Diode circuits

Outline:

> 0 - simple transfer function
> 1 - Rectifier
> 2 - Zener diode
> 3 - Clipper + clamper
> 4 - Multiple diode
> 5 - Photo + LED

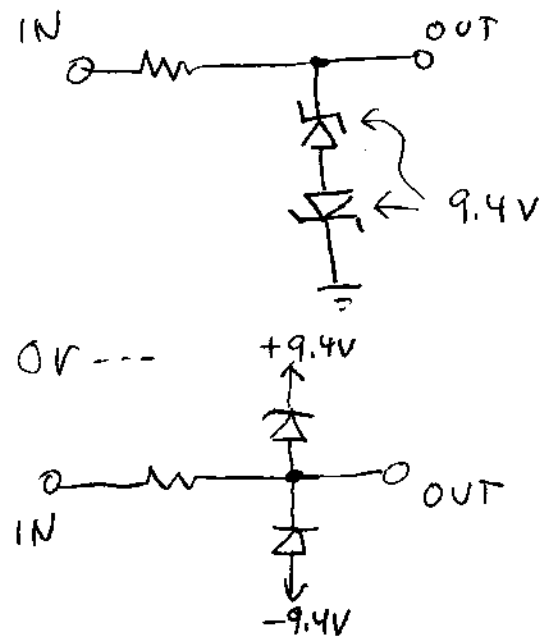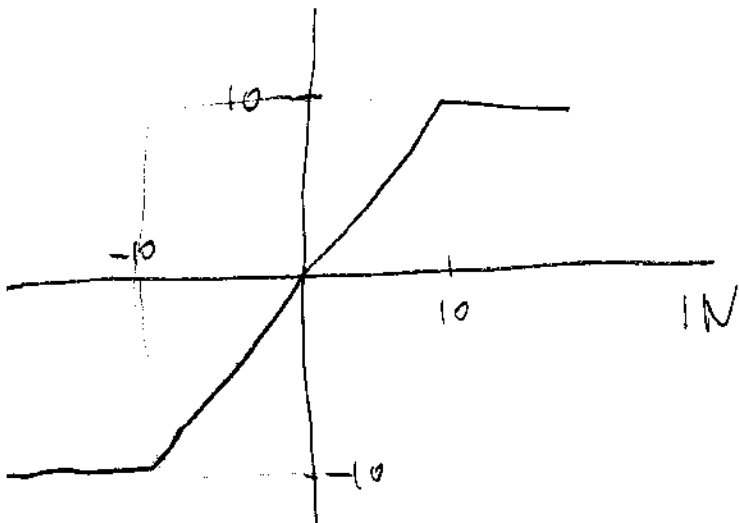## Diode circuits for simple transfer functions

We want: —

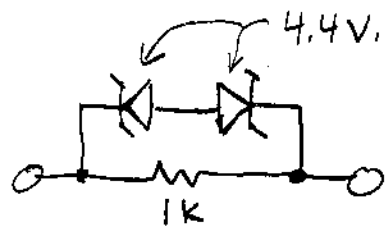A simple circuit with a nonlinear in-out characteristic.

Example: A clipper circuit —

Output is limited to $\pm$ 10 volts.

(Assume $V_\gamma = .6$)
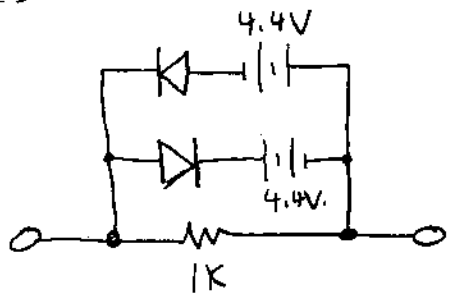
A   nonlinear resistor

I

+5ma

−5V

5V   V

−5ma
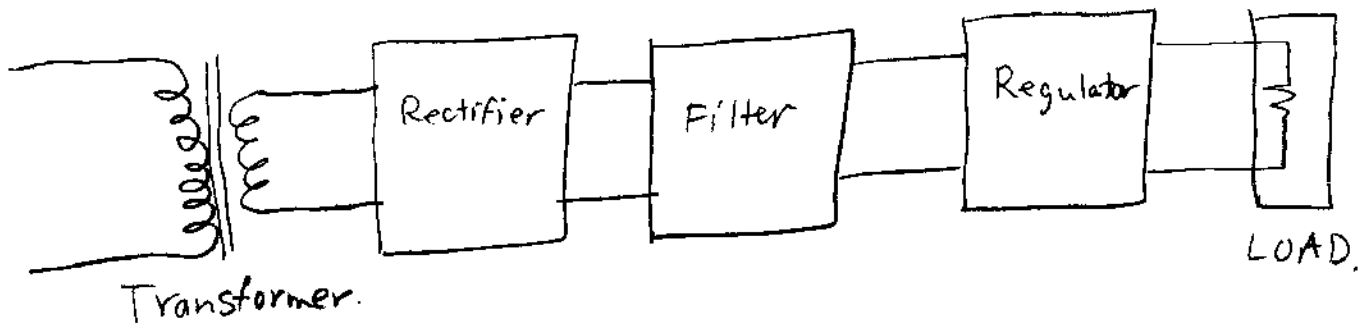
4.4V.

