

17. [Substitution]

Skill 17.1 Substituting value 0 into simple expressions.

MM5.2 1 2 2 3 3 4 4
MM10 1 1 2 2 3 3 4 4

- Replace the letter (variable) with 0.
- Solve the mathematical sentence to find the value of the expression.

number + 0 = 0 + number = number
 number - 0 = number
 number × 0 = 0 × number = 0
 0 ÷ number = 0

Q. If $x = 0$, find the value of $10x$

A. $10x = 10x = 10 \times x$
 $= 10 \times x$ Substitute $x = 0$
 $= 10 \times 0$ Multiply 10 by 0
 $= 0$

a) If $y = 0$, find the value of $12 + y$

$12 + 0 = 12$

b) If $a = 0$, find the value of $a + 45$

$\dots\dots\dots = \square$

c) If $m = 0$, find the value of $100 + m$

$\dots\dots\dots = \square$

d) If $f = 0$, find the value of $f + 6$

$\dots\dots\dots = \square$

e) If $b = 0$, find the value of $8 - b$

$8 - 0 = 8$

f) If $v = 0$, find the value of $17 - v$

$\dots\dots\dots = \square$

g) If $d = 0$, find the value of $d - 40$

$\dots\dots\dots = \square$

h) If $z = 0$, find the value of $z - 200$

$\dots\dots\dots = \square$

i) If $t = 0$, find the value of $8t$

$8t = 8 \times t = 8 \times 0 = \square$

j) If $j = 0$, find the value of $25j$

$\dots\dots\dots = \square$

k) If $g = 0$, find the value of $12g$

$\dots\dots\dots = \square$

l) If $p = 0$, find the value of $81p$

$\dots\dots\dots = \square$

m) If $h = 0$, find the value of $\frac{h}{5}$

$\dots\dots\dots = \square$

n) If $n = 0$, find the value of $\frac{n}{10}$

$\dots\dots\dots = \square$

o) If $u = 0$, find the value of $\frac{u}{7}$

$\dots\dots\dots = \square$

p) If $q = 0$, find the value of $\frac{q}{24}$

$\dots\dots\dots = \square$

Skill 17.2 Substituting one value into expressions involving +, −, × and ÷

MM5.2 1 1 2 2 3 3 4 4
MM10 1 1 2 2 3 3 4 4

- Replace the letter (variable) with the given value.
- Solve the mathematical sentence to find the value of the expression.
- Use the order of operations rules: Multiply (×) and/or divide (÷) in order from left to right.
Add (+) and/or subtract (−) in order from left to right.

Q. If $x = 4$, find the value of $18 - 3x$

A. $18 - 3x = 18 - 3 \times 4$
 $= 18 - 12$
 $= 6$

(Note: In the original image, a callout bubble points to the $3x$ term in the first step, containing the text $3x = 3 \times x$.)

Substitute $x = 4$
 Multiply 3 by 4
 Subtract 12 from 18

a) If $c = 5$, find the value of $36 + c$

$$36 + c = 36 + 5 = \boxed{41}$$

b) If $k = 7$, find the value of $k + 56$

$$k + 56 = \boxed{}$$

c) If $y = 12$, find the value of $88 + y$

$$88 + y = \boxed{}$$

d) If $r = 50$, find the value of $r + 150$

$$r + 150 = \boxed{}$$

e) If $z = 20$, find the value of $25 - z$

$$25 - z = \boxed{5}$$

f) If $a = 40$, find the value of $a - 28$

$$a - 28 = \boxed{}$$

g) If $e = 35$, find the value of $e - 30$

$$e - 30 = \boxed{}$$

h) If $x = 8$, find the value of $7x$

$$7x = 7 \times x = 7 \times 8 = \boxed{}$$

i) If $b = 12$, find the value of $12b$

$$12b = \boxed{}$$

j) If $y = 22$, find the value of $5y$

$$5y = \boxed{}$$

k) If $j = 3$, find the value of $\frac{48}{j}$

$$\frac{48}{j} = \boxed{}$$

l) If $p = 4$, find the value of $\frac{56}{p}$

$$\frac{56}{p} = \boxed{}$$

m) If $u = 5$, find the value of $4u - 19$

$$4u - 19 = \boxed{}$$

n) If $f = 6$, find the value of $25 - 3f$

$$25 - 3f = \boxed{}$$

o) If $x = 8$, find the value of $2x + 6$

$$2x + 6 = \boxed{}$$

p) If $z = 3$, find the value of $15 + 6z$

$$15 + 6z = \boxed{}$$

Skill 17.3 Substituting two values into expressions involving +, −, × and ÷

MM5.2 1 1 2 2 3 3 4 4
MM10 1 1 2 2 3 3 4 4

- Replace the two letters (variables) with the given values.
- Solve the mathematical sentence to find the value of the expression.
- Use the order of operations rules: Multiply (×) and/or divide (÷) in order from left to right.
Add (+) and/or subtract (−) in order from left to right.

