

Voltage Dividers: good for signals
poor for power conversion

Example: Convert $120V_{rms} \rightarrow 12V_{rms}$ to run
 10Ω load.

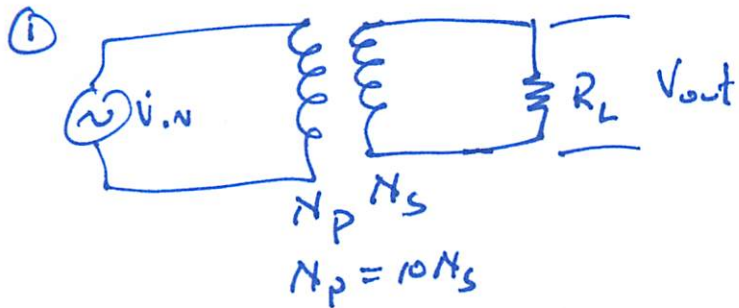
2 methods

① Ideal transformer

$$V_{out} = \frac{N_s}{N_p} V_{in} \text{ AND } P_{in} = P_{out}$$

② Ideal voltage divider

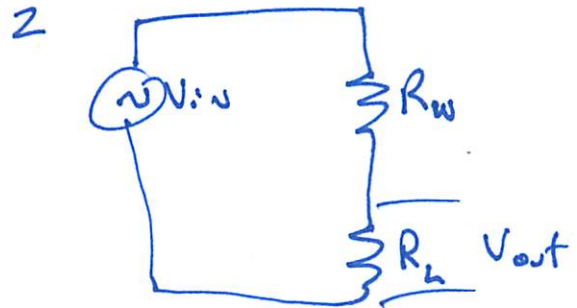
$$V_{out} = \frac{R_1}{R_T} V_{in}$$



$$V_{out} = \frac{N_s}{N_p} V_{in} = \frac{V_{in}}{10} = 12V_{rms}$$

$$P_{out} = \frac{V_{rms}^2}{R} = \frac{(12V_{rms})^2}{10\Omega} = \frac{14.4V^2}{\Omega} = 14.4W$$

$$P_{in} = P_{out} = 14.4W$$



$$V_{out} = \frac{R_L}{R_L + R_w} V_{in}$$

$$R_w = 90\Omega$$

$$P_{out} = \frac{(12V_{rms})^2}{10\Omega} = 14.4W$$

$$P_{in} = \frac{(120V_{rms})^2}{100\Omega} = 144W$$

\Rightarrow 90% waste

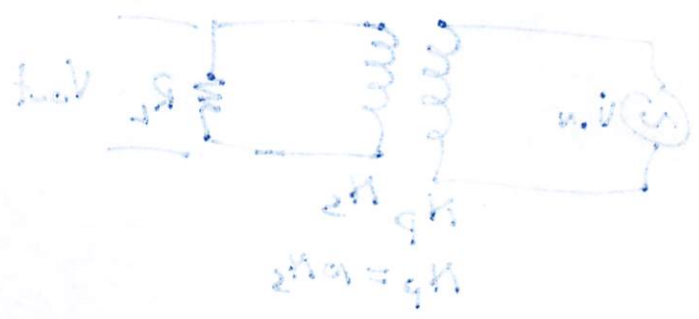
Voltage Divider: good for signal
 but not power conversion

Example: Current divider \rightarrow 15V source to 100mA load

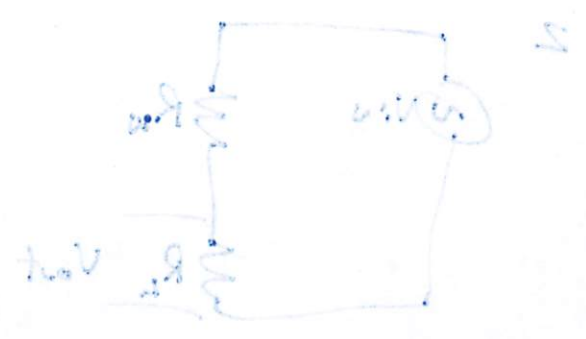
2 methods

① Ideal transformer
 $V_{out} = \frac{N_2}{N_1} V_{in}$
 $I_{out} = \frac{N_1}{N_2} I_{in}$

② Ideal voltage divider
 $V_{out} = \frac{R_2}{R_1 + R_2} V_{in}$



$V_{out} = \frac{N_2}{N_1} V_{in} = \frac{10}{10} \cdot 15V = 15V$
 $P_{out} = \frac{V_{out}^2}{R_L} = \frac{(15V)^2}{25} = 9W$
 $P_{in} = P_{out} = 9W$



$V_{out} = \frac{R_L}{R_1 + R_L} V_{in}$
 $R_{in} = 20\Omega$
 $P_{out} = \frac{(15V)^2}{25} = 9W$
 $P_{in} = \frac{(15V)^2}{20} = 11.25W$

\rightarrow 20% waste