Intro to College Math: Chapter 7.7
Proportions

* Proportions — a statement that ratios are equal.

1. Find the missing term in proportions: $\frac{6}{7} = \frac{30}{y}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{6}{7} = \frac{30}{y}$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$6 \cdot y = 30 \cdot 7$

* Now divide both sides by the number in front of y (variable)

$\frac{6y}{6} = \frac{210}{6}$

$y = 35$

2. Find the missing term in proportions: $\frac{1}{n} = \frac{6}{13}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{1}{n} = \frac{6}{13}$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$1 \cdot 13 = 6 \cdot n$

* Now divide both sides by the number in front of n (variable)

$\frac{13}{6} = \frac{6n}{6}$

$\frac{13}{6} = n$

3. Find the missing term in proportions: $\frac{n}{2} = \frac{5}{6}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{n}{2} \times \frac{5}{6}$

$n \cdot 6 = 5 \cdot 2$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$\frac{6n}{6} = \frac{10}{6}$

* Now divide both sides by the number in front of n (variable)

$n = \frac{10}{6} = \boxed{\frac{5}{3}}$

* Simplify

4. Find the missing term in proportions: $\frac{4}{11} = \frac{x}{9}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{4}{11} \times \frac{x}{9}$

$4 \cdot 9 = x \cdot 11$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$\frac{36}{11} = \frac{11x}{11}$

* Now divide both sides by the number in front of x (variable)

$\boxed{\frac{36}{11}} = x$

5. Find the missing term in proportions: $\frac{12}{6} = \frac{6}{y}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{12}{6} \times \frac{6}{y}$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$12 \cdot y = 6 \cdot 6$

$\frac{12y}{12} = \frac{36}{12}$

* Now divide both sides by the number in front of y (variable)

$y = 3$

6. Find the missing term in proportions: $\frac{0.3}{0.9} = \frac{4}{x}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{0.3}{0.9} \times \frac{4}{x}$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$0.3 \cdot x = 4 \cdot 0.9$

$\frac{0.3x}{0.3} = \frac{3.6}{0.3}$

* Now divide both sides by the number in front of x (variable)

$x = 12$

7. Solve the following proportions. $\frac{x+4}{4} = \frac{8}{x}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{x+4}{4} = \frac{8}{x}$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$(x+4) \cdot x = 8 \cdot 4$

* Then multiply the term outside the ( ) by each term inside the ( ).

$x(x+4) = 32$

$x^2 + 4x = 32$
$\quad -32 \quad -32$

* Then since we have both an "x^2" + a "x", we will get everything on one side so we can use the quadratic formula.

$x^2 + 4x - 32 = 0$

$a=1 \quad b=4 \quad c=-32$

* "a" = number in front of x^2
"b" = number in front of x
"c" = number by itself

$$\frac{-b \pm \sqrt{b^2+4ac}}{2a}$$ } Quadratic formula

* Replace each letter with the number that corresponds to it.

$$\frac{-4 \pm \sqrt{4^2 - 4(1)(-32)}}{2(1)}$$

$x = 4, -8$

8. Solve the following proportions. $\frac{4}{a+2} = \frac{a}{2}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{4}{a+2} \quad \frac{a}{2}$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$4 \cdot 2 = a(a+2)$

$8 = a(a+2)$

* Then multiply the term outside the ( ) by each term inside the ( ).

$8 = a^2 + 2a$

$-8 \qquad -8$

$0 = a^2 + 2a - 8$

* Then since we have both an "x^2" + a "x", we will get everything on one side so we can use the quadratic formula.

$a=1 \quad b=2 \quad c=-8$

* "a" = number in front of x^2
  "b" = number in front of x
  "c" = number by itself

$$\frac{-b \pm \sqrt{b^2-4ac}}{2a}$$ Quadratic formula

$$\frac{-2 \pm \sqrt{2^2-4(1)(-8)}}{2(1)}$$

* Replace each letter with the number that corresponds to it.

$x = 2, -4$

9. Solve the following proportions. $\frac{7}{x} = \frac{x-2}{5}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{7}{x} \times \frac{x-2}{5}$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$7 \cdot 5 = (x-2) \cdot x$

$35 = x(x-2)$ * Then multiply the term outside the ( ) by each term inside the ( ).

$35 = x^2 - 2x$

$-35 \qquad -35$

$0 = x^2 - 2x - 35$

* Then since we have both an "x^2" + a "x", we will get everything on one side so we can use the quadratic formula.

$a=1 \quad b=-2 \quad c=-35$

$$\frac{-b \pm \sqrt{b^2-4ac}}{2a}$$ Quadratic formula

* "a" = number in front of x^2
"b" = number in front of x
"c" = number by itself

$$\frac{-(-2) \pm \sqrt{(-2)^2-4(1)(-35)}}{2(1)}$$

* Replace each letter with the number that corresponds to it.

$x = 7, -5$

10. Solve the following proportions. $\frac{x}{4} = \frac{5}{3x+11}$

* Since there are 2 fractions equal to each other, we cross multiply.

$\frac{x}{4} = \frac{5}{3x+11}$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$x \cdot (3x+11) = 5 \cdot 4$

$x(3x+11) = 20$

* Then multiply the term outside the ( ) by each term inside the ( ).

$3x^2 + 11x = 20$

$-20 \quad -20$

* Then since we have both an "x^2" + a "x", we will get everything on one side so we can use the quadratic formula.

