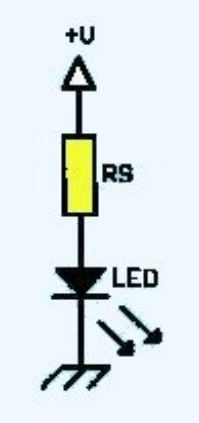
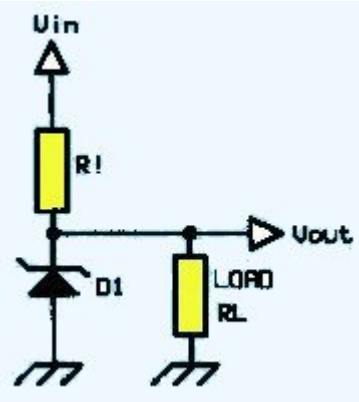
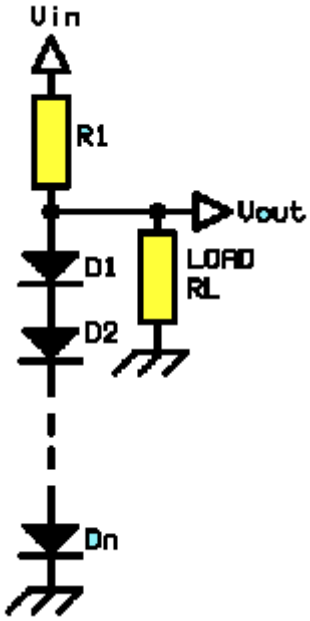
Working out those resistors.







LED POLARITY:

Easy Rule- the flat spot on the case marks the bar on the symbol - the end that goes to ground.

A series resistor, RS, is required to limit the current through the LED.

Most common LEDs operate at about 1.8v @ 20-30mA.

The simplest formula to work out the value of RS (for supply voltages above 3v) is :

RS = Supply Voltage
20mA

and use the nearest preferred resistor value above the figure obtained.

Common Supply Voltages work out as:

6v : 330 ohm	9v : 470 ohm	12v : 680 ohm

If you want a brighter LED use a smaller value - they really are quite rugged devices.

ZENER DIODES
Zener Diode Polarity: Easy Rule - The end of the diode with the band goes to the positive side.
The limiting resistor [R1] is worked out from:
R1 = [Vin - Vz] ÷ I where Vz = Zener Diode Voltage, I = Current through R1

(this should be the maximum planned current) The current is shared between D1 and R1 according to the load applied.

e.g. a 12v supply to give 9v at a maximum current of 50mA requires a 9v zener diode and R1 of 60 ohms.

ZENER DIODE POWER
The zener diode must have an appropriate power rating which can be calculated from:

$$Pz = Vz \times IL$$

where Vz = Zener Diode Voltage, IL = Max. Load Current

Advice: Be conservative! Use the maximum projected load current to calculate R1 and the safest power rating for the zener diode

The bottom circuit shows common silicon diodes used as zener diodes. Each diode can regulate in 0.6v steps. Regulated Voltage = Dn x 0.6v (Dn = number of diodes). Very useful for odd voltages or a "stepped" supply for nicad charging.