600	1000	13	24K	160K
15	400	390	10	11K	47K
12	300	330	8	9.1K	43K
9	200	180	5.8	5.1K	22K
6	100	150	3.5	3.0K	11K

Observe that in each case the optimum value of VEQ is in the general range of between about half and three-fourths of VCC. Thus VBB is much higher than used for CE design.

Analyze each amplifier for Rin and AVL. The answers are in the spreadsheet.