Q. If $x = 4$ and $y = 8$,
find the value of $\frac{4x - y}{2}$

A. $\frac{4x - y}{2} = \frac{4 \times 4 - 8}{2}$ $4x = 4 \times x$

$= \frac{4 \times 4 - 8}{2}$ Substitute $x = 4$ and $y = 8$

$= \frac{4 \times 4 - 8}{2}$ Multiply 4 by 4

$= \frac{16 - 8}{2}$ Subtract 8 from 16

$= 8 \div 2$ Divide 8 by 2

$= 4$

a) If $c = 5$ and $d = 3$,
find the value of $3c - 5d$

$3 \times c - 5 \times d$

$= 3 \times 5 - 5 \times 3 = 15 - 15 = \boxed{0}$

b) If $v = 6$ and $w = 7$,
find the value of $4v - 3w$

$= \dots = \boxed{}$

c) If $a = 7$ and $b = 1$,
find the value of $6a + 5b$

$= \dots = \boxed{}$

d) If $m = 5$ and $n = 3$,
find the value of $24 - mn$

$= \dots = \boxed{}$

e) If $p = 6$ and $q = 8$,
find the value of $\frac{pq}{4}$

$= \dots = \boxed{}$

f) If $x = 6$ and $y = 1$,
find the value of $\frac{2xy}{3}$

$= \dots = \boxed{}$

g) If $y = 1$ and $z = 9$,
find the value of $\frac{z}{3} - y$

$= \dots = \boxed{}$

h) If $d = 12$ and $e = 2$,
find the value of $\frac{d}{4} - e$

$= \dots = \boxed{}$

i) If $m = 2$ and $l = 6$,
find the value of $\frac{m + 3l}{4}$

$= \dots = \boxed{}$

j) If $j = 5$ and $k = 4$,
find the value of $\frac{2j - k}{3}$

$= \dots = \boxed{}$

Skill 17.4 Substituting into rules.

MM5.2 11 2 3 3 4 4
MM10 1 2 2 3 3 4 4

- Replace the letter (variable) x with the given value.
- Solve the mathematical sentence to find the value of y .
- Use the order of operations rules: Multiply (\times) and/or divide (\div) in order from left to right. Add ($+$) and/or subtract ($-$) in order from left to right.

Q. If $y = 4x^2 - 3$, find y when $x = 2$

A. $y = 4x^2 - 3$ $\leftarrow 4x^2 = 4 \times x^2$
 $= 4 \times x^2 - 3$ Substitute $x = 2$
 $= 4 \times 2^2 - 3$ Evaluate 2^2
 $= 4 \times 4 - 3$ Multiply 4 by 4
 $= 16 - 3$ Subtract 3 from 16
 $= 13$

a) If $y = x - 9$, find y when $x = 12$

$$y = 12 - 9 = \boxed{3}$$

b) If $y = 25 - x$, find y when $x = 7$

$$y = \dots = \boxed{}$$

c) If $y = 4x + 8$, find y when $x = 2$

$$y = 4 \times 2 + 8 = 8 + 8 = \boxed{}$$

d) If $y = 3x - 9$, find y when $x = 9$

$$y = \dots = \boxed{}$$

e) If $y = 5x - 6$, find y when $x = 3$

$$y = \dots = \boxed{}$$

f) If $y = 2x + 7$, find y when $x = 12$

$$y = \dots = \boxed{}$$

g) If $y = \frac{18}{x} - 7$, find y when $x = 2$

$$y = 18 \div 2 - 7 = 9 - 7 = \boxed{}$$

h) If $y = \frac{24}{x} - 10$, find y when $x = 6$

$$y = \dots = \boxed{}$$

i) If $y = x^2 + 18$, find y when $x = 3$

$$y = \dots = \boxed{}$$

j) If $y = x^2 - 7$, find y when $x = 4$

$$y = \dots = \boxed{}$$

k) If $y = 3x^2 + 2$, find y when $x = 5$

$$y = \dots = \boxed{}$$

l) If $y = 5x^2 - 18$, find y when $x = 2$

$$y = \dots = \boxed{}$$

m) If $y = \frac{3x}{4}$, find y when $x = 8$

$$y = \dots = \boxed{}$$

n) If $y = \frac{6x}{5}$, find y when $x = 10$

$$y = \dots = \boxed{}$$

Skill 17.5 Substituting into formulae.

