

Exponent Laws

KEY IDEAS

Power: in 2^5 , 2 is the **base** and 5 is the **exponent**: $2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$.

Product law: $a^m \times a^n = a^{m+n}$ · **Quotient law:** $a^m \div a^n = a^{m-n}$ · **Power of a power:** $(a^m)^n = a^{m \times n}$

Zero exponent: $a^0 = 1$ ($a \neq 0$). **Brackets matter:** $(-3)^2 = 9$, but $-3^2 = -(3 \times 3) = -9$.

The laws only work when the **bases are the same**.

A Evaluate each power

4 marks

1. $2^5 =$ _____

2. $10^4 =$ _____

3. $(-3)^2 =$ _____

4. $-3^2 =$ _____

B Product law: write as a single power

4 marks

5. $2^3 \times 2^4 =$ _____

6. $5 \times 5^6 =$ _____

7. $x^4 \times x^5 =$ _____

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

C Quotient law: write as a single power

4 marks

9. $7^9 \div 7^4 =$ _____

10. $10^8 \div 10^3 =$ _____

11. $y^{10} \div y^2 =$ _____

12. $6^5 \div 6^5 =$ _____

D Power of a power and zero exponents

4 marks

Write as a single power, or evaluate when there is a zero exponent.

13. $(2^3)^4 =$ _____

14. $(x^5)^2 =$ _____

15. $12^0 =$ _____

16. $4^0 + 4^1 =$ _____

E True or false?

2 marks

$\frac{1}{2}$ mark each. Fix the statements that are false.

	Statement	True / False	If false, write the correct answer
17.	$3^2 \times 3^4 = 9^6$		
18.	$2^3 \times 2^2 = 2^5$		
19.	$(5^2)^3 = 5^5$		
20.	$8^0 = 0$		

F Simplify, then evaluate**4 marks**

Use the exponent laws to write a single power first, then find its value. Show your work in the box.

21. $(3^4 \times 3^2) \div 3^3$

22. $(2^5)^2 \div 2^7$

23. $10^6 \times 10^2 \div 10^5$

24. $(4^3 \times 4^0) \div 4^2$

G Real-world problems**6 marks**

Show your work. 2 marks each.

25. One bacterium splits into 2 every hour, so the number doubles each hour. Write the number of bacteria after 10 hours as a power of 2, then evaluate it.

26. A kilobyte (KB) is 2^{10} bytes, and a megabyte (MB) is 2^{10} kilobytes. Use an exponent law to write the number of bytes in 1 MB as a single power of 2. Then evaluate it.

27. A cube has edges 3^2 cm long. Its volume is $(\text{edge})^3$. Write the volume as a single power of 3, then find it in cm^3 .

H Spot the mistake**2 marks**

28. A student writes $2^3 \times 2^4 = 4^7$. Explain the error and write the correct answer.

29. A student writes $4^6 \div 4^2 = 4^3$. Explain the error and write the correct answer.

Exponent Laws

ANSWER KEY**KEY IDEAS****Power:** in 2^5 , 2 is the **base** and 5 is the **exponent**: $2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$.**Product law:** $a^m \times a^n = a^{m+n}$ · **Quotient law:** $a^m \div a^n = a^{m-n}$ · **Power of a power:** $(a^m)^n = a^{m \times n}$ **Zero exponent:** $a^0 = 1$ ($a \neq 0$). **Brackets matter:** $(-3)^2 = 9$, but $-3^2 = -(3 \times 3) = -9$.The laws only work when the **bases are the same**.**A Evaluate each power****4 marks**

1. $2^5 = 32$

2. $10^4 = 10\,000$

3. $(-3)^2 = 9$

4. $-3^2 = -9$

B Product law: write as a single power**4 marks**

5. $2^3 \times 2^4 = 2^{3+4} = 2^7$

6. $5 \times 5^6 = 5^{1+6} = 5^7$

7. $x^4 \times x^5 = x^{4+5} = x^9$

8. $3^2 \times 3^3 = 3^{2+3} = 3^5$

C Quotient law: write as a single power**4 marks**

9. $7^9 \div 7^4 = 7^{9-4} = 7^5$

10. $10^8 \div 10^3 = 10^{8-3} = 10^5$

11. $y^{10} \div y^2 = y^{10-2} = y^8$

12. $6^5 \div 6^5 = 6^{5-5} = 6^0 = 1$

D Power of a power and zero exponents**4 marks**

Write as a single power, or evaluate when there is a zero exponent.

13. $(2^3)^4 = 2^{3 \times 4} = 2^{12}$

14. $(x^5)^2 = x^{5 \times 2} = x^{10}$

15. $12^0 = 1$

16. $4^0 + 4^1 = 1 + 4 = 5$

E True or false?**2 marks** $\frac{1}{2}$ mark each. Fix the statements that are false.

	Statement	True / False	If false, write the correct answer
17.	$3^2 \times 3^4 = 9^6$	False	3^6 (keep the base)
18.	$2^3 \times 2^2 = 2^5$	True	Already correct
19.	$(5^2)^3 = 5^5$	False	5^6 (multiply exponents)
20.	$8^0 = 0$	False	$8^0 = 1$

F Simplify, then evaluate

4 marks

Use the exponent laws to write a single power first, then find its value. Show your work in the box.

21. $(3^4 \times 3^2) \div 3^3$
 $3^{4+2-3} = 3^3 = 27$

22. $(2^5)^2 \div 2^7$
 $2^{10-7} = 2^3 = 8$

23. $10^6 \times 10^2 \div 10^5$
 $10^{6+2-5} = 10^3 = 1000$

24. $(4^3 \times 4^0) \div 4^2$
 $4^{3+0-2} = 4^1 = 4$

G Real-world problems

6 marks

Show your work. 2 marks each.

25. One bacterium splits into 2 every hour, so the number doubles each hour. Write the number of bacteria after 10 hours as a power of 2, then evaluate it.

$2^{10} = 1024$ bacteria

26. A kilobyte (KB) is 2^{10} bytes, and a megabyte (MB) is 2^{10} kilobytes. Use an exponent law to write the number of bytes in 1 MB as a single power of 2. Then evaluate it.

$2^{10} \times 2^{10} = 2^{20} = 1\,048\,576$ bytes

27. A cube has edges 3^2 cm long. Its volume is $(\text{edge})^3$. Write the volume as a single power of 3, then find it in cm^3 .

$(3^2)^3 = 3^6 = 729 \text{ cm}^3$ (check: $9 \times 9 \times 9 = 729$)

H Spot the mistake

2 marks

28. A student writes $2^3 \times 2^4 = 4^7$. Explain the error and write the correct answer.

The base stays the same; you don't multiply the bases. $2^3 \times 2^4 = 2^7 = 128$.

29. A student writes $4^6 \div 4^2 = 4^3$. Explain the error and write the correct answer.

When dividing powers, **subtract** the exponents ($6 - 2$), not divide them: $4^4 = 256$.