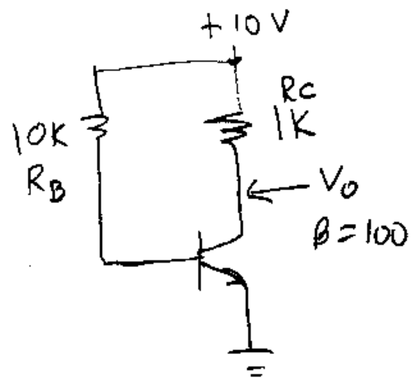
8A
1

HW	p.	#		p	#
Sec 3.2	125	11, 12, 13		154	19, 22,
	130	14, 15, 16, 17		155	25, 28
Sec 3.3	136	18, 19, 20, 21	(switch)		
		22	(logic)		

Basic Transistor Applications (3.3)

The Switch



What is V_o?

$$I_B = \frac{V_{RB}}{R_B} = \frac{9.4}{10K} = .94\,ma$$

If $\beta = 100$...

$$I_C = \beta I_B = 94\,ma\ ??$$

No - it is saturated - can't be more than $\frac{10V}{1k} = 10\,ma$

We use this as a <u>switch</u>.

Designing a switch -

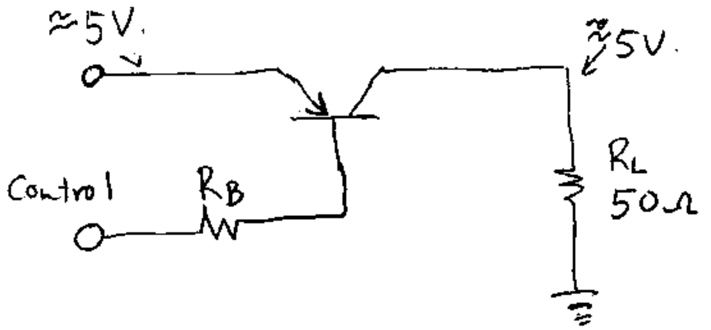
We need to supply power to a device requiring approx +5 volts at .1 Amps with one side grounded.

This is to be controlled by a logic device, with output level 0 volts for On, 5 volts for off, with maximum current of 1 ma.

The transistors have a minimum β of 50

Solution:

Use a PNP in series:



When on the voltage drop across the transistor is .2 Volts. Ignore it.

Base current required:

If load current is 100 ma,
You need at least 2 ma to turn it on.

⇒ To guarantee that, make the base current at least twice that.

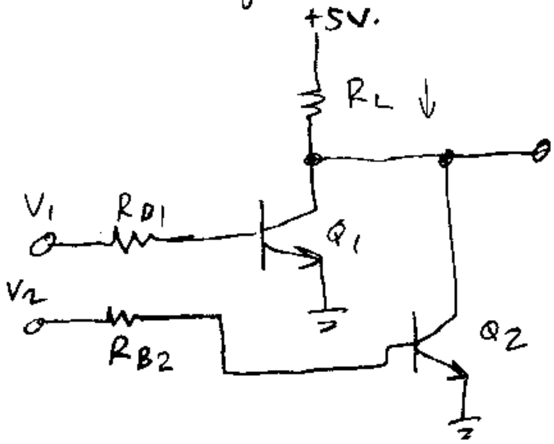
Make base current 4ma. (as if $\beta = 25$)

$$R_B = \frac{V_{RB}}{I_B} = \frac{5-.6}{4\text{ma}} = \frac{4.4\text{V.}}{4\text{ ma}} = 1.1\text{K}$$

