Office Hours!

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Mondays 1–2PM
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Proportionality Review

"y is proportional to x" or $y \propto x$ means

- When we double x, we double y
- When we triple x, we triple y
- When we halve x, we halve y
- $y = Kx$, where K is called the constant of proportionality.

Constant of Proportionality

Example: We are told

- Tax is proportional to income, and
- The tax on $\$1,000$ is $\$280$.

Express $y =$ amount of tax paid in terms of $x =$ the income. Then $y =$

$$\text{A}= 1000x \qquad \text{B}= 280x \qquad \text{C}= \frac{1,000}{280}\,x$$

$$\text{D}= 2.8x \qquad \text{E}= 0.28x \qquad \boxed{\text{E}}$$

Question: What does the constant of proportionality $K = 0.28$ mean?

Answer: It is the tax on one dollar.

Example

For this question, we assume:

- The weight of an elephant is proportional to its height cubed, and
- An elephant 1 meter high weighs 1/3 tons.

How many tons does an elephant h meters tall weigh?

A= $h/3$ B= h^3 C= $h^3/3$ D= $(h/3)^3$ E= $(3h)^3$ $\boxed{\text{C}}$

Question: What does the constant of proportionality $K = 1/3$ mean?

Answer: It is the weight of 1 cubic meter of elephant.

More Complicated Examples

y is inversely proportional to x means $y \propto 1/x$

Example:

- I have \$300
- N = number of apples I can buy
- p = price per apple

Then N is inversely proportional to p: $N \propto 1/p$.

Question: What is the constant of proportionality?

Answer: It is \$300, the amount of money I have.

More Complicated Examples

z is jointly proportional to x and y means $x \propto x \cdot y$ (or $z = Kxy$)

Example:

- C = cost of a rectangular plot of land,
- ℓ = length (in meters) of plot, and
- w = width (in meters) of plot.

Then C is jointly proportional to ℓ and w: $C = K \cdot \ell \cdot w$.

Question: What does the constant of proportionality mean?

Answer: It is the cost of one square meter of land.

More Complicated Examples

Strength of Light

- P = strength of light (power per unit area)
  = amount of light on unit area
- R = distance to light source

Inverse Square Law: $P \propto 1/R^2$

Same idea for heat, gravity, sound, and many others...

Newton's Law of Gravity: $F \propto \dfrac{m_1 m_2}{r^2}$

Constant of proportionality: $G \approx 6.67 \times 10^{-11}\ \mathrm{m}^3/(\mathrm{kg} \cdot \mathrm{s}^2)$

(the Gravitational constant)

Winter 17 Exam #1

1. Solve for x in the equation

$$\frac{3}{x+a} = \frac{a}{x+2}.$$

2. Multiply out and simplify. Check your answer.

$$(a-3b)(4a+2b)+6ab$$

Winter 17 Exam #1

3. Substitute $x = 3t - 4$ into

$$2x(x+1).$$

Simplify the result as much as possible.

4. Solve for x and y in the simultaneous equations

$$x + 2y = p \qquad\qquad x + y = 4.$$

Winter 17 Exam #1

5. Marie leaves Santa Barbara at 10am, driving to Bakersfield on a route which is 150 miles long. Jason leaves Bakersfield at 11am driving the same route to Santa Barbara. Marie's speed is 40 miles/hr and Jason's speed is 60 miles/hr.

(a) How far apart are they at noon?

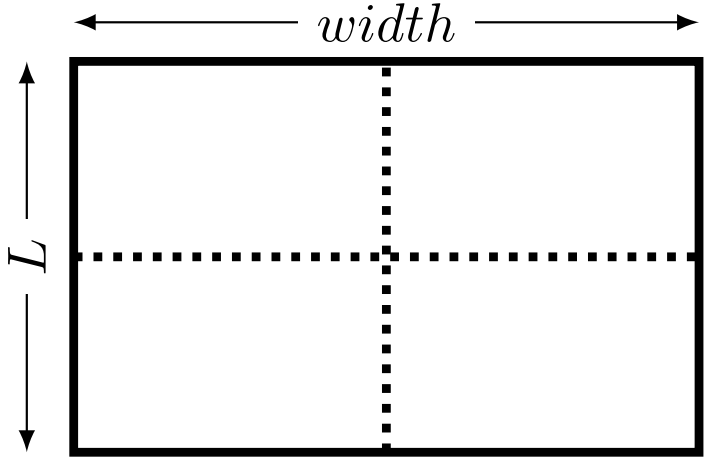
(b) How far from Santa Barbara are they when they meet?

(c) How many hours has Jason been driving when they meet?

[leave your answers as fractions]

Winter 17 Exam #1

6. A farmer wants to partition a rectangular field into quarters, as shown. The total area of the field is 500 square meters. Suppose the length of the field is L meters.



(a) Express the width of the field in terms of L.

(b) The outer boundary fence (on the perimeter of the field, shown solid) costs \$4 per meter, and the inside fence (shown dotted) costs \$3 per meter. Express the total cost of the fence needed in terms of L.