1k

or --

4.4V

4.4V.

1k

"Rectifier" circuits
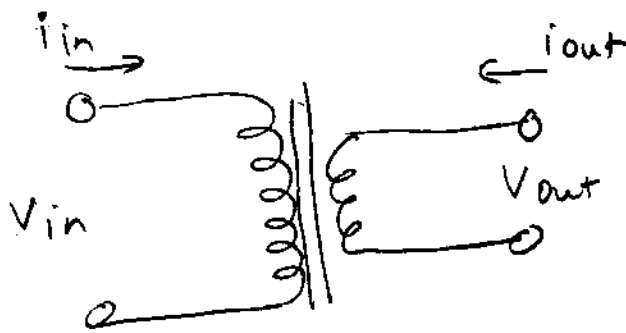
(Diodes in Power supplies)

Design requirement:

We need to supply D.C. power
at a particular voltage,
but we have only AC (60 Hz).

Idea:

Transformer.

A <u>transformer</u> converts one voltage (review)?
to another, determined by the
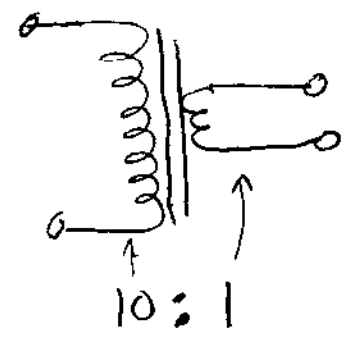<u>turns ratio</u>

$$\frac{V_{in}}{V_{out}} = \frac{\text{primary turns}}{\text{secondary turns}}$$

$$\frac{i_{in}}{i_{out}} = \frac{\text{secondary turns}}{\text{primary turns}}$$

Example: We need 12 volts
we have 120 volts.

$$\text{Turns ratio} = \frac{120}{12} = 10 \quad \left(\frac{primary}{secondary}\right)$$

$\underline{10:1}$ ↑

↳ usually specified
this way.

No standard on which
goes first!

(We didn't say exactly how many turns —
just the ratio.).

Current ratio — suppose the secondary current

is 1 Amp.

What is the primary current? ———
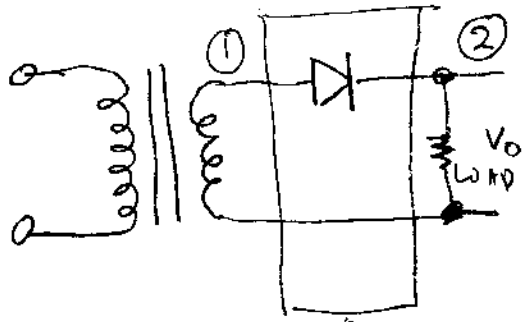
For 1 Amp, the resistance of the
load must be 12 ohms.

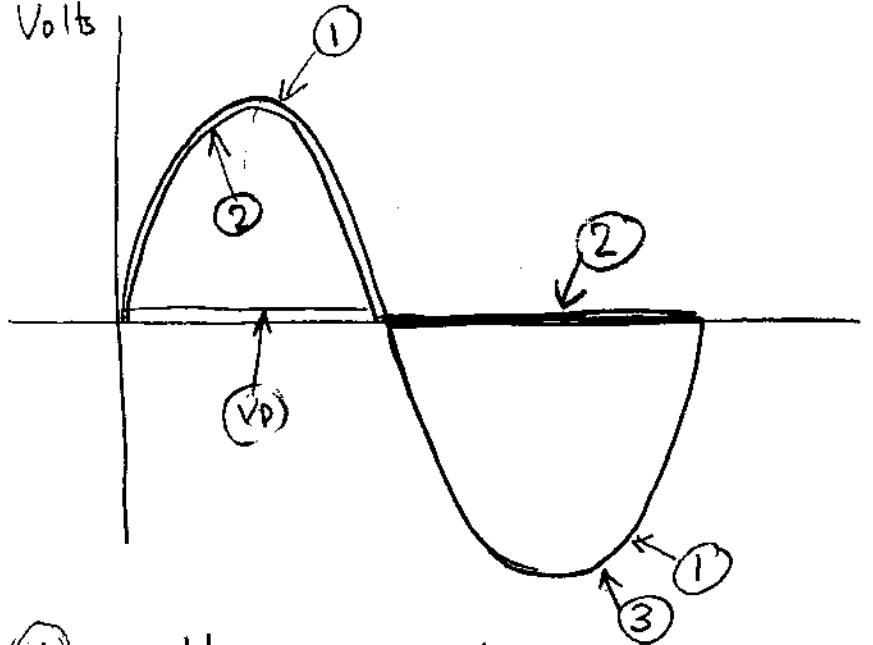What do I see looking into the
primary? ———

