

National 5: Changing the Subject of a Formula

To understand this algebra skill you will need to make use of the video links that are provided and look carefully at the examples given. There are lots of variations on this type of question so the more questions you attempt the better.

What does 'changing the subject of a formula' mean?

Task 1 – Using Simple Formulas

Video: Watch from the start to 10:59 <https://www.youtube.com/watch?v=RCWoP69ooLA&feature=youtu.be>

Example 1:

$a = 3b - 1$

To make b 'the **subject**', you need to re-arrange the formula to get b on its own.

$$\begin{array}{l} a = 3b - 1 \\ a + 1 = 3b \\ \frac{a + 1}{3} = b \end{array}$$

+ 1 to both sides

Divide both sides by 3

Example 2:

$m = 7n + 5$

To make n 'the **subject**', you need to re-arrange the formula to get n on its own.

$$\begin{array}{l} m = 7n + 5 \\ m - 5 = 7n \\ \frac{m - 5}{7} = n \end{array}$$

- 5 from both sides

Divide both sides by 7

Example 3:

$s = 3t + 5u$

To make u 'the **subject**', you need to re-arrange the formula to get u on its own.

$$\begin{array}{l} s = 3t + 5u \\ s - 3t = 5u \\ \frac{s - 3t}{5} = u \end{array}$$

- 3t from both sides

Divide both sides by 5

**Now try Exercise 1, checking your answers regularly.
Complete a selection of questions from across the exercise.**

In Questions 1 - 4, change the subject of the given formula to x :-

1. (a) $x - c = b$ (b) $x + 5 = y$ (c) $x + r = s$ (d) $x - a = p$

(e) $g = x + h$ (f) $m = x - t$ (g) $7 = c - x$ (h) $k = l - x$

2. (a) $\frac{x}{p} = q$ (b) $\frac{x}{9} = m$ (c) $\frac{x}{3} = 10$ (d) $\frac{x}{n} = r$

(e) $k = \frac{l}{x}$ (f) $\frac{x}{g} = \frac{h}{4}$ (g) $\frac{x}{a} = \frac{b}{c}$ (h) $\frac{v}{w} = \frac{d}{4x}$

3. (a) $2x + 5 = a$ (b) $4x + p = q$ (c) $5x - q = r$ (d) $7x - y = m$

(e) $ax + b = w$ (f) $g = cx + 2$ (g) $b = mx + q$ (h) $e = v - wx$

4. (a) $\frac{x + 1}{2} = 5$ (b) $\frac{x + 1}{2} = y$ (c) $\frac{x - 5}{2} = 3$ (d) $\frac{x - 7}{4} = 8$

(e) $\frac{x + 2}{b} = c$ (f) $\frac{x - 9}{r} = s$ (g) $\frac{x - k}{d} = e$ (h) $w = \frac{t + x}{v}$

Answers to Ex. 1

- | | | | | |
|----|---|-----------------|---|-----------------|
| 1. | a | $x = b + c$ | b | $x = y - 5$ |
| | c | $x = s - r$ | d | $x = p + a$ |
| | e | $x = g - h$ | f | $x = m + t$ |
| | g | $x = c - 7$ | h | $x = l - k$ |
| 2. | a | $x = pq$ | b | $x = 9m$ |
| | c | $x = 30$ | d | $x = nr$ |
| | e | $x = l/k$ | f | $x = 8h/4$ |
| | g | $x = ab/c$ | h | $x = 4v/d$ |
| 3. | a | $x = (a - 5)/2$ | b | $x = (q - p)/4$ |
| | c | $x = (r + q)/5$ | d | $x = (m + y)/7$ |
| | e | $x = (w - b)/a$ | f | $x = (g - 2)/c$ |
| | g | $x = (b - q)/m$ | h | $x = (v - e)/w$ |
| 4. | a | $x = 9$ | b | $x = 2y - 1$ |
| | c | $x = 11$ | d | $x = 4g + 7$ |
| | e | $x = bc - 2$ | f | $x = rs + 9$ |
| | g | $x = dc + k$ | h | $x = wv - t$ |

Task 2 Using more complicated formulas.

