

PROJECT MATHS

Text & Tests

Leaving

3

Certificate

Algebra 1

chapter

1

Section 1.10 Changing the subject of a formula

Rearrange the given equation to make a letter the subject of the formula.

Use stabilizers to rearrange the equation.

Ex 1) Express p in terms of t and k when
 $t p - k = 7k$, $t \neq 0$.

Make p the subject of the formula
we want p on its own

$$t p - k = 7k$$

$$\begin{array}{l|l} +k & t p = 8k \\ \div t & p = \frac{8k}{t} \end{array} \quad \begin{array}{l} +k \\ \div t \end{array}$$

Eg 2) Make x the subject of the formula.

$$\textcircled{1} \quad x - y = 22$$
$$+y \mid x = 22 + y \mid +y$$

C/W

Pg 21

Q5 \rightarrow 12.

$$\textcircled{2} \quad 3x - b = 4c$$
$$+b \mid 3x = 4c + b \mid +b$$
$$\div 3 \mid x = \frac{4c + b}{3} \mid \div 3$$

$$\textcircled{3} \quad \overset{3 \downarrow}{\cancel{x}} - \overset{3 \downarrow}{2y} = \overset{3 \downarrow}{8} = x - 6y = 24$$
$$+6y \mid x = 24 + 6y \mid +6y$$

Notes

In the equation $x = 2y - z$, we say that x is expressed in terms of y and z , or that x is the **subject** of the formula.

If the formula is changed to the form $z = 2y - x$, then z is the subject of the formula.

If we rearrange a formula (or equation) so that there is a different variable on the left-hand side, we are said to have **changed the subject of the formula**.

The process of changing the subject of a formula is very similar to the steps we use when solving an equation.

The following examples will illustrate the basic rules for changing the subject of a formula.

An equation remains unchanged if the same operation is performed on both sides.

Example 1

If $bc - d = a$, make c the subject of the formula.

Example 2

If $x = \frac{3y}{2} - 1$, make y the subject of the formula.

Example 3

If $a = \frac{bc}{b+c}$, make c the subject of the formula.

Exercise 1.10

Answer: (i) $x = \frac{y+4}{2}$ (ii) $b = \frac{a+6}{8}$ (iii) $d = \frac{c+1}{4}$ (iv) $k = \frac{h+2}{2}$

1. Make the underlined letter the subject of the formula in each of the following:

(i) $2\underline{x} - 4 = y$

(ii) $a = 8\underline{b} - 6$

(iii) $c = 4\underline{d} - 1$

(iv) $h = 2\underline{k} - 2$

Exercise 1.10

Answer:

$$(i) b = \frac{a + 5}{3}$$

$$(ii) w = \frac{b - 2}{4}$$

$$(iii) e = \frac{d + 12}{6}$$

$$(iv) h = \frac{-g + 18}{5}$$

2. Rearrange each of these formulas to make the underlined letter the subject:

$$(i) a = 3\underline{b} - 5$$

$$(ii) b = 4\underline{w} + 2$$

$$(iii) d = 6e - 12$$

$$(iv) g = 18 - 5h$$

Exercise 1.10

Answer:

$$(i) t = \frac{v - u}{a}$$

$$(ii) p = \frac{k - bq}{a}$$

$$(iii) g = 5(p - 3h)$$

3. Copy and complete each of the following:

(i) $v = u + at$

$$v - \square = at$$

$$t = \dots$$

(ii) $ap + bq = k$

$$ap = k - \square$$

$$p = \frac{k - \square}{\square}$$

(iii) $p = \frac{g}{5} + 3h$

$$p - \square = \frac{g}{5}$$

$$\square(p - \square) = g$$

$$g = \dots$$

Exercise 1.10

Answer:

