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1 Introduction

Today we did some hard and involved problems from the section 4.1 and then a preview of the section 4.2 plus a home take quiz.

2 Problem 1

It's 4.1, problem 31.

If two resistors with resistances R_1 and R_2 are connected in parallel, as in the figure, then the total resistance R, measured in ohms (Ω), is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

If R_1 and R_2 are increasing at rates of $0.3\,\frac{\Omega}{\mathrm{s}}$ and $0.2\,\frac{\Omega}{\mathrm{s}}$, respectively, how fast is R changing when $R_1 = 80\Omega$ and $R_2 = 100\Omega$?

Answer

We express R:

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

and differentiate with respect to t:

$$R' = \frac{(R_1R_2)'(R_1+R_2) - R_1R_2(R_1+R_2)'}{(R_1+R_2)^2} = \frac{(R_1'R_2 + R_1R_2')(R_1+R_2) - R_1R_2(R_1'+R_2')}{(R_1+R_2)^2}$$

Now we can substitute the values for R_1, R_2, $\frac{\mathrm{d}R_1}{\mathrm{d}t} = 0.3\,\frac{\Omega}{\mathrm{s}}$ and $\frac{\mathrm{d}R_2}{\mathrm{d}t} = 0.2\,\frac{\Omega}{\mathrm{s}}$:

$$R' = \frac{(0.3\cdot 100 + 80\cdot 0.2)(80+100) - 80\cdot 100(0.3+0.2)}{(80+100)^2}\,\frac{\Omega}{\mathrm{s}} = \frac{107}{810}\,\frac{\Omega}{\mathrm{s}} \doteq 0.132\,\frac{\Omega}{\mathrm{s}}$$

3 Quiz

The Quiz 17 is a hometake, due Tuesday.