Video: Watch from the start to 4:39 https://www.youtube.com/watch?v=FdB_q42PBt4

Example 1:

Rearrange the following equation to make a the subject.

$$\begin{aligned}6a^2 &= 12b \\ a^2 &= 2b \\ a &= \sqrt{2b}\end{aligned}$$

$\div 6$
 $\sqrt{\text{ (Square root)}}$

Example 2:

Rearrange the following equation to make r the subject.

$$\begin{aligned}V &= \frac{4}{3}\pi r^3 \\ 3V &= 4\pi r^3 \\ \frac{3V}{4\pi} &= r^3 \\ \sqrt[3]{\frac{3V}{4\pi}} &= r\end{aligned}$$

$\times 3$
 $\div 4\pi$
 $\sqrt[3]{\text{ (Cube root)}}$

Example 3:(Quite Tricky)

- Rearrange the following equation to make y the subject.

You cannot make a letter the subject if it appears in multiple terms
→ In this type of question you will need to factorise at some point!

$$\begin{aligned}x &= ay + by \\ x &= y(a + b) \\ \frac{x}{(a + b)} &= y\end{aligned}$$

Factorise
Divide by (a + b)

Now try Exercise 2, checking your answers regularly.
Complete a selection of questions from across the exercise.

1. Change to the letter given in brackets:

(a) $m = kn^2$ (n) (b) $V = \pi r^2 h$ (r) (c) $p^2 + q^2 = r^2$ (p)
 (d) $a^2 = 2ab^2 + d$ (b) (e) $w = \frac{1}{2}uv^2$ (v) (f) $J = \frac{1}{4}h^3 p$ (h)

2. Change to the letter given in brackets:

(a) $g = \sqrt{f}$ (f) (b) $W = \frac{1}{5}\sqrt{v}$ (v) (c) $k = \frac{7\sqrt{m}}{n}$ (m)
 (d) $S = \sqrt{\frac{A}{\pi d}}$ (d) (e) $n = 2\pi\sqrt{\frac{L}{P}}$ (P) (f) $W = \frac{5}{2\sqrt{x}}$ (x)

3. Change to the letter 'x':

(a) $px + qx = r$ (b) $mx = nx + k$

4. Change the subject of each formula to 'x'.

(a) $x - g = h$ (b) $k = p - x$ (c) $y = \frac{v}{x}$ (d) $\frac{6}{w} = \frac{m}{3x}$
 (e) $gx + t = s$ (f) $a = b - cx$ (g) $\frac{x+1}{5} = h$ (h) $m = \frac{p+x}{n}$
 (i) $b = a(x - c)$ (j) $V = 9x^2y$ (k) $p = \frac{1}{5}(2x + 5)$ (l) $a = \frac{5\sqrt{x}}{b}$

Answers to Exercise 2

1. (apologies for print quality)

a $n = \sqrt{\frac{m}{k}}$ b $r = \sqrt{\frac{V}{\pi h}}$
 c $p = \sqrt{r^2 - q^2}$ d $b = \sqrt{\frac{(a^2 - d)}{2a}}$
 e $v = \sqrt{\frac{2w}{u}}$ f $h = \sqrt[3]{\frac{4J}{P}}$

2. a $f = g^2$ b $v = 25w^2$
 c $m = (kn/\gamma)^2$ d $d = A/\pi^2$
 e $p = 4\pi^2L/n^2$ f $x = (\sqrt{\frac{2w}{L}})^2$

3. a $x = h + g$ b $x = p - k$
 c $x = v/y$ d $x = \frac{wm}{18}$
 e $x = (s-t)/g$ f $x = (b-a)/c$
 g $x = 5h - 1$ h $x = mn - p$
 i $x = b/a + c$ j $x = \sqrt[3]{by}$

Task 3 N5 Exam Questions

If you are feeling confident with the work above, try the N5 exam questions on this topic.

I've linked each question with a worked solution.

1.

The area of a trapezium is given by the formula

$$A = \frac{1}{2}h(x + y).$$

Make x the subject of the formula.

Solution: <https://www.youtube.com/watch?v=LKdUVYFX-5o>

2.

Change the subject of the formula $y = g\sqrt{x} + h$ to x .

Solution: 1:45 to 3:08 <https://www.youtube.com/watch?v=1mMndokq6-s>

3.

Change the subject of the formula $F = \frac{t^2 + 4b}{c}$ to b .

Solution: Start to 1:14 <https://www.youtube.com/watch?v=nGuVERRILDs>