17. [Substitution]

Skill 17.1 Substituting value 0 into simple expressions.

- Replace the variable (letter) 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
$= \mathbf{0}$

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

$12 + 0$ = 12

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

..... =

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

..... =

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

..... =

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

$8 - 0$ = 8

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

..... =

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

..... =

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

..... =

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

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

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

..... =

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

..... =

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

..... =

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

..... =

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

..... =

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

..... =

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

..... =

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

- Replace the variable (letter) 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. $18 - 3x =$ ($3x = 3 \times x$)
$= 18 - 3 \times x$ Substitute $x = 4$
$= 18 - 3 \times 4$ Multiply 3 by 4
$= 18 - 12$ Subtract 12 from 18
$= \mathbf{6}$

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

$36 + c = 36 + 5$ = 41

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

.....= ☐

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

.....= ☐

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

.....= ☐

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

.....= 5

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

.....= ☐

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

.....= ☐

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

$7x = 7 \times x = 7 \times 8$ = ☐

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

.....= ☐

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

.....= ☐

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

.....= ☐

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

.....= ☐

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

.....
= .....= ☐

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

.....
= .....= ☐

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

.....
= .....= ☐

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

.....
= .....= ☐

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

- Replace the two 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.
$\frac{4x - y}{2} =$ ($4x = 4 \times x$)
$= \frac{4 \times x - y}{2}$ 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
$= \mathbf{4}$

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

$3 \times c - 5 \times d$
$= 3 \times 5 - 5 \times 3 = 15 - 15$ = 0

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

= ..... =

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

= ..... =

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

= ..... =

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

= ..... =

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

= ..... =

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

= ..... =

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

= ..... =

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

= ..... =

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

= ..... =

Skill 17.4 Substituting into rules.

- Replace the variables x with the given value.
- Solve the mathematical sentence to find the value of y.
- 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 $y = 4x^2 - 3$, find y when $x = 2$

A. $y = 4x^2 - 3$ ($4x^2 = 4 \times x^2$)
$= 4 \times x^2 - 3$ 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
$= \mathbf{13}$

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

$y = 12 - 9$ = 3

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

$y =$ .....

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

$y = 4 \times 2 + 8 = 8 + 8$ = ...

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y = 18 \div 2 - 7 = 9 - 7$ = ...

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

Skill 17.5 Substituting into formulae.

- Replace the variables with the given values.
- Solve the mathematical sentence to find the requested value in the formula.
- 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. Use $V = \pi r^2 h$ to find the volume of a cylinder when $r = 10$, $h = 5$ and $\pi \approx 3.14$

A. $V = \pi r^2 h$ ($\pi r^2 h = \pi \times r^2 \times h$)

$= \pi \times r^2 \times h$

$\approx 3.14 \times 10^2 \times 5$ Substitute $r = 10$, $h = 5$ and $\pi \approx 3.14$ and evaluate 10^2

$= 3.14 \times 100 \times 5$ Multiply 3.14 by 100

$= 314 \times 5$ Multiply the result by 5

$= \mathbf{1570}$

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

$P = 4 \times l = 4 \times 4.5$ = 18

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

..... =

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

$A = l \times w =$ ..... =

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

..... =

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

..... =

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

..... =

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

..... =

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

..... =

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

..... =

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

..... =

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

..... =

= ..... =

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

.....

= ..... $a =$

Skill 17.6 Substituting into rules, expressions and formulae with brackets.

MM5.2 1 1 2 2 3 3 4 4
MM6.1 1 1 2 2 3 3 4

- Replace the 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 (×) and/or divide (÷) 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. $y = (x + 3)(x - 4)$ ( ) = ( ) × ( )
$= (x + 3) \times (x - 4)$ Substitute $x = 6$
$= (6 + 3) \times (6 - 4)$ Evaluate each bracket.
$= 9 \times 2$ Multiply the results.
$= \mathbf{18}$

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

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

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

$y = 5 \times (6 - 2)$ =

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

$y =$ =

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

$y =$ =

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

$y =$ =

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

$y =$ =

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

$y =$ =

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

$y =$ =

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

$c \times (d - 10) =$

$= 5 \times (15 - 10) = 5 \times 5$ =

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

$y \times (x + 16) =$

= =

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

=

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

=

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

=

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

=

Skill 17.7 Substituting negative values into rules and expressions.

- Replace the 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 (×) and/or divide (÷) 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 93)

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

A. $-3y - x =$ (3y = 3 × y)
$= -3 \times y - x$ 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 $x = -6$

$y = -3 + - 6$ (+ – = –) $=$

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

$y =$ $=$

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

$y =$ $=$

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

$y =$ $=$

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

$y =$ $=$

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

$y = 2 \times -3 - 5 = -6 - 5$ $=$

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

$y =$ $=$

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

$2 \times m - 3 \times n =$
$= 2 \times -5 - 3 \times 0 = -10 - 0$ (+ × – = –) $=$

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

$=$ $=$

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

$=$ $=$

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

$=$ $=$

Skill 17.8 Substituting into more complex rules and expressions.

- Replace the 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 (×) and/or divide (÷) 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. $\frac{1}{2a}(3b - c) =$ ($3b = 3 \times b$)

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

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

Multiply 2 by 2

$= \frac{1}{4} \times (-15 - 3)$

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

$= \mathbf{-4.5}$

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

$y = 3^3 + 2 = 27 + 2$ = 29

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

$y =$ .....

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

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

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

.....

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

$y =$ .....

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

$y =$ .....

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

.....

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

.....

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

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

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

.....

Skill 17.9 Substituting into quadratic rules.

- Replace the variable x with the given value.
- Solve the mathematical sentence to find the value of y.
- 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 $y = 3x^2 + x - 6$, 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 from 12
$= \mathbf{4}$	

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

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

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....

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

$y =$ .....