MM5.2 11 22 33 44
MM10 11 22 33 44

- Replace the letters (variables) with the given values.
- Solve the mathematical sentence to find the requested value in the formula.
- Use the order of operations rules: Multiply (\times) and/or divide (\div) in order from left to right. Add ($+$) and/or subtract ($-$) in order from left to right.

Q. Use $V = \pi r^2 h$ to find the volume of a cylinder when $r = 10$, $h = 5$ and $\pi \approx 3.14$

A. $V = \pi r^2 h$ $\pi r^2 h = \pi \times r^2 \times h$
 $= \pi \times r^2 \times h$ Substitute $r = 10$, $h = 5$ and
 $\approx 3.14 \times 10^2 \times 5$ $\pi \approx 3.14$ and evaluate 10^2
 $= 3.14 \times 100 \times 5$ Multiply 3.14 by 100
 $= 314 \times 5$ Multiply the result by 5
 $= 1570$

a) Use $P = 4l$ to find the perimeter P of a square when $l = 4.5$

$$P = 4 \times l = 4 \times 4.5 = \boxed{18}$$

b) Use $M = 0.6K$ to find the number of miles M when $K = 2000$

$$M = 0.6 \times K = 0.6 \times 2000 = \boxed{1200}$$

c) Use $A = lw$ to find the area A of a rectangle when $l = 12$ and $w = 8$

$$A = l \times w = 12 \times 8 = \boxed{96}$$

d) Use $C = \pi d$ to find the circumference C of a circle when $d = 15$ and $\pi \approx 3.14$

$$C = \pi d = 3.14 \times 15 = \boxed{47.1}$$

e) Use $A = \frac{d_1 d_2}{2}$ to find the area A of a rhombus when $d_1 = 15$ and $d_2 = 6$

$$A = \frac{d_1 d_2}{2} = \frac{15 \times 6}{2} = \boxed{45}$$

f) Use $M = \frac{1}{2}(x + y)$ to find the average M of $x = 20$ and $y = 16$

$$M = \frac{1}{2}(x + y) = \frac{1}{2}(20 + 16) = \boxed{18}$$

g) Use $v = \frac{d}{t}$ to find the speed v when $d = 400$ and $t = 5$

$$v = \frac{d}{t} = \frac{400}{5} = \boxed{80}$$

h) Use $A = \frac{l^2 \sqrt{3}}{4}$ to find the area A of an equilateral triangle when $l = 4$ and $\sqrt{3} \approx 1.73$

$$A = \frac{l^2 \sqrt{3}}{4} = \frac{4^2 \times 1.73}{4} = \boxed{13.84}$$

i) Use $V = lwh$ to find the volume V of a prism when $l = 5$, $w = 3$ and $h = 10$

$$V = lwh = 5 \times 3 \times 10 = \boxed{150}$$

j) Use $TSA = 6l^2$ to find the total surface area TSA of a cube when $l = 20$

$$TSA = 6l^2 = 6 \times 20^2 = \boxed{2400}$$

k) Use $TSA = 4\pi r^2$ to find the total surface area TSA of a sphere when $r = 10$ and $\pi \approx 3.14$

$$TSA = 4\pi r^2 = 4 \times 3.14 \times 10^2 = \boxed{1256}$$

l) Use $a^2 = c^2 - b^2$ to find the value of $a > 0$ when $c = 15$ and $b = 9$

$$a^2 = c^2 - b^2 = 15^2 - 9^2 = 225 - 81 = 144$$

$$a = \sqrt{144} = \boxed{12}$$

- Replace the letters (variables) with the given values.
- Solve the mathematical sentence to find the value of the expression.
- Use the order of operations rules: Simplify within the brackets.
 Multiply (\times) and/or divide (\div) in order from left to right.
 Add ($+$) and/or subtract ($-$) in order from left to right.