$3x^2 + 11x - 20 = 0$

$a = 3 \quad b = 11 \quad c = -20$

$$\frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

* "a" = number in front of x^2
"b" = number in front of x
"c" = number by itself

$$\frac{-11 \pm \sqrt{11^2-4(3)(-20)}}{2(3)}$$

* Replace each letter with the number that corresponds to it.

$x = \frac{4}{3}, -5$

11. Baseball. A baseball player gets 9 hits in the first 12 games of the season. If he continues hitting at the same rate, how many hits will he get in the first 20 games?

hits → $\frac{9}{12}$ ← games

$=$

$\frac{x}{20}$ ← hits, games

* First, we set 2 fractions equal each other.

Then cross-multiply:

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$9 \cdot 20 = x \cdot 12$

$\frac{180}{12} = \frac{12x}{12}$

← Divide both sides by the number in front of x.

$15 = x$

12. Basketball. A basketball player makes 10 of 25 free throws in the first week of the season. If she shoots with the same accuracy for the next week, how many of the 20 free throws she attempts will she make?

made → $\frac{10}{25}$ ← made

attempts →

$=$

$\frac{x}{20}$ ← attempts

* First, we set 2 fractions equal each other.

Then cross-multiply:

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$10 \cdot 20 = x \cdot 25$

$\frac{200}{25} = \frac{25x}{25}$

Divide both sides by the number in front of x

$8 = x$

13. Mixture problem. A solution contains 25 milliliters of alcohol and 30 milliliters of water. If another solution is to have the same concentration of alcohol in water but is to container 12 milliliters of water, how much alcohol must it contain?

alcohol → $\frac{25}{30} = \frac{x}{12}$ ← alcohol

water → ← water

* First, we set 2 fractions equal each other.

Then cross-multiply:

$25 \cdot 12 = x \cdot 30$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$\frac{300}{30} = \frac{30x}{30}$

Divide both sides by the number in front of x

$10 = x$

14. Mixture problem. A solution contains 49 milliliters of HCl and 77 milliliters of water. If another solution is to have the same concentration of HCl in water but is to container 99 milliliters of water, how much HCl must it contain?

HCl → $\frac{49}{77} = \frac{x}{99}$ ← HCl

water → ← water

* First, we set 2 fractions equal each other.

Then cross-multiply:

$49 \cdot 99 = x \cdot 77$

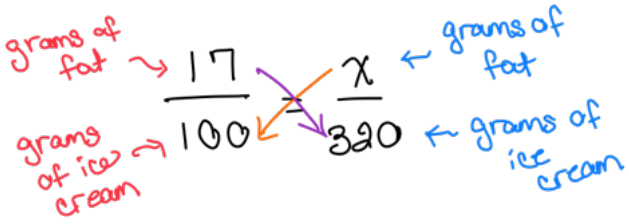
* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$\frac{4851}{77} = \frac{77x}{77}$

Divide both sides by the number in front of x

$63 = x$

15. Nutrition. If 100 grams of ice cream contains 17 grams of fat, how much fat is in 320 grams of ice cream?



* First, we set 2 fractions equal each other.

Then cross-multiply:

$17 \cdot 320 = \chi \cdot 100$

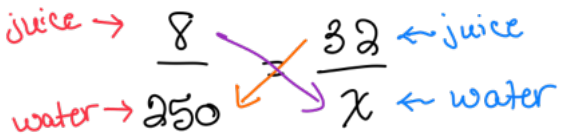
* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$\frac{5440}{100} = \frac{100\chi}{100}$

Divide both sides by the number in front of χ

$54.4 = \chi$

16. Nutrition. A 8-ounce serving of grapefruit juice contains 250 grams of water. How many grams of water are in 32 ounces of grapefruit?



* First, we set 2 fractions equal each other.

Then cross-multiply:

$8 \cdot \chi = 32 \cdot 150$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$\frac{8\chi}{8} = \frac{480}{8}$

Divide both sides by the number in front of χ

$\chi = 600$

17. Map Reading. A map is drawn so that every 3.5 inches on the map corresponds to an actual distance of 100 miles. If the actual distance between the two cities is 420 miles, how far apart are they on the map?

inches → $\frac{3.5}{100} = \frac{x}{420}$ ← inches

miles → ← miles

* First, we set 2 fractions equal each other.

Then cross-multiply:

$3.5 \cdot 420 = x \cdot 100$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$\frac{1470}{100} = \frac{100x}{100}$

$\boxed{14.7} = x$

Divide both sides by the number in front of x

18. Distance. A man drives his car 350 miles in 5 hours. At this rate, how far will he travel in 6 hours?

miles → $\frac{350}{5} = \frac{x}{6}$ ← miles

hours → ← hours

* First, we set 2 fractions equal each other.

Then cross-multiply:

$350 \cdot 6 = x \cdot 5$

* multiply the top term on the left by the bottom term on the right.
* Then multiply the top term on the right by the bottom term on the left.

$\frac{2100}{5} = \frac{5x}{5}$

$\boxed{420} = x$

19. Distance. An airplane flies 2,850 miles in 5 hours. How far will it fly in 7 hours?

miles → $\frac{2850}{5} = \frac{x}{7}$ ← miles

hours → ← hours

$2850 \cdot 7 = x \cdot 5$

$\frac{19950}{5} = \frac{5x}{5}$

$x = \boxed{3990}$