$$(i) x = y + 2z$$

$$(ii) x = \frac{b + 4c}{3}$$

$$(iii) x = \frac{-6y + 7}{3}$$

$$(iv) x = 6y + 24$$

4. Make x the subject of the formula in each of these:

$$(i) x - y = 2z$$

$$(ii) 3x - b = 4c$$

$$(iii) 6y + 3x = 7$$

$$(iv) \frac{x}{3} - 2y = 8$$

Exercise 1.10

Answer:

$$(i) a = \frac{2b + 1}{4}$$

$$(ii) a = \frac{5}{b - 3}$$

$$(iii) a = \frac{4b + 21}{7}$$

5. Make a the subject of the formula in each of these:

$$(i) 2a - b = \frac{1}{2}$$

$$\begin{aligned} 4a - 2b &= 1 \\ +2b \quad | \quad 4a &= 2b + 1 \quad | +2b \\ \div 4 \quad | \quad a &= \frac{2b + 1}{4} \quad | \div 4 \end{aligned}$$

$$\frac{b}{2} + \frac{1}{4}$$

$$(ii) ab - 3a = 5$$

factorize

$$a(b - 3) = 5$$

$$a = \frac{5}{b - 3}$$

$$(iii) 7(a - 3) = 4b$$

$$\begin{aligned} 7a - 21 &= 4b \\ +21 \quad | \quad 7a &= 4b + 21 \quad | +21 \\ \div 7 \quad | \quad a &= \frac{4b + 21}{7} \quad | \div 7 \end{aligned}$$

$$\frac{4b}{7} + 3$$

Exercise 1.10

Answer: (i) $a = b(k + 2)$

(ii) $v = \frac{u}{s - 10}$

6. (i) Make a the subject of the formula

$$k = \frac{a}{b} - 2$$

$$bk = a - 2b$$

$$\begin{array}{l} +2b \mid bk + 2b = a \mid +2b \\ \mid b(k+2) = a \mid \end{array}$$

(ii) Make v the subject of the formula

$$s = \frac{u}{v} + 10$$

$$vs = u + 10v$$

$$\begin{array}{l} -10v \mid vs - 10v = u \mid -10v \\ \div (s-10) \mid v(s-10) = u \mid (s-10) \end{array}$$

$$v = \frac{u}{s-10}$$

HLW Pg 21
Q7

Exercise 1.10

Answer: (i) $a = 2(c + 4b)$ (ii) $a = \frac{4b + 3c}{2}$ (iii) $x = \frac{y + 1}{6}$

7. Make the letter in brackets the subject of the formula in each of the following:

(i) $c = \frac{a}{2} - 4b \dots (a)$

$$2c = a - 8b$$

$$+8b \mid 2c + 8b = a \mid +8b$$

(ii) $2(a - 2b) = 3c \dots (a)$

$$2a - 4b = 3c$$

$$+4b \mid 2a = 3c + 4b \mid +4b$$

$$\div 2 \mid a = \frac{3c + 4b}{2} \mid \div 2$$

(iii) $2x - \frac{1}{3} = \frac{y}{3} \dots (x)$

$$6x - 1 = y$$

$$+1 \mid 6x = y + 1 \mid +1$$

$$\div 6 \mid x = \frac{y + 1}{6} \mid \div 6$$

Exercise 1.10

Answer: (iv) $b = \frac{a + 30}{10}$ (v) $z = \frac{-3x + y}{2}$ (vi) $b = \frac{4a + 3c}{2}$

7. Make the letter in brackets the subject of the formula in each of the following:

(iv) $5(b - 3) = \frac{a}{2} \dots (b)$

$$\begin{array}{l} 2 \downarrow \quad 2 \quad \cancel{1} \\ 5b - 15 = \frac{a}{2} \\ \quad \quad \quad \cancel{2} \end{array}$$

$$10b - 30 = a$$

$$\begin{array}{l} +30 \mid 10b = 30 + a \mid +30 \\ \div 10 \mid b = \frac{30 + a}{10} \mid \div 10 \end{array}$$

