WORKING WITH PRIME FACTORS

BUILDING BLOCKS

NAME _____ CLASS _____ DATE _____

KEY IDEA



$3 \times 3 = 3^2 = 9$

9 is a square number.



$2 \times 2 \times 2 = 2^3 = 8$

8 is a cube number.

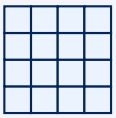
1 How many small squares are in each big square?



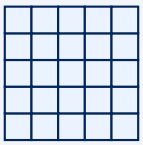
$2^2 =$ ☐



$3^2 =$ ☐



$4^2 =$ ☐



$5^2 =$ ☐

Continue: 1, 4, 9, 16, ☐, ☐

2 A square root undoes squarying. Fill in the boxes.

a) $\sqrt{49} =$ ☐ **because** ☐ × ☐ = 49

b) $\sqrt{81} =$ ☐ **because** ☐ × ☐ = 81

3 Count the small cubes in each big cube.



$1^3 = 1$



$2^3 =$ ☐



$3^3 =$ ☐

Hint for 4^3:
$4 \times 4 \times 4$

$4^3 =$ ☐

4 Simplify each fraction. Divide the top and the bottom by the same number.

Write what you divide by on both arrows.

a) $\frac{6}{9}$ (÷ 3 / ÷ 3) ☐/☐

b) $\frac{10}{15}$ ☐/☐

c) $\frac{12}{16}$ ☐/☐

d) $\frac{8}{20}$ ☐/☐

WORKING WITH PRIME FACTORS

SUPPORT

NAME _____ CLASS _____ DATE _____

KEY IDEA

$36 = 2^2 \times 3^2$ Every index is even, so 36 is a square number.

$\sqrt{36} = 2 \times 3 = 6$ Halve each index to find the square root.

1 144 = 2 × 2 × 2 × 2 × 3 × 3. Use this to find the square root of 144.

a) Write 144 in index form: $144 = 2^{\square} \times 3^{\square}$

b) Is every index even? Circle: YES NO

c) Halve each index: $\sqrt{144} = 2^{\square} \times 3^{\square} = \square$

2 N = $2^2 \times 3^2 \times 5$. Write each number as primes. Is it a factor of N?

A number is a factor of N if all its primes can be found in N.

NUMBER	AS PRIMES	FACTOR OF N?
6	2 × 3	YES
10		
27		
8		

3 Is each number a square number? Circle YES or NO.

a) $2^2 \times 5^2$ YES NO

b) $2^3 \times 3^2$ YES NO

c) $3^4 \times 7^2$ YES NO

d) 2×5^2 YES NO

4 Simplify each fraction by writing the top and bottom as products of primes.

Cancel the primes that are on the top and the bottom.

a) $\frac{30}{42} = \frac{2 \times 3 \times 5}{2 \times 3 \times 7} = \frac{\square}{\square}$

b) $\frac{28}{70} = \frac{\square}{\square} = \frac{\square}{\square}$

WORKING WITH PRIME FACTORS

CORE

NAME _____ CLASS _____ DATE _____

KEY IDEA

Every index even: a square number (halve the indices to find the square root). Every index a multiple of 3: a cube number (divide the indices by 3 for the cube root). A is a factor of N if every prime in A appears in N at least as many times.

FLUENCY

1 Use prime factors to work out each root.

a) $\sqrt{2^6 \times 5^2} =$ ☐

b) $\sqrt{3^4 \times 7^2} =$ ☐

c) $\sqrt[3]{2^6 \times 3^3} =$ ☐

d) $\sqrt{1764} =$ ☐

2 $N = 2^3 \times 3^2 \times 5$. Circle the numbers that are factors of N.

12	27	40	90	16	45

Show your working: .....

3 Use prime factors to simplify each fraction fully.

a) $\frac{2^2 \times 3 \times 7}{2 \times 3^2 \times 7} =$ ☐/☐

b) $\frac{90}{150} =$ ☐/☐

REASONING

4 Look at the number 2 × 2 × 2 × 2 × 2 × 3 × 3.

a) Explain why this is not a square number.

