# Solving Equations

- When asked to solve an equation, you are looking for the value that makes the statement true. For example, $x + 4 = 10$ is true when $x = 6$.

- To solve an equation, we need to isolate the variable. That is, get x by itself. Whatever number is left on the other side of the equation is the solution.

- To get x by itself, use inverse operations. Also remember, what you do to one side, do to the other".

Addition ⬌ Subtraction          Multiplication ⬌ Division

Ex/ Use addition and subtraction to solve for x.

a) $x + 7 = 10$

subtract 7
to isolate
x

$\quad -7 \quad -7$

$x = 10 - 7$

$= 3$

b) $x - 3 = -4$

$\quad +3 \quad +3$

$x = -4 + 3$

$x = -1$

c) $x - 5 = 8$ $\quad {}^{+5} \qquad {}^{+5}$

$x = 8 + 5$

$x = 13$

d) $x - 17 = 10$ $\quad {}^{+17} \qquad {}^{+17}$

$x = 10 + 17$

$x = 27$

e) $2 = x + 5$ $\quad {}^{-5} \qquad {}^{-5}$

$2 - 5 = x$

$-3 = x$

f) $5 = 6 + x$ $\quad {}^{-6} \qquad {}^{-6}$

$5 - 6 = x$

$-1 = x$

g) $12 + x = 14$ $\quad {}^{-12} \qquad {}^{-12}$

$x = 14 - 12$

$x = 2$

h) $4 + x = -5$ $\quad {}^{-4} \qquad {}^{-4}$

$x = -5 - 4$

$x = -9$

Ex/ Use multiplication and division to solve for x.

to get one
of something
divide

a) $\dfrac{3x}{3} = \dfrac{15}{3}$

$x = 5$

b) $\dfrac{-6x}{-6} = \dfrac{18}{-6}$

$x = -3$

multiply
by (-5)
c) $\dfrac{x}{-5} = 10$ ${}^{(-5)}$

$x = -50$

${}^{(4)}$ d) $\dfrac{x}{4} = -3$ ${}^{(4)}$

$x = -12$

Ex/ Solve.

a) $13 + r = 19$ $\quad {}^{-13} \qquad {}^{-13}$

$r = 19 - 13$

$r = 6$

b) $\dfrac{3m}{3} = \dfrac{27}{3}$

$m = 9$

c) $-4 = x - 11$ $\quad {}^{+11} \qquad {}^{+11}$

$-4 + 11 = x$

$7 = x$

d) $\dfrac{-17}{-10} = \dfrac{-10g}{-10}$

$1.7 = g$

e) $4 = -15 + k$ $\quad {}^{+15} \qquad {}^{+15}$

$4 + 15 = k$

$19 = k$

f) $\dfrac{5w}{5} = \dfrac{0}{5}$

$w = 0$

A negative 1

g) $-x = 9$ $\quad \dfrac{}{-1} \qquad \dfrac{}{-1}$

$x = -9$

h) $9 + b = -4$ $\quad {}^{-9} \qquad {}^{-9}$

$b = -4 - 9$

$b = -13$

- When two quantities increase or decrease by the same ratio, they will form an equivalent ratio.

i.e. $\dfrac{3}{4} = \dfrac{6}{8} = \dfrac{12}{16} = \dfrac{30}{40}$

$\times 2 \quad \times 4 \quad \times 10$

- A statement that two ratios are equal is called a proportion.

i.e. $\dfrac{12}{8} \not= \dfrac{3}{2}$

$12(2) = 8(3)$

$24 = 24$

- A handy tool of proportions is the cross-product rule which allows us to solve for an unknown value

Ex/ Solve.

a) $\dfrac{x}{4} \not= \dfrac{36}{48}$   multiply diagonally (cross)

divide out

$48x = 144$

$\dfrac{48x}{48} = \dfrac{144}{48}$

$x = 3$

b) $\dfrac{45}{y} \not= \dfrac{32}{8}$

$32y = 360$

$\dfrac{32y}{32} = \dfrac{360}{32}$

$y = 11.25$

c) $5:30 = 45:x$   Re-write as fractions

$\dfrac{5}{30} = \dfrac{45}{x}$

$5x = 1350$

$x = 270$

d) $a:16 = 5:20$

$\dfrac{a}{16} = \dfrac{5}{20}$

$20a = 80$

$a = 4$

e) $\dfrac{3}{x} = \dfrac{50}{81}$

$50x = 324$

$x = 6.48$

Ex/ The sail on a sailboat has a height to length ratio of 3:2. If the height of a sail is 9 m, how long would the sail be?

height   $\dfrac{3}{2} = \dfrac{9}{x}$   height

length            length

$3x = 18$

$x = 6m$

Practice:  Handout – Simple Equations and Proportions