For a turns ratio of N:1
What is "impedance" ratio? ———

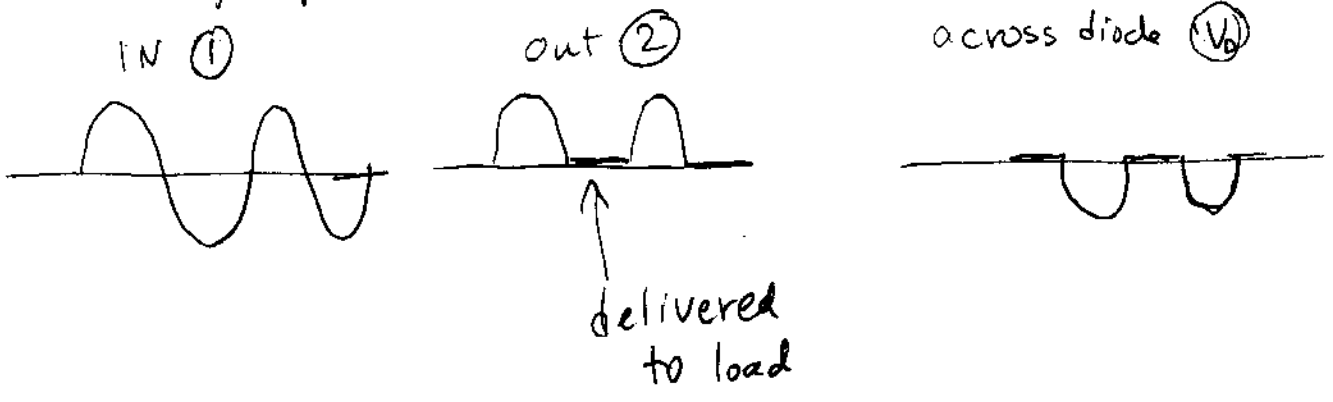(This should be 313 review).

Half wave rectifier (2.1.1)

① ② Vo Load

Vout

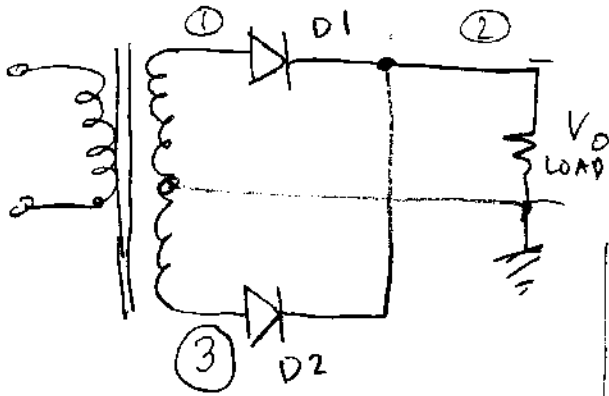← slope = 1

Vin

Vγ

Voltage at ① ② One graph!

Volts

①
②
②
①
③
(Vo)

(Vo) = voltage across diode

3 graphs!

IN ①

out ②

across diode (Vo)

↑ delivered to load

Full wave rectifier (2.1.2)

By adding another secondary, we can get both sides.

one graph:

5 graphs

IN ①

out ②

Voltage
to load.

IN ③

<u>Advantages</u>:

← Twice the frequency

Smoother

Easier to filter.