.....

b) Find the smallest whole number you can multiply it by to make a square. ☐

c) Find the smallest whole number you can multiply it by to make a cube. ☐

WORKING WITH PRIME FACTORS

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) If every index is even, the number is square. ALWAYS SOMETIMES NEVER

b) A square number is also a cube number. ALWAYS SOMETIMES NEVER

c) If 2 and 5 are factors of a number, so is 10. ALWAYS SOMETIMES NEVER

d) If 4 and 6 are factors of a number, so is 24. ALWAYS SOMETIMES NEVER

PROBLEM SOLVING

2 Write each number as a product of primes. Use this to find each root.

a) $\sqrt[4]{20736} =$ ☐ **b)** $\sqrt{17424} =$ ☐ **c)** $\sqrt[3]{2744} =$ ☐

3 $540 = 2^2 \times 3^3 \times 5$

a) Find the smallest whole number k so that 540k is a square number. ☐

b) Find the smallest whole number k so that 540k is a cube number. ☐

c) Find the smallest whole number m so that $540 \div m$ is a square number. ☐

★ CHALLENGE FOR ALL

4 Counting factors with prime factors

Hint: $2^a \times 3^b \times 5^c$ has $(a + 1)(b + 1)(c + 1)$ factors.

a) Find the smallest number with exactly 9 factors. ☐

b) Find the smallest number with exactly 10 factors. ☐

c) How many factors does 360 have? ☐

WORKING WITH PRIME FACTORS

ANSWERS

BUILDING BLOCKS

1 4, 9, 16, 25 · continue: 25, 36

2 a) 7 (7 × 7) · b) 9 (9 × 9)

3 $2^3 = 8$ · $3^3 = 27$ · $4^3 = 64$

4 a) ÷ 3: $\frac{2}{3}$ · b) ÷ 5: $\frac{2}{3}$ · c) ÷ 4: $\frac{3}{4}$ · d) ÷ 4: $\frac{2}{5}$

SUPPORT

1 a) $2^4 \times 3^2$ · b) YES · c) $\sqrt{144} = 2^2 \times 3 = 12$

2 10 = 2 × 5, YES · 27 = 3 × 3 × 3, NO (only two 3s in N) · 8 = 2 × 2 × 2, NO (only two 2s in N)

3 a) YES · b) NO · c) YES · d) NO

4 a) $\frac{5}{7}$ · b) $\frac{2 \times 2 \times 7}{2 \times 5 \times 7} = \frac{2}{5}$

CORE

1 a) $2^3 \times 5 = 40$ · b) $3^2 \times 7 = 63$ · c) $2^2 \times 3 = 12$ · d) $1764 = 2^2 \times 3^2 \times 7^2$, so 42

2 12, 40, 90, 45 (27 needs three 3s; 16 needs four 2s)

3 a) $\frac{2}{3}$ · b) $\frac{2 \times 3^2 \times 5}{2 \times 3 \times 5^2} = \frac{3}{5}$

4 a) It is $2^5 \times 3^2$ and the index of 2 is 5, which is odd · b) 2 (gives $2^6 \times 3^2$) · c) 6 (gives $2^6 \times 3^3$)

GREATER DEPTH

1 a) always · b) sometimes: $64 = 8^2 = 4^3$, but 4 is not a cube · c) always · d) sometimes: 24 yes, but 12 has 4 and 6 as factors and not 24

2 a) $20736 = 2^8 \times 3^4$, so $2^2 \times 3 = 12$ · b) $17424 = 2^4 \times 3^2 \times 11^2$, so 132 · c) $2744 = 2^3 \times 7^3$, so 14

3 a) 15 (gives $2^2 \times 3^4 \times 5^2 = 8100$) · b) 50 (gives $2^3 \times 3^3 \times 5^3 = 27000$) · c) 15 (540 ÷ 15 = 36)

4 a) $36 = 2^2 \times 3^2$ · b) $48 = 2^4 \times 3$ · c) $360 = 2^3 \times 3^2 \times 5$, so 4 × 3 × 2 = 24