Literal Equations Worksheet

Solve a formula for one letter · geometry and science formulas · exact answers

Name _____ **Date** _____ **Score** _____ **/ 28**

THE METHOD

A literal equation has more than one letter. Solving it for one letter means getting that letter alone on one side — the other letters are treated exactly like numbers.

1. Decide which letter you are solving for. Everything else is a number.
2. Undo addition and subtraction first, then multiplication and division — the same inverse operations, in the same order, as any equation.
3. Whatever you do to one side, do to the other.
4. If the letter you want appears in more than one term, gather those terms on one side and **factor it out**.
5. Leave the answer as a fraction or a radical. There are no decimals to round to.

WORKED EXAMPLE — solve $P = 2l + 2w$ for w

Step 1. w is the one we want, so P and l behave like numbers.

Step 2. Subtract $2l$ from both sides: $P - 2l = 2w$

Step 3. Divide both sides by 2: $\frac{P - 2l}{2} = w$

Step 4. Write it the usual way round: $w = \frac{P - 2l}{2}$ (the same steps as solving $48 = 2(15) + 2w$, with letters instead of numbers)

SECTION A One step

Each of these needs a single division. Solve for the letter named under the formula.

1 $d = rt$

Solve for t

Answer $t =$ _____

2 $A = lw$

Solve for w

Answer $w =$ _____

3 $C = 2\pi r$

Solve for r

Answer $r =$ _____

4 $V = Bh$

Solve for h

Answer $h =$ _____

5 $F = ma$

Solve for a

Answer $a =$ _____

6 $I = Prt$

Solve for r

Answer $r =$ _____

THE MISTAKE TO AVOID

Dividing by the wrong thing. To get r out of $I = Prt$, the r is multiplied by *both* P and t, so both have to go: divide by Pt, not by P alone. And a letter only cancels when it is a factor of the **whole** side — in $S = 2\pi r^2 + 2\pi rh$ you cannot divide just the h term by $2\pi r$.

Practise free online: ► Equation Solver ► Multi-Step Equations Worksheet ► Math Worksheets

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Literal Equations Worksheet

Two steps · show every line of working

SECTION B Two steps

Undo the addition or subtraction first, then the multiplication or division.

7 $y = mx + b$

Solve for x

Answer $x =$ _____

8 $P = 2l + 2w$

Solve for w

Answer $w =$ _____

9 $A = \frac{bh}{2}$

Solve for b

Answer $b =$ _____

10 $3x + 4y = 12$

Solve for y

Answer $y =$ _____

11 $ax + b = c$

Solve for x

Answer $x =$ _____

12 $y - y_1 = m(x - x_1)$

Solve for x

Answer $x =$ _____

SECTION C Real formulas

Geometry and science formulas. Leave π and radicals exactly as they are; take the positive root.

13 $A = \frac{h(b_1 + b_2)}{2}$

Solve for b_1

Answer $b_1 =$ _____

14 $C = \frac{5(F - 32)}{9}$

Solve for F

Answer $F =$ _____

15 $V = \pi r^2 h$

Solve for h

Answer $h =$ _____

16 $S = 2\pi r^2 + 2\pi rh$

Solve for h

Answer $h =$ _____

17 $a^2 + b^2 = c^2$

Solve for b

Answer $b =$ _____

18 $K = \frac{mv^2}{2}$

Solve for v

Answer $v =$ _____

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Literal Equations Worksheet

When the letter you want appears twice · gather, then factor

THE LETTER APPEARS TWICE

This is the part most sheets leave out, and the part exams ask about. If the letter you want sits in two terms, you cannot divide it away one term at a time.

Example: solve $ay = by + c$ for y. Gather: $ay - by = c$. Factor: $y(a - b) = c$. Divide: $y = \frac{c}{a - b}$.

Factoring is what makes the two terms into one, and only then can you divide.

SECTION D Gather and factor

In each one the letter you are solving for appears more than once. Collect its terms, factor it out, then divide.

19 $ax = bx + c$

Solve for x

Answer $x =$ _____

20 $S = rs + rt$

Solve for r

Answer $r =$ _____

21 $ay + y = T$

Solve for y

Answer $y =$ _____

22 $G = kp + 2ak$

Solve for k

Answer $k =$ _____

23 $P = S - Sdt$

Solve for S

Answer $S =$ _____

24 $m = np - qm$

Solve for m

Answer $m =$ _____

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Literal Equations Worksheet

Rearrange, then use it · this is what the formulas are for

SECTION E Rearrange and substitute

Solve each formula for the letter asked for, then put the numbers into your rearranged formula.

25 A deposit grows to $A = P(1 + rt)$. Solve for t, then find the number of years when $A = 1150$, $P = 1000$ and $r = 0.05$.

Rearranged $t =$ _____

Value $t =$ _____

26 The temperature conversion is $C = \frac{5}{9}(F - 32)$. Solve for F, then convert 35°C to Fahrenheit.

Rearranged $F =$ _____

Value $F =$ _____

27 A cylinder has volume $V = \pi r^2 h$. Solve for h, then find the height when $V = 150\pi$ cm^3 and $r = 5$ cm.

Rearranged $h =$ _____

Value $h =$ _____

28 A rectangle has perimeter $P = 2l + 2w$. Solve for w, then find the width when $P = 48$ m and $l = 15$ m.

Rearranged $w =$ _____

Value $w =$ _____

Stuck on the algebra rather than the formula? The multi-step equations worksheet on notesofmath.com drills the same inverse operations with numbers instead of letters.