Q. If $y = (x + 3)(x - 4)$, find y when $x = 6$

A. $y = (x + 3)(x - 4)$ $() = () \times ()$
 $= (x + 3) \times (x - 4)$ Substitute $x = 6$
 $= (6 + 3) \times (6 - 4)$ Evaluate each bracket.
 $= 9 \times 2$ Multiply the results.
 $= 18$

a) If $y = 4(x + 3)$, find y when $x = 0$

$$y = 4 \times (0 + 3) = 4 \times 3 = \boxed{12}$$

b) If $y = 5(x - 2)$, find y when $x = 6$

$$y = 5 \times (6 - 2) = \boxed{}$$

c) If $y = -3(x - 6)$, find y when $x = 10$

$$y = = \boxed{}$$

d) If $y = -4(x + 8)$, find y when $x = 0$

$$y = = \boxed{}$$

e) If $y = x(x - 7)$, find y when $x = 9$

$$y = = \boxed{}$$

f) If $y = x(x + 2)$, find y when $x = 0$

$$y = = \boxed{}$$

g) If $y = (x + 1)(x - 3)$, find y when $x = -2$

$$y = = \boxed{}$$

h) If $y = (x - 1)(x + 5)$, find y when $x = 11$

$$y = = \boxed{}$$

i) If $c = 5$ and $d = 15$,
find the value of $c(d - 10)$

$$c \times (d - 10) = $$

$$= 5 \times (15 - 10) = 5 \times 5 = \boxed{}$$

j) If $x = 2$ and $y = 4$,
find the value of $y(x + 16)$

$$y \times (x + 16) = $$

$$= = \boxed{}$$

k) If $j = 2$ and $k = 1$,
find the value of $3j(2k - j)$

$$= = \boxed{}$$

l) If $a = 5$ and $b = 0$,
find the value of $4a(a - 3b)$

$$= = \boxed{}$$

m) Use $S = (n - 2) \times 180^\circ$ to find the sum S of all interior angles when $n = 6$ (hexagon).

$$= = \boxed{}$$

n) Use $TSA = \pi r(r + s)$ to find the total surface area TSA of a cone when $r = 2$, $s = 3$ and $\pi \approx 3.14$

$$= = \boxed{}$$

Skill 17.7 Substituting negative values into rules and expressions.

MM5.2 1 1 2 2 3 3 4 4
MM10 1 1 2 2 3 3 4 4

- Replace the letters (variables) with the given values.
- Solve the mathematical sentence to find the value of the expression.
- Use the order of operations rules: Simplify within the brackets.
Multiply (\times) and/or divide (\div) in order from left to right.
Add ($+$) and/or subtract ($-$) in order from left to right.
- Use the sign rules: $+++ = +$ $--- = -$ $+-- = -$ $-+- = -$ (see skill 9.1, page 91)

Q. If $x = -2$ and $y = 3$,
find the value of $-3y - x$

A. $-3y - x = -3 \times 3 - (-2)$
 $= -3 \times 3 - (-2)$ Substitute $x = -2$ and $y = 3$
 $= -3 \times 3 - (-2)$ Multiply -3 by 3
 $= -9 + 2$ Add -9 and 2
 $= -7$

a) If $y = -x + 5$, find y when $x = -3$

$$y = -(-3) + 5 = 3 + 5 = 8$$

b) If $y = -3 + x$, find y when $x = -6$

$$y = -3 + (-6) = \boxed{}$$

c) If $y = 8x$, find y when $x = -4$

$$y = \boxed{}$$

d) If $y = -3x$, find y when $x = -2$

$$y = \boxed{}$$

e) If $y = \frac{15}{x}$, find y when $x = -5$

$$y = \boxed{}$$

f) If $y = \frac{12}{x}$, find y when $x = -6$

$$y = \boxed{}$$

g) If $y = 2x - 5$, find y when $x = -3$

$$y = 2 \times (-3) - 5 = -6 - 5 = \boxed{}$$

h) If $y = 3x - 4$, find y when $x = -1$

$$y = \boxed{}$$

i) If $m = -5$ and $n = 0$,
find the value of $2m - 3n$

$$2 \times m - 3 \times n =$$

$$= 2 \times (-5) - 3 \times 0 = -10 - 0 = \boxed{}$$

j) If $a = 6$ and $b = -2$,
find the value of $2b - 5a$

$$= \boxed{}$$

k) If $p = 2$ and $q = -10$,
find the value of $p(3p + q)$

$$= \boxed{}$$

l) If $y = 1$ and $z = -4$,
find the value of $8 - 3z + 2y$

$$= \boxed{}$$

Skill 17.8 Substituting into more complex rules and expressions.

MM5.2 11 22 33 44
MM10 11 22 33 44

- Replace the letters (variables) with the given values.
- Solve the mathematical sentence to find the value of the expression.
- Use the order of operations rules: Simplify within the brackets.
Multiply (\times) and/or divide (\div) in order from left to right.
Add ($+$) and/or subtract ($-$) in order from left to right.

