REARRANGING HARDER FORMULAE

BUILDING BLOCKS

NAME _____ CLASS _____ DATE _____

KEY IDEA

Treat a group like 2f as one block.

m	
p	2f

m = p + 2f so p = m – 2f

Squaring and square rooting undo each other.

$5^2 = 25$ and $(-5)^2 = 25$

so $x^2 = 25$ gives $x = 5$ or $x = -5$ $(\pm\sqrt{25})$

1 Use the bar models. Take the whole block away from both sides.

a)

m	
p	3f

p = ☐

b)

y	
3x	5k

3x = ☐ x = ☐

2 Squares and square roots.

a) 6^2 = ☐

b) $(-3)^2$ = ☐

c) $x^2 = 49$: x = ☐ or ☐

d) $x^2 = 100$: x = ☐ or ☐

3 Solve 10 = 16 – 2k. Fill in the boxes.

	10 = 16 – 2k	
+ 2k	10 + 2k = 16	☐
– 10	2k = ☐	☐
÷ 2	k = ☐	☐

TIP Add 2k to both sides

so the k term is positive.

4 A = $3r^2$. Fill in the inverse machine to make r the subject (r is positive).

r → square → r^2 → × 3 → A going in →

r = ☐ ← ☐ ← ☐ ← ☐ ← A ← inverse

REARRANGING HARDER FORMULAE

SUPPORT

NAME _____ CLASS _____ DATE _____

KEY IDEA

Make t the subject of $y = 5 - 4t$

Add 4t first so that the t term is positive. Then solve as normal.

$y = 5 - 4t$

$+4t$: $y + 4t = 5$

$-y$: $4t = 5 - y$

$\div 4$: $t = \frac{5 - y}{4}$

1 Make p the subject in a) and x the subject in b). Treat 3f and 5t as blocks.

a) $m = p + 3f$

$-3f$: $\square = p$

b) $y = 2x - 5t$

$+5t$: $\square = 2x$

$\square = x$

2 Make the letter shown the subject.

TIP Add the negative term to both sides first.

a) $y = 10 - x$ $x =$ ____ b) $p = 8 - 3q$ $q =$ ____

3 Make the letter shown the subject. Undo + or – first, then the square.

a) $A = s^2 + 4 \quad (s > 0)$ $s =$ ____

b) $y = 2x^2$ $x =$ ____

Remember: $x^2 = k$ gives $x = \pm\sqrt{k}$.

4 Two students give different answers. Test them with a number.

$\frac{a - 3}{-2}$ and $\frac{3 - a}{2}$ Put in a = 7: $\frac{7 - 3}{-2} =$ ____ $\frac{3 - 7}{2} =$ ____

Are the two expressions equivalent? YES NO

REARRANGING HARDER FORMULAE

CORE

NAME _____ CLASS _____ DATE _____

KEY IDEA

Look at the structure first: deal with whole terms (like 2as) as one block, make a negative term positive by adding it to both sides, and undo a square with $\pm\sqrt{}$ (keep only + for lengths).

FLUENCY

1 Make the letter shown the subject of each formula.

a) $v^2 = u^2 + 2as$ $a =$ ☐

b) $y = 3x^2$ $(x > 0)$ $x =$ ☐

c) $y = 7 - 2x$ $x =$ ☐

d) $V = \frac{1}{3}\pi r^2 h$ $h =$ ☐

e) $T = 2\sqrt{L}$ $L =$ ☐

f) $w = \frac{a - 5b}{3}$ $a =$ ☐

2 The kinetic energy of an object is $E = \frac{1}{2}mv^2$.

a) Make v the subject $(v > 0)$. ☐

b) v when E = 90, m = 5: ☐

REASONING

3 Ali and Bea make t the subject of $y = 9 - 3t$.

Ali $t = \frac{y - 9}{-3}$

Bea $t = \frac{9 - y}{3}$

Who is correct? Explain.

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.....

4 Explain why making x the subject of $y = x^2$ gives two answers. Use y = 16 as an example.

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REARRANGING HARDER FORMULAE

GREATER DEPTH

NAME _____ CLASS _____ DATE _____

REASONING

1 Is each statement always, sometimes or never true? Circle your answer.

If it is sometimes true, give an example of when it is true and when it is not.

a) $\sqrt{(a + b)} = \sqrt{a} + \sqrt{b}$ $(a, b \geq 0)$ ALWAYS SOMETIMES NEVER

b) If $y = x^3$, then x is the cube root of y. ALWAYS SOMETIMES NEVER

c) $(a - b) \div (-c) = (b - a) \div c$ ALWAYS SOMETIMES NEVER

PROBLEM SOLVING

2 The area of a circle is given by this formula.

$A = \pi r^2$

a) Make r the subject.

b) Find the radius of a circle with area 200 cm² (1 d.p.).

c) The area of a circle is doubled. What happens to the radius?

3 The volume of a cylinder is given by this formula.

$V = \pi r^2 h$

A cylinder is 12 cm tall and has a volume of 600 cm³.

Find its radius r to 1 decimal place.

★ CHALLENGE FOR ALL

4 Complex rearranging.

a) Make q the subject of $p = 3q + kq$

b) Make y the subject of $\sqrt{(y - 3)} = 2x + 1$

c) Make x the subject of the formula in b).

REARRANGING HARDER FORMULAE ? ANSWERS

ANSWERS

BUILDING BLOCKS

1 a) $p = m - 3f$ · b) $3x = y - 5k$, $x = (y - 5k)/3$
2 a) 36 · b) 9 · c) $x = 7$ or -7 · d) $x = 10$ or -10
3 $10 + 2k = 16$ · -10: $2k = 6$ · $\div 2$: $k = 3$
4 backwards $\div 3$ then $\sqrt{}$: $A/3$, then $\sqrt{(A/3)}$ · $r = \sqrt{(A/3)}$

SUPPORT

1 a) $m - 3f = p$ · b) $y + 5t = 2x$, $\div 2$: $(y + 5t)/2 = x$
2 a) $x = 10 - y$ · b) $q = (8 - p)/3$
3 a) $s = \sqrt{(A - 4)}$ · b) $x = \pm\sqrt{(y/2)}$
4 $4/-2 = -2$ and $-4/2 = -2$: YES, they are equivalent

CORE

1 a) $a = (v^2 - u^2)/(2s)$ · b) $x = \sqrt{(y/3)}$ · c) $x = (7 - y)/2$ · d) $h = 3V/(\pi r^2)$ · e) $L = (T/2)^2 = T^2/4$ · f) $a = 3w + 5b$
2 a) $v = \sqrt{(2E/m)}$ · b) $v^2 = 36$, $v = 6$
3 Both: multiplying the top and bottom of Ali's fraction by -1 gives Bea's (e.g. $y = 3$: Ali $-6/-3 = 2$, Bea $6/3 = 2$)
4 Both a positive and a negative number square to give y: $x^2 = 16$ gives $x = 4$ or $x = -4$, so $x = \pm\sqrt{y}$

GREATER DEPTH

1 a) sometimes (true if a or b is 0; $\sqrt{(9 + 16)} = 5$ but $3 + 4 = 7$) · b) always · c) always
2 a) $r = \sqrt{(A/\pi)}$ · b) 8.0 cm (7.98...) · c) it is multiplied by $\sqrt{2}$ (about 1.41)
3 $r = \sqrt{(600 \div 12\pi)} = \sqrt{15.9...} = 4.0$ cm
4 a) $p = q(3 + k)$, $q = p/(3 + k)$ · b) $y = (2x + 1)^2 + 3$ · c) $x = (\sqrt{(y - 3)} - 1)/2$