MATHS FIELD GUIDE · GRADE 7

Powers record repeated multiplication

OPENING PROBLEM

Why add the exponents?

$$2^3 \times 2^2$$
$$\downarrow$$
$$(2 \times 2 \times 2) \times (2 \times 2)$$
$$\downarrow$$
$$2^5 = 32$$

02 Count the factors before using a power rule
03 Rules and worked cases
04 Paper folding and powers
05 Separate repeated addition from repeated multiplication
06 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Count the factors before using a power rule

Multiplying equal bases joins factor lists. Dividing cancels matching factors when the base is nonzero.

1

$$2^3 \times 2^2$$
$$\downarrow$$
$$(2 \times 2 \times 2) \times (2 \times 2)$$
$$\downarrow$$
$$2^5 = 32$$

Why add the exponents?

All five factors have the same base.

2

$$3^4 \div 3^2$$
$$\downarrow$$
$$(3 \times 3 \times 3 \times 3) \div 9$$
$$\downarrow$$
$$3^2 = 9$$

Why subtract the exponents?

Two numerator factors cancel with two denominator factors.

3

$$5^0 = 5^3 \div 5^3$$
$$\downarrow$$
$$125 \div 125$$
$$\downarrow$$
$$1$$

What condition matters for a zero exponent?

Use a nonzero base so that the division exists.

4

$$0.0048$$
$$\downarrow$$
$$4.8 \times 10^{-3}$$
$$\downarrow$$
$$4.8 \div 1000$$

How does the minus sign change the scale?

It selects the reciprocal power of ten. The number itself stays positive.

$10^{-2} \times 10^5$
10^3.

$10^{-2} \div 10^5$
10^{-7}.

CHAPTER PROBLEM

Why is $3^2 + 3^2$ not 3^4?

The sum is 9 + 9 = 18. Combining exponents applies to multiplication of matching bases, not addition.

MATHS REFERENCE · GRADE 7

Powers record repeated multiplication

A power records repeated multiplication of the same factor. In 2^4, two is the base and four is the exponent: $2 \times 2 \times 2 \times 2$.

Scientific notation uses a power of ten to describe a number's scale together with a coefficient.

Four cases to recognise

Situation	What to do and why
$3^2 \times 3^4$	Combine six factors of three: 3^6.
$5^6 \div 5^2$	Cancel two common factors to get 5^4.
$(2^3)^2$	Two groups of three factors give 2^6, or 64.
$2^3 + 2^3$	Two equal eights make sixteen. Addition does not use the product-of-powers rule.

Read the model

Build the idea

Join three factors of two and two more factors of two. The total contains five factors: $2^3 \times 2^2 = 2^5$.

Dividing powers with the same nonzero base cancels matching factors. For example $2^5 \div 2^2 = 2^3$.

Count the equal factors

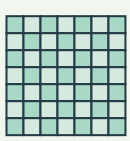
$2^3 \times 2^2$	$(2 \times 2 \times 2) \times (2 \times 2)$	$2^5 = 32$
$2^5 \div 2^2$	$32 \div 4$	$2^3 = 8$

Why it works

Adding exponents in a product counts repeated factors. It is not a rule for adding powers.

Because $2^3 \div 2^3 = 1$, consistency gives $2^0 = 1$. A negative exponent gives a reciprocal: $2^{-2} = 1/2^2$.

base The repeated factor.
exponent The number or rule of repetition.
scientific notation A coefficient from one to below ten times a power of ten.



Which square has area 49 square units?

Seven rows of seven. Its side length is $\sqrt{49} = 7$.

WORKED INVESTIGATION

Paper folding and powers

Imagine doubling the number of layers with each fold of an ideal sheet. Start with one layer before the first fold.

Look at this part	What it tells you
2 folds	$2^2 = 4$
4 folds	$2^4 = 16$
6 folds	$2^6 = 64$

Work it through

Two more folds multiply the layer count by four. Write $2^4 \times 2^2$ as six factors of two to see why exponents add for equal bases.

Catch the mistake

$2^3 + 2^2$ is $8 + 4 = 12$, whereas 2^5 is 32. The exponent rule describes multiplication of powers, not addition.

Compare the cases

Follow an example

$45{,}000 = 4.5 \times 10^4$. The coefficient 4.5 lies between one and ten, and the power gives the size of the place-value shift.

$0.0032 = 3.2 \times 10^{-3}$. The negative exponent describes a reciprocal power of ten.

What changes? What stays true?

Parentheses control the base: $(-3)^2 = 9$, while -3^2 conventionally means $-(3^2) = -9$.

The zero and negative exponent rules here require a nonzero base. Zero raised to a negative power is undefined.

Change one condition

Working backwards from 64 layers, undo three folds by dividing by 2^3. Eight layers remain in the model.



Which integers trap √7?

$2^2 < 7 < 3^2$. Hence $2 < \sqrt{7} < 3$.

ILLUSTRATED PROBLEM SHEET

Separate repeated addition from repeated multiplication

A geometric sequence repeats a factor. An arithmetic sequence repeats a difference.

1

2 6 18 54 ?

What single multiplier fits every step?

Multiply by three. The next term is 162.

2

Stage	0	1	2	3
Pieces	1	3	9	27

If each piece makes three copies, how many after stage four?

81. Four multiplications carry the initial piece to stage four.

3

$$2 \rightarrow -6 \rightarrow 18$$
$$\downarrow$$
$$r = -3$$

Does a negative ratio prevent growth in size?

No. Signs alternate while the magnitudes triple.

4

Stage	0	1	2
Squares	1	8	64
Area left	1	8/9	64/81

Remove the middle ninth from every surviving square. What grows and what shrinks?

The count grows eightfold while total remaining area is multiplied by 8/9 each round.

r = 1
positive first term stays fixed.

r = 1/2
positive terms halve at each step.

CHAPTER PROBLEM

Evaluate $2^3 \times 2^4$. Why do the exponents add?

There are three factors of 2 followed by four more. The product is $2^7 = 128$.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 Is $2^3 + 2^2$ equal to 2^5?	No. Addition combines the values 8 and 4 to give 12. The product rule applies to multiplication.
02 A sequence starts at five and doubles. How many doublings take it to 160?	Five: 5, 10, 20, 40, 80, 160. Counting the starting point as a doubling gives one too many.
03 A model has 32 layers. How many more folds make 256, and why?	$256 \div 32 = 8 = 2^3$. Three doublings make 64, 128 and then 256 layers.
04 Simplify $7^5 \div 7^3 \times 7$.	The net exponent is $5 - 3 + 1 = 3$. Result 343.
05 Which is larger, 3^4 or 4^3?	Compare 81 and 64. Three to the fourth power is larger.

$3.3^2 = 10.89$
↓
11
↓
$3.4^2 = 11.56$

Which tenths trap √11?

$3.3 < \sqrt{11} < 3.4$. Compare squares before rounding the root.

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