Q. If $a = 2$, $b = -5$ and $c = 3$,
find the value of $\frac{1}{2a}(3b - c)$

A. $\frac{1}{2a}(3b - c) = 3b = 3 \times b$

$$= \frac{1}{2 \times a} \times (3 \times b - c) \quad \text{Substitute } a = 2, b = -5 \text{ and } c = 3$$

$$= \frac{1}{2 \times 2} \times (3 \times -5 - 3) \quad \text{Evaluate the bracket}$$

$$= \frac{1}{4} \times (-15 - 3) \quad \text{Multiply 2 by 2}$$

$$= \frac{1}{4} \times -18 \quad \text{Multiply the results}$$

$$= -4.5$$

a) If $y = x^3 + 2$, find y when $x = 3$

$$y = 3^3 + 2 = 27 + 2 = \boxed{29}$$

b) If $y = x^3 - 100$, find y when $x = 5$

$$y = \dots = \boxed{}$$

c) If $x = 5$ and $y = 2$,
find the value of $\frac{x}{3} + \frac{y}{5}$

$$\frac{5}{3} + \frac{2}{5} = \frac{25 + 6}{15} = \frac{31}{15} = \boxed{2\frac{1}{15}}$$

d) If $a = 7$ and $b = 3$,
find the value of $\frac{a}{5} - \frac{b}{7}$

$$\dots = \boxed{}$$

e) If $y = \frac{3x - 5}{x}$, find y when $x = 5$

$$y = \dots = \boxed{}$$

f) If $y = x^2(x + 2)$, find y when $x = -3$

$$y = \dots = \boxed{}$$

g) If $a = 8$ and $b = -10$,
find the value of $\frac{a}{4}(b - 12)$

$$\dots = \boxed{}$$

h) If $x = -3$, $y = 3$ and $z = 6$,
find the value of $\frac{9}{y}(yz + x)$

$$\dots = \boxed{}$$

i) If $x = -4$,
find the value of $\frac{x^2 - 3x}{2}$

$$\frac{(-4)^2 - 3 \times -4}{2} = \frac{16 + 12}{2} = \frac{28}{2} = \boxed{14}$$

j) If $a = -4$ and $b = -10$,
find the value of $a^2 + \frac{2b}{5}$

$$\dots = \boxed{}$$

- Replace the letter (variable) x with the given value.
- Solve the mathematical sentence to find the value of y .
- Use the order of operations rules: Multiply (\times) and/or divide (\div) in order from left to right.
Add ($+$) and/or subtract ($-$) in order from left to right.

Q. If $y = 3x^2 + x - 6$, find y when $x = -2$

A. $y = 3x^2 + x - 6$
 $= 3 \times x^2 + x - 6$ Substitute $x = -2$
 $= 3 \times (-2)^2 + -2 - 6$ Evaluate $(-2)^2$
 $= 3 \times 4 - 2 - 6$ Multiply 3 by 4
 $= 12 - 2 - 6$ Subtract 2 and 6
 $= 4$ from 12

a) If $y = x^2 + 2x$, find y when $x = 4$

$$y = 4^2 + 2 \times 4 = 16 + 8 = \boxed{24}$$

b) If $y = x^2 + 3x$, find y when $x = 0$

$$y = \dots = \boxed{}$$

c) If $y = x^2 - 3x + 2$, find y when $x = 1$

$$y = \dots = \boxed{}$$

d) If $y = x^2 - 4x + 3$, find y when $x = 3$

$$y = \dots = \boxed{}$$

e) If $y = x^2 + 6x - 5$, find y when $x = 2$

$$y = \dots = \boxed{}$$

f) If $y = x^2 - 4x - 10$, find y when $x = 5$

$$y = \dots = \boxed{}$$

g) If $y = 2x^2 - 3x + 1$, find y when $x = 1$

$$y = \dots = \boxed{}$$

h) If $y = 3x^2 - 11x + 6$, find y when $x = 3$

$$y = \dots = \boxed{}$$

i) If $y = 4x^2 + x - 7$, find y when $x = 2$

$$y = \dots = \boxed{}$$

j) If $y = 5x^2 - 2x - 1$, find y when $x = 0$

$$y = \dots = \boxed{}$$

k) If $y = 3x^2 - x + 4$, find y when $x = 3$

$$y = \dots = \boxed{}$$

l) If $y = 2x^2 + 6x$, find y when $x = -2$

$$y = \dots = \boxed{}$$

m) If $y = x^2 - 5x + 6$, find y when $x = -1$

$$y = \dots = \boxed{}$$

n) If $y = x^2 - 16$, find y when $x = -4$

$$y = \dots = \boxed{}$$

o) If $y = x^2 - 3x - 4$, find y when $x = -2$

$$y = \dots = \boxed{}$$

p) If $y = x^2 + 2x - 9$, find y when $x = -3$

$$y = \dots = \boxed{}$$