(v) $x = \frac{y - 2z}{3} \dots (z)$

$$3x = y - 2z$$

$$\begin{array}{l} +2z \mid 2z + 3x = y \mid +2z \\ -3x \mid 2z = y - 3x \mid -3x \\ \div 2 \mid 2 = \frac{y - 3x}{2} \mid \div 2 \end{array}$$

(vi) $a = \frac{b}{2} - \frac{3c}{4} \dots (b)$

$$4a = 2b - 3c$$

$$\begin{array}{l} +3c \mid 4a + 3c = 2b \mid +3c \\ \div 2 \mid \frac{4a + 3c}{2} = b \mid \div 2 \end{array}$$

Exercise 1.10

Answer: (i) $a = \frac{mn}{m-n}$ (ii) $n = \frac{b-a+d}{d}$

8. (i) Make a the subject of the formula $ma = n(m+a)$.
 (ii) Make n the subject of the formula $b = a + (n-1)d$.

(i) $ma = n(m+a)$
 $ma = mn + an$
 $-an \mid ma - an = mn \mid -an$
 $\cdot \mid a(m-n) = mn \mid \div m-n$
 $-m-n \mid a = \frac{mn}{m-n}$

ii) $b = a + dn - d$
 $-a \mid b - a = dn - d \mid -a$
 $+d \mid b - a + d = dn \mid +d$
 $\div d \mid \frac{b - a + d}{d} = n \mid \div d$

Exercise 1.10

Answer: (i) $y = \frac{3x}{20} - z$ (ii) $b = \frac{6c}{2a - 3c}$

9. Make the letter in brackets the subject of the formula in each of the following:

(i) $\frac{3x}{4} = 5(y + z) \dots (y)$

(ii) $\frac{ab}{3} = \frac{b}{2} + c \dots (b)$

Exercise 1.10

Answer: (iii) $y = \frac{x - tz}{2}$ (iv) $t = \frac{q^2}{p - q}$

9. Make the letter in brackets the subject of the formula in each of the following:

(iii) $t = \frac{x - 2y}{z}$... (y)

(iv) $\frac{p}{q} = \frac{q}{t} + 1$... (t)

Exercise 1.10

Answer: (i) $a = \frac{b + xb}{x - 1}$ (ii) $x = \frac{y + 4}{y - 3}$ (iii) $r = \frac{pq}{p + q}$

10. Make the letter in brackets the subject of the formula in each of these:

(i) $x = \frac{a + b}{a - b} \dots (a)$

(ii) $y = \frac{3x + 4}{x - 1} \dots (x)$

(iii) $p = \frac{qr}{q - r} \dots (r)$

Exercise 1.10

Answer: $k = \frac{abe}{ab - d}$

11. Make k the subject of the formula $ab = \frac{dk}{k - e}$.

12. Which of the following are correct arrangements of $s = w - \frac{g}{r}$?

A $w = s - \frac{g}{r}$

B $g = r(s - w)$

C $r = \frac{g}{s - w}$

D $r = \frac{g}{w - s}$

E $w = \frac{g}{r} + s$

F $g = r(w - s)$

Exercise 1.10

Answer: (i) $b = x^2 - a$ (ii) $y = \frac{x}{a^2}$ (iii) $b = \frac{4a}{k^2}$

13. By squaring each side, make the letter in brackets the subject of the formula in each of these:

(i) $x = \sqrt{a + b} \dots (b)$

(ii) $a = \sqrt{\frac{x}{y}} \dots (y)$

(iii) $k = 2\sqrt{\frac{a}{b}} \dots (b)$

Exercise 1.10

Answer: $F = \frac{9C + 160}{5}$

14. If $C = \frac{5}{9}(F - 32)$, make F the subject of the formula.

Exercise 1.10

Answer: (i) $q = \frac{8p}{pt - 8}$ (ii) $b = \frac{am}{ac + m}$

15. (i) Make q the subject of the formula $t = \frac{8(p + q)}{pq}$.

(ii) If $m = \frac{cab}{a - b}$, express b in terms of a , c and m .