# Simultaneous equations: substitution

ANSWERS

**1**

Solve the simultaneous equations.

(1) $\boxed{y} = x + 2$
(2) $4x + \boxed{3y} = 20$

Substitute (1) into (2)

$4x + 3(x + 2) = 20$
$4x + 3x + 6 = 20$
$7x = 14$
$x = 2$
(1) $y = 2 + 2$
$y = 4$

$x =$ 2 , $y =$ 4

**Check** in (2): 8 + 12 = 20 ✓

**2**

Solve the simultaneous equations.

(1) $\boxed{y} = 2x - 1$
(2) $3x + \boxed{2y} = 19$

Substitute (1) into (2)

$3x + 2(2x - 1) = 19$
$3x + 4x - 2 = 19$
$7x = 21$
$x = 3$
(1) $y = 2 \times 3 - 1$
$y = 5$

$x =$ 3 , $y =$ 5

**Check** in (2): 9 + 10 = 19 ✓

**3**

Solve the simultaneous equations.

(1) $\boxed{y} = 3x + 2$
(2) $x + \boxed{2y} = 18$

Substitute (1) into (2)

$x + 2(3x + 2) = 18$
$x + 6x + 4 = 18$
$7x = 14$
$x = 2$
(1) $y = 3 \times 2 + 2$
$y = 8$

$x =$ 2 , $y =$ 8

**Check** in (2): 2 + 16 = 18 ✓

**4**

Solve the simultaneous equations.

(1) $\boxed{y} = 5x - 4$
(2) $2x + \boxed{3y} = 22$

Substitute (1) into (2)

$2x + 3(5x - 4) = 22$
$2x + 15x - 12 = 22$
$17x = 34$
$x = 2$
(1) $y = 5 \times 2 - 4$
$y = 6$

$x =$ 2 , $y =$ 6

**Check** in (2): 4 + 18 = 22 ✓

**5**

Solve the simultaneous equations.

(1) $\boxed{x} = 2y + 1$
(2) $\boxed{3x} + 4y = 23$

Substitute (1) into (2)

$3(2y + 1) + 4y = 23$
$6y + 3 + 4y = 23$
$10y = 20$
$y = 2$
(1) $x = 2 \times 2 + 1$
$x = 5$

$x =$ 5 , $y =$ 2

**Check** in (2): 15 + 8 = 23 ✓

**6**

Solve the simultaneous equations.

(1) $\boxed{y} = 2x + 7$
(2) $5x + \boxed{2y} = -4$

Substitute (1) into (2)

$5x + 2(2x + 7) = -4$
$5x + 4x + 14 = -4$
$9x = -18$
$x = -2$
(1) $y = 2 \times (-2) + 7$
$y = 3$

$x =$ −2 , $y =$ 3

**Check** in (2): −10 + 6 = −4 ✓

**7**

Leo solves these simultaneous equations.

(1) $y = x + 6$
(2) $4x + 2y = 30$

He writes $4x + 2x + 6 = 30$.
Explain his mistake.
Then solve the equations.

He left out the bracket, so the 6 was not multiplied by 2.
$4x + 2(x + 6) = 30$, so $6x + 12 = 30$,
$6x = 18$, $x = 3$ and $y = 9$.

**Answer** $x = 3$, $y = 9$

**8**

Which pair would you solve by substitution? Explain why.
Then solve that pair.

**A**
(1) $y = 3x - 1$
(2) $2x + y = 14$

**B**
(1) $2x + 3y = 12$
(2) $4x - 3y = 6$

A, because (1) already starts y =.
(B: elimination, the y terms match.)
$2x + (3x - 1) = 14$, so $5x = 15$, $x = 3$
$y = 3 \times 3 - 1 = 8$

**Answer** A: $x = 3$, $y = 8$

# Simultaneous equations: substitution *further practice*

ANSWERS

**9**

Solve the simultaneous equations.

(1) $y = 2x - 5$

(2) $3x + 4y = 13$

Substitute (1) into (2)
$3x + 4(2x - 5) = 13$
$3x + 8x - 20 = 13$
$11x = 33$
$x = 3$
(1) $y = 2 \times 3 - 5$
$y = 1$

**Answer** $x = 3, y = 1$

**10**

Solve the simultaneous equations.

(1) $b = 2a + 3$

(2) $3a + 2b = 20$

Substitute (1) into (2)
$3a + 2(2a + 3) = 20$
$3a + 4a + 6 = 20$
$7a = 14$
$a = 2$
(1) $b = 2 \times 2 + 3$
$b = 7$

**Answer** $a = 2, b = 7$

**11**

The lines $y = 3x - 1$ and $y = x + 5$ cross at the point $P$. Find the coordinates of $P$.

$3x - 1 = x + 5$
$2x = 6$, so $x = 3$
$y = 3 + 5 = 8$

**Answer** $P(3, 8)$

**12**

Solve the simultaneous equations.

(1) $x = 5 - 2y$

(2) $3x + 4y = 13$

Substitute (1) into (2)
$3(5 - 2y) + 4y = 13$
$15 - 6y + 4y = 13$
$-2y = -2$
$y = 1$
(1) $x = 5 - 2 \times 1$
$x = 3$

**Answer** $x = 3, y = 1$

**13**

A rectangle's length is 4 cm more than twice its width. Its perimeter is 44 cm. Let $w$ be its width and $l$ its length, in cm. Find its width and length.

$l = 2w + 4$
Substitute (1) into (2)
$2w + 2(2w + 4) = 44$
$2w + 4w + 8 = 44$
$6w = 36$
$w = 6$
(1) $l = 2 \times 6 + 4$
$l = 16$

**Answer** width 6 cm, length 16 cm

**14**

An adult ticket costs £3 more than a child ticket. 2 adult tickets and 3 child tickets cost £36. Let $a$ be the cost of an adult ticket and $c$ a child ticket, in pounds. Find both costs.

$a = c + 3$
Substitute (1) into (2)
$3c + 2(c + 3) = 36$
$3c + 2c + 6 = 36$
$5c = 30$
$c = 6$
(1) $a = 6 + 3$
$a = 9$

**Answer** child £6, adult £9

**15**

Write a pair of simultaneous equations with the solution $x = 2, y = 5$, where one equation starts $y =$.

For example. Check: $2 \times 2 + 1 = 5$ and $6 + 5 = 11$

**Answer** $y = 2x + 1$, $3x + y = 11$

**16**

Kai says you can't solve $3x + y = 10$ and $2x + 3y = 16$ by substitution, because neither equation starts $y =$. Show that you can, and solve them.

Rearrange first: $y = 10 - 3x$
Substitute (1) into (2)
$2x + 3(10 - 3x) = 16$
$2x + 30 - 9x = 16$
$-7x = -14$
$x = 2$
(1) $y = 10 - 3 \times 2$
$y = 4$

**Answer** $x = 2, y = 4$