<u>Disadvantages</u>:
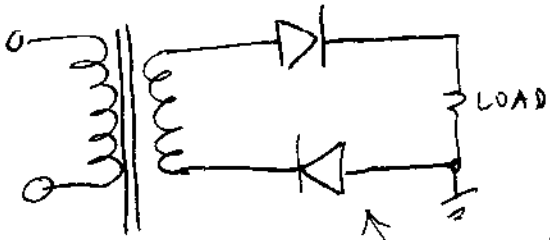
Twice the reverse
diode voltage

Bridge rectifier

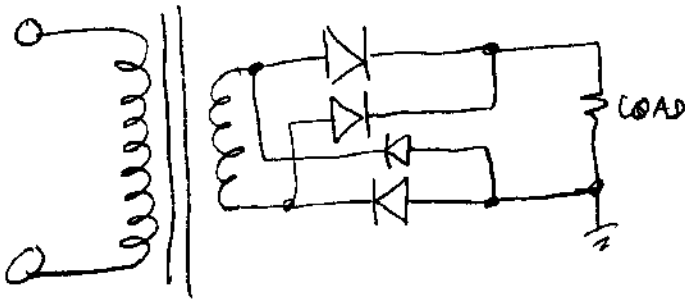Instead of the extra secondary, use
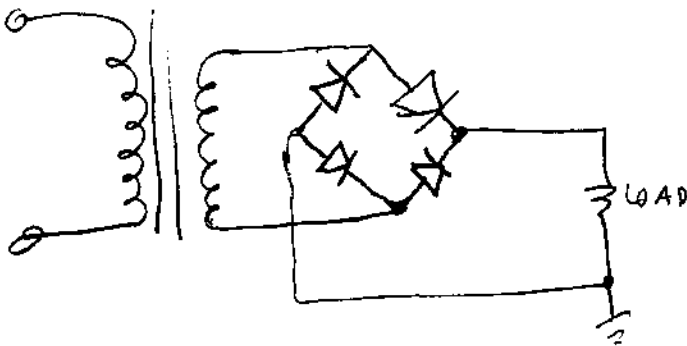an extra pair of diodes;

Half wave:

Two diodes in series
are redundant, !
but leads to an idea !

Works like the
old half wave rectifier

Full wave.

Works almost like
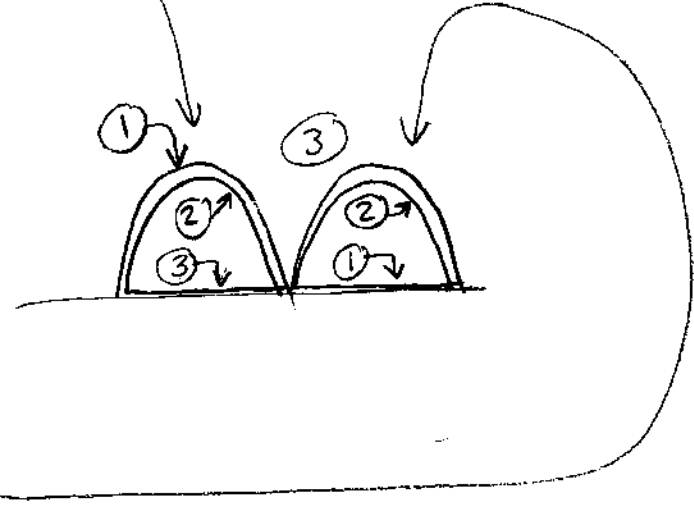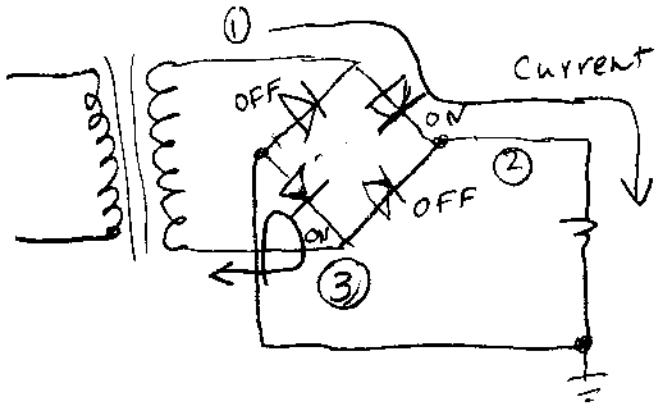the other full wave,
without the extra
winding.

Usually draw it like this!

Advantages:
Like other full wave
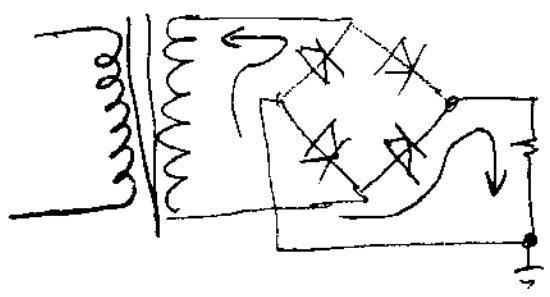Same reverse voltage
as half wave

Disadvantages
Twice the diode loss.

Positive half:

Current

OFF   ON

ON   OFF

① ② ③

① ③

② ②

③ ①

Negative half

Using a bridge for both positive
and negative voltages

⊖   ⊕

Loads