Series Rule

Consider these two complex equations:

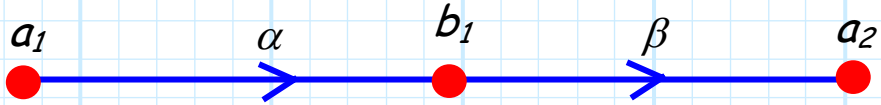
$$b_1 = \alpha\, a_1 \qquad a_2 = \beta\, b_1$$

where α and β are **arbitrary** complex constants. Using the **associative property** of multiplication, these two equations can combined to form an **equivalent set** of equations:

$$b_1 = \alpha\, a_1 \qquad a_2 = \beta\, b_1 = \beta(\alpha\, a_1) = (\alpha\beta)\, a_1$$

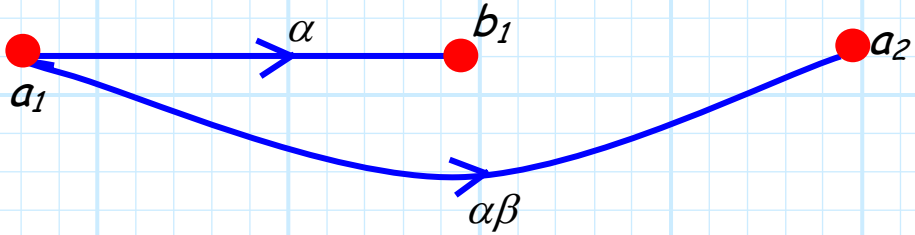
Now let's express these two sets of equations as **signal flow graphs**!

The first set provides:



$$b_1 = \alpha\, a_1$$
$$a_2 = \beta\, b_1$$

While the second is:



$$b_1 = \alpha\, a_1$$
$$a_2 = \alpha\beta\, a_1$$

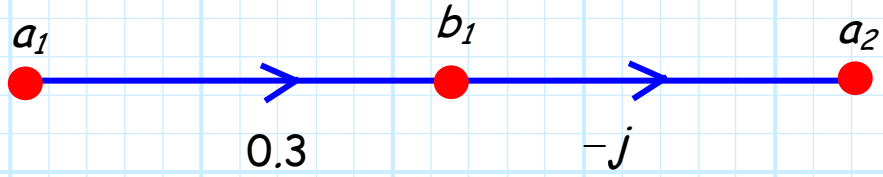
Q: *Hey wait! If the two sets of equations are **equivalent**, shouldn't the two resulting signal flow graphs **likewise** be equivalent?*

A: Absolutely! The two signal flow graphs are indeed **equivalent**.

This leads us to our **first** signal flow graph **reduction rule:**

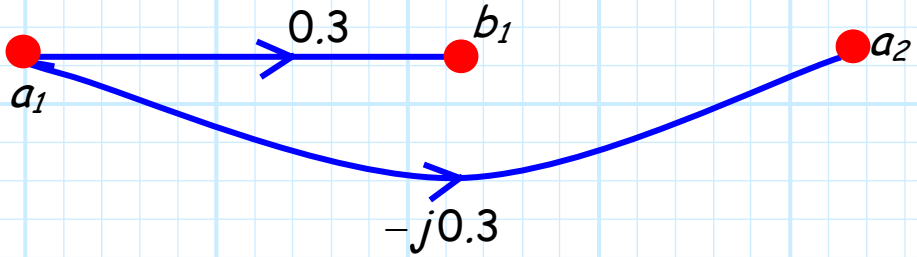
> **Rule 1 - Series Rule**
>
> *If a node has **one** (and only one!) incoming branch, and **one** (and only one!) outgoing branch, the node can be eliminated and the two branches can be combined, with the new branch having a value equal to the product of the original two.*

For **example**, the graph:



$$b_1 = 0.3\,a_1$$
$$a_2 = -j\,b_1$$

can be reduced to:



$$b_1 = 0.3\,a_1$$
$$a_2 = -j0.3\,a_1$$