Multiple switch circuits –

Digital logic –

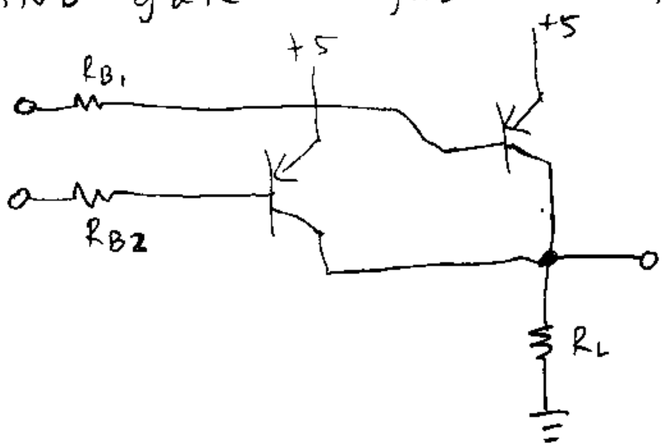
NOR gate – switches in parallel (NOT-OR)



Current flows in R_L if Q_1 or Q_2 is on.

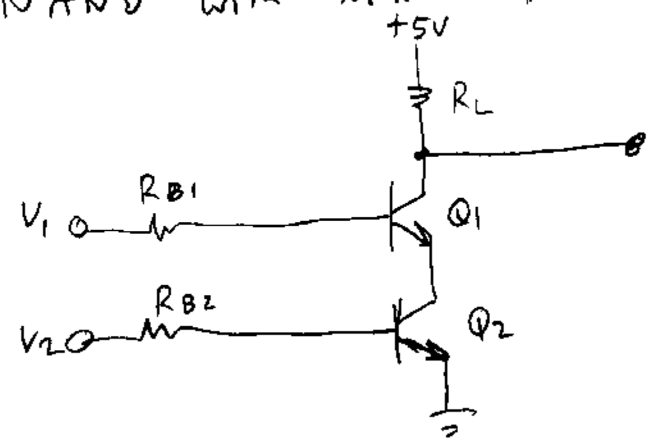
But if we look at the voltage, it is low if Q_1 or Q_2 is on. which is if V_1 or V_2 is high.

NAND gate – just use PNP. (NOT-AND)



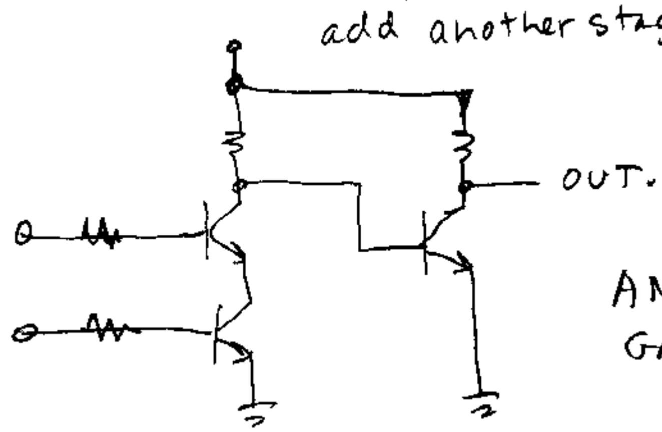
They usually don't do it this way

NAND with NPN – put them in series



These gates invert the signal.

If you need non-inverting add another stage



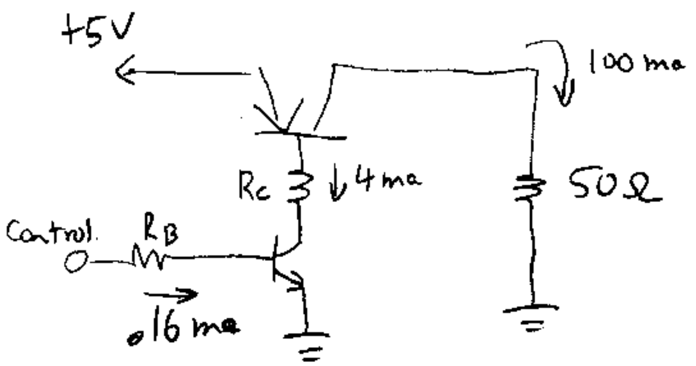
AND GATE

Extra ---

Back to the switch (p. 1 & 2)

What if we need the control to be + for on, ⊖ for off?

Just add an inverter to the control line.



The control current can be lower now –

$R_C = 1.1K$ (as before)

$$R_B = \frac{4.4V}{.16\ ma} = 27K$$