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Answer Key

Every answer solved independently and substituted back into the original formula.

SECTION A One step

1. $d = rt$ for t

divide both sides by r

$t = \frac{d}{r}$

2. $A = lw$ for w

divide both sides by l

$w = \frac{A}{l}$

3. $C = 2\pi r$ for r

divide both sides by 2π

$r = \frac{C}{2\pi}$

4. $V = Bh$ for h

divide both sides by B

$h = \frac{V}{B}$

5. $F = ma$ for a

divide both sides by m

$a = \frac{F}{m}$

6. $I = Prt$ for r

divide both sides by Pt

$r = \frac{I}{Pt}$

SECTION B Two steps

7. $y = mx + b$ for x

subtract b, then divide by m

$y - b = mx$

$x = \frac{y-b}{m}$

8. $P = 2l + 2w$ for w

subtract 2l, then halve

$P - 2l = 2w$

$w = \frac{P-2l}{2}$

9. $A = \frac{bh}{2}$ for b

multiply by 2, then divide by h

$2A = bh$

$b = \frac{2A}{h}$

10. $3x + 4y = 12$ for y

subtract 3x, then divide by 4

$4y = 12 - 3x$

$y = \frac{12-3x}{4}$

11. $ax + b = c$ for x

subtract b, then divide by a

$ax = c - b$

$x = \frac{c-b}{a}$

12. $y - y_1 = m(x - x_1)$ for x

divide by m, then add x_1

$\frac{y-y_1}{m} = x - x_1$

$x = \frac{y-y_1}{m} + x_1$

SECTION C Real formulas

13. $A = \frac{h(b_1+b_2)}{2}$ for b_1

multiply by 2, divide by h, subtract b_2

$2A = h(b_1 + b_2)$

$\frac{2A}{h} = b_1 + b_2$

$b_1 = \frac{2A}{h} - b_2$

14. $C = \frac{5(F-32)}{9}$ for F

multiply by 9/5, then add 32

$\frac{9C}{5} = F - 32$

$F = \frac{9C}{5} + 32$

15. $V = \pi r^2 h$ for h

divide both sides by πr^2

$h = \frac{V}{\pi r^2}$

16. $S = 2\pi r^2 + 2\pi rh$ for h

subtract $2\pi r^2$, then divide by $2\pi r$

$S - 2\pi r^2 = 2\pi rh$

$h = \frac{S-2\pi r^2}{2\pi r}$

17. $a^2 + b^2 = c^2$ for b

subtract a^2, then take the positive root

$b^2 = c^2 - a^2$

$b = \sqrt{c^2 - a^2}$

18. $K = \frac{mv^2}{2}$ for v

multiply by 2, divide by m, take the positive root

$2K = mv^2$

$\frac{2K}{m} = v^2$

$v = \sqrt{\frac{2K}{m}}$

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Answer Key

Gather and factor, and the rearrange-then-substitute questions

SECTION D Gather and factor

19. $ax = bx + c$ for x

move both x terms to one side, factor out x, divide

$ax - bx = c$

$x(a - b) = c$

$x = \frac{c}{a-b}$

20. $S = rs + rt$ for r

factor out r, then divide

$S = r(s + t)$

$r = \frac{S}{s+t}$

21. $ay + y = T$ for y

factor out y, then divide

$y(a + 1) = T$

$y = \frac{T}{a+1}$

22. $G = kp + 2ak$ for k

factor out k, then divide

$G = k(p + 2a)$

$k = \frac{G}{p+2a}$

23. $P = S - Sdt$ for S

factor out S, then divide

$P = S(1 - dt)$

$S = \frac{P}{1-dt}$

24. $m = np - qm$ for m

add qm to both sides, factor out m, divide

$m + qm = np$

$m(1 + q) = np$

$m = \frac{np}{1+q}$

SECTION E Rearrange and substitute

25. $A = P(1 + rt)$ for t

divide by P, subtract 1, divide by r

$\frac{A}{P} = 1 + rt$

$\frac{A}{P} - 1 = rt$

$t = \frac{A-P}{Pr}$

With $A = 1150$, $P = 1000$, $r = 0.05$: $t = 3$

26. $C = \frac{5(F-32)}{9}$ for F

multiply by 9/5, then add 32

$\frac{9C}{5} = F - 32$

$F = \frac{9C}{5} + 32$

With $C = 35$: $F = 95$

27. $V = \pi r^2 h$ for h

divide both sides by πr^2

$h = \frac{V}{\pi r^2}$

With $V = 150\pi$, $r = 5$: $h = 6$

28. $P = 2l + 2w$ for w

subtract 2l, then halve

$P - 2l = 2w$

$w = \frac{P-2l}{2}$

With $P = 48$, $l = 15$: $w = 9$

A fraction answer is a finished answer. $w = \frac{P-2l}{2}$ is exact; writing it as a decimal only works once numbers replace the letters.

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