Gen Phys:

- Get out notebook and pen/pencil
- Open your notebook to the notes section
- Leave all other materials in the cubby in front of your desk.

Got Grit?


GRIT
The raw endurance, perseverance and passion that keep you going despite obstacles.

Lesson 2

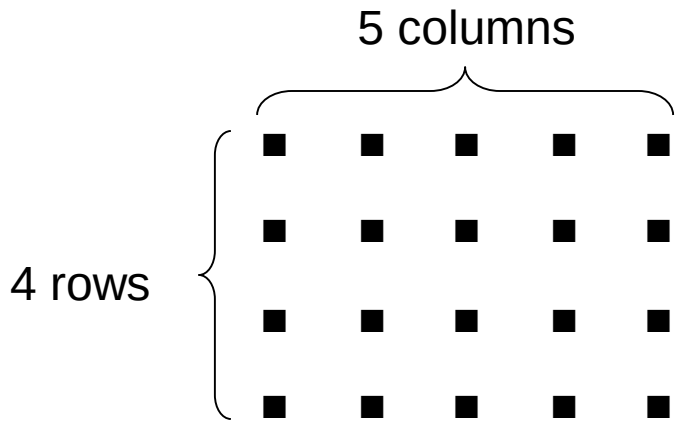
Invariant Principles for Products and Quotients

Objective:

Use the invariant principles for products and quotients.

Invariant Principle for Multiplication

$$4 \times 5 = 20$$



Invariant Principle for Multiplication

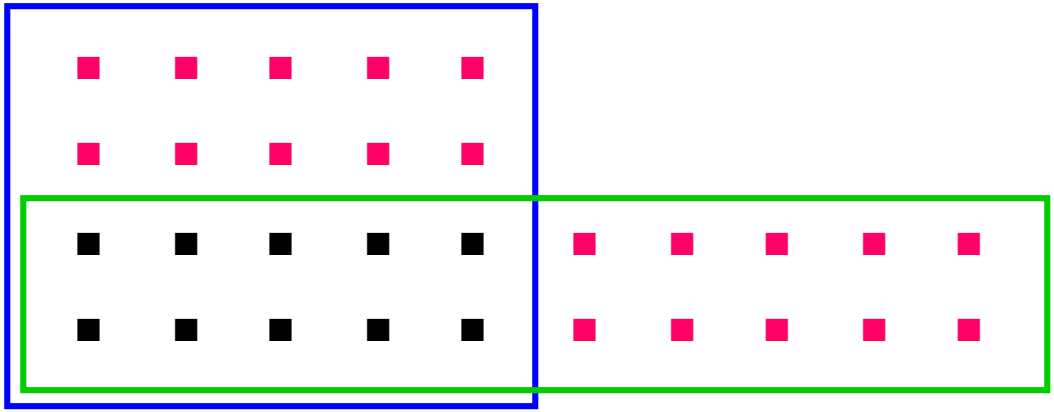
$$4 \times 5 = 20$$

$\frac{4}{2}$ rows and $(5 \cdot 2)$ columns

2 rows and 10 columns

$$2 \times 10 = 20$$

Invariant Principle for Multiplication



4 rows and 5 columns

4 x 5 = 20

2 rows and 10 columns

2 x 10 = 20

Invariant Principle for Multiplication

rows columns

$4 \times 5 = 20$

Divide the number of rows by 2 and multiply the number of columns by 2.

$\frac{4}{2} \times (5 \cdot 2) = 20$

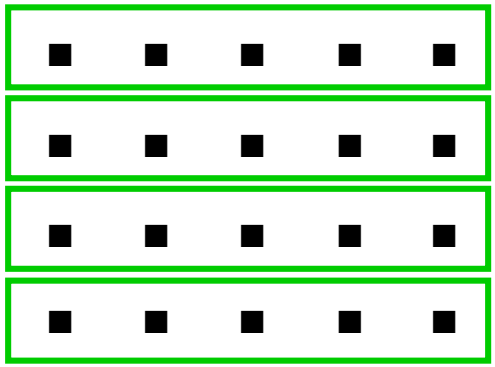
The product remains the same.

General Rule: $xy = \left[\frac{x}{z}\right](yz)$

If you divide one factor by a number and multiply the other factor by the same number, the product remains the same.

Invariant Principle for Division

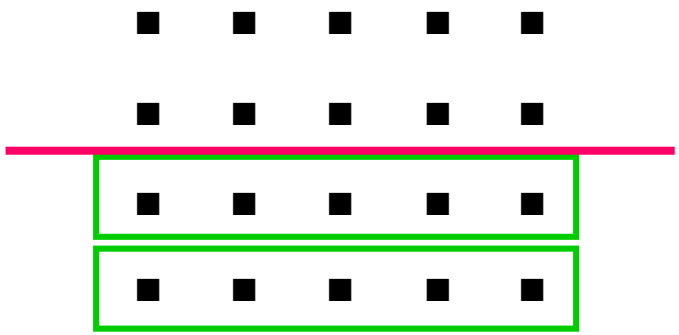
$$\frac{20}{4} = 5$$



If 20 is divided into 4 equal parts, each part will contain 5.

Invariant Principle for Division

$$\frac{20}{4} = 5$$



If the number of markers is divided by 2 and the number of parts is also divided by 2, then each part will still contain 5.

That is, if $\frac{20}{2}$ is divided into $\frac{4}{2}$ equal parts, each part will contain 5.

$$\frac{\frac{20}{2}}{\frac{4}{2}} = \frac{10}{2} = 5$$

Invariant Principle for Division

$$\frac{20}{4} = \frac{\frac{20}{2}}{\frac{4}{2}} \quad \text{and} \quad \frac{20}{4} = \frac{(20)2}{(4)2}$$

General Rule:

$$\frac{x}{y} = \frac{\frac{x}{z}}{\frac{y}{z}} \quad \text{and} \quad \frac{x}{y} = \frac{x \cdot z}{y \cdot z}$$

If both parts of a quotient are divided or multiplied by the same number, the quotient remains the same.

With the Invariant Principle for Multiplication, the changes are inverses.

$$xy = \left[\frac{x}{z}\right](y \cdot z)$$

This is like addition: $x + y = (x - z) + (y + z)$

With the Invariant Principle for Division, the changes are the same.

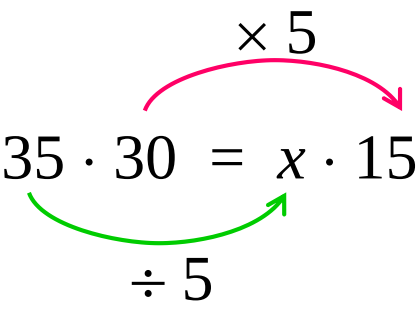
$$\frac{x}{y} = \frac{\frac{x}{z}}{\frac{y}{z}} \quad \text{and} \quad \frac{x}{y} = \frac{x \cdot z}{y \cdot z}$$

This is like subtraction: $x - y = (x - z) - (y - z)$

$$x - y = (x + z) - (y + z)$$

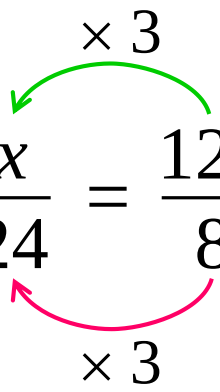
Examples:

If $35 \cdot 30 = x \cdot 150$, what is x?



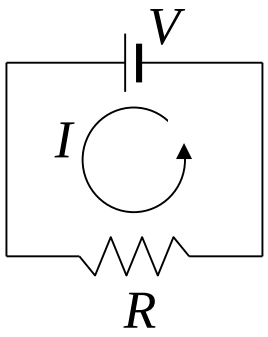
$$x = 35 \div 5 = 7$$

If $\dfrac{x}{24} = \dfrac{120}{8}$, what is x?



$$x = 120 \times 3 = 360$$

Application (Electricity): According to Ohm's law, the electric potential difference V in volts in a circuit is equal to the product of the current I in amps and the resistance R in ohms: $V = IR$. If the current in a circuit is 6 amps when the resistance is 21 ohms, calculate the current when the resistance is 7 ohms. Assume the voltage is constant.



Let x = current in amps.

Set up an equation with a product on each side and solve the equation.

The product of I and R is constant.

$$6 \cdot 21 = x \cdot 7$$

÷ 3 above the left side; × 3 below the left side

$$x = 6 \cdot 3 = 18 \text{ amps}$$