



Manipulating powers (3)

Getting ready for A-Level Maths...

What you need...

- Your brain and attention
- A device to watch connected to internet
- A pen and paper
- Can do attitude

Manipulating powers (3)

Important rules

$$a^1 = a$$

$$a^0 = 1$$

$$a^m \times a^n = a^{m+n}$$

$$a^m \div a^n = \frac{a^m}{a^n} = a^{m-n}$$

$$(a^m)^n = a^{mn}$$

$$(ka^m)^n = k^n a^{mn}$$

$$a^{-m} = \frac{1}{a^m}$$

$$a^{\frac{1}{m}} = \sqrt[m]{a}$$

$$a^{\frac{n}{m}} = \left(\sqrt[m]{a}\right)^n$$

Manipulating powers (3)

My turn

Express 81^{3x} as a power of 3 in terms of x .

$$81^{3x} = 3^{12x}$$

$$81^{3x} = (3 \times 3 \times 3 \times 3)^{3x}$$

$$= (3^4)^{3x}$$

$$= 3^{4 \times 3x}$$

$$81^{3x} = 3^{12x}$$

Your turn

Express 64^{7x} as a power of 2 in terms of x .

$$64^{7x} = 2^{42x}$$

$$64^{7x} = (2 \times 2 \times 2 \times 2 \times 2)^{7x}$$

$$= (2^5)^{7x}$$

$$= 2^{5 \times 7x}$$

$$64^{7x} = 2^{42x}$$

Manipulating powers (3)

My turn

Express 25×125^{3x} as a power of 5 in terms of x .

$$25 \times 125^{3x} = 5^n$$

$$25 \times 125^{3x} = (5 \times 5) \times (5 \times 5 \times 5)^{3x}$$

$$= 5^2 \times (5^3)^{3x}$$

$$= 5^2 \times 5^{9x}$$

$$25 \times 125^{3x} = 5^{2+9x} \text{ or } 5^{9x+2}$$

Your turn

Express 27×243^{2x} as a power of 3 in terms of x .

$$27 \times 243^{2x} = 3^n$$

$$27 \times 243^{2x} = (3 \times 3 \times 3) \times (3 \times 3 \times 3 \times 3 \times 3)^{2x}$$

$$= 3^3 \times (3^5)^{2x}$$

$$= 3^3 \times 3^{10x}$$

$$27 \times 243^{2x} = \underline{\underline{3^{3+10x}}}$$

Manipulating powers (3)

My turn

Express $8 \times \frac{1}{32^{4x}}$ as a power of 2 in terms of x .

$$8 \times \frac{1}{32^{4x}} = 2^n$$

$$8 \times \frac{1}{32^{4x}} = (2^3) \times \frac{1}{(2^5)^{4x}}$$

$$= 2^3 \times \frac{1}{2^{20x}}$$

$$= 2^3 \times 2^{-20x}$$

$$= 2^{3-20x}$$

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Your turn

Express $25 \times \frac{1}{625^{2x}}$ as a power of 5 in terms of x .

$$25 \times \frac{1}{625^{2x}} = 5^n$$

$$25 \times \frac{1}{625^{2x}} = 5^2 \times \frac{1}{(5^4)^{2x}}$$

$$= 5^2 \times \frac{1}{5^{8x}}$$

$$= 5^2 \times 5^{-8x}$$

$$= 5^{2-8x}$$

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Manipulating powers (3)

My turn

Express $32 \times 16^{x-5}$ as a power of 2 in terms of x .

$$32 \times 16^{x-5} = 2^n$$

$$\begin{aligned} 32 \times 16^{x-5} &= (2^5) \times (2^4)^{x-5} \\ &= 2^5 \times 2^{4(x-5)} \\ &= 2^5 \times 2^{4x-20} \\ &= 2^{5+4x-20} \\ &= 2^{4x-15} \end{aligned}$$

Your turn

Express $81 \times 27^{x-4}$ as a power of 3 in terms of x .

$$81 \times 27^{x-4} = 3^n$$

$$\begin{aligned} 81 \times 27^{x-4} &= (3^4) \times (3^3)^{x-4} \\ &= 3^4 \times 3^{3(x-4)} \\ &= 3^4 \times 3^{3x-12} \\ &= 3^{4+3x-12} \\ &= 3^{3x-8} \end{aligned}$$

Manipulating powers (3)

My turn

$27^m \times 81^n$ can be written in the form 3^a . Express a in terms of m and n .

$$27^m \times 81^n = 3^a$$

$$\begin{aligned} 27^m \times 81^n &= (3^3)^m \times (3^4)^n \\ &= 3^{3m} \times 3^{4n} \\ &= 3^{3m+4n} \end{aligned}$$

Therefore $a = 3m + 4n$

Your turn

$32^m \times 128^n$ can be written in the form 2^a . Express a in terms of m and n .

$$32^m \times 128^n = 2^a$$

$$\begin{aligned} 32^m \times 128^n &= (2^5)^m \times (2^7)^n \\ &= 2^{5m} \times 2^{7n} \\ &= 2^{5m+7n} \end{aligned}$$

Therefore $a = 5m + 7n$

Manipulating powers (3)

My turn

$\frac{64}{\sqrt[6]{8^n}}$ can be written in the form 2^a .

Express a in terms of n .

$$\frac{64}{\sqrt[6]{8^n}} = 2^a$$

$$\frac{64}{\sqrt[6]{8^n}} = \frac{2^6}{\sqrt[6]{(2^3)^n}}$$

$$= \frac{2^6}{\sqrt[6]{2^{3n}}}$$

$$= \frac{2^6}{(2^{3n})^{\frac{1}{6}}}$$

$$= \frac{2^6}{2^{\frac{3n}{2}}}$$

$$= 2^{6-\frac{n}{2}}$$

$$\therefore a = \underline{\underline{6-\frac{n}{2}}}$$

Exam Q

Your turn

Exam Q

$\frac{32}{\sqrt[4]{4^n}}$ can be written in the form 2^a .

Express a in terms of n .

$$\frac{32}{\sqrt[4]{4^n}} = 2^a$$

$$\frac{32}{\sqrt[4]{4^n}} = \frac{2^5}{\sqrt[4]{(2^2)^n}}$$

$$= \frac{2^5}{\sqrt[4]{2^{2n}}}$$

$$= \frac{2^5}{(2^{2n})^{\frac{1}{4}}}$$

$$= \frac{2^5}{2^{\frac{n}{2}}}$$

$$= 2^{5-\frac{n}{2}}$$

$$\underline{\underline{a = 5-\frac{n}{2}}}$$

Manipulating powers (3)

Review Exercise

1. Express 25^{4x} as a power of 5 in terms of x .
2. Express 16×128^{2x} as a power of 2 in terms of x .
3. Express $9 \times \frac{1}{81^{3x}}$ as a power of 3 in terms of x .
4. Express $64 \times 8^{x-4}$ as a power of 2 in terms of x .
5. $64^m \times 16^n$ can be written in the form 2^a . Express a in terms of m and n .
6. $\frac{27}{\sqrt[6]{9^n}}$ can be written in the form 3^a . Express a in terms of n .

Extra Practice

7. $8^m \div 32^n$ can be written in the form 2^a . Express a in terms of m and n .
8. $(27^m)^{4n}$ can be written in the form 3^a . Express a in terms of m and n .
9. $\sqrt[3]{9} \times 81^n$ can be written in the form 3^a . Express a in terms of n .
10. $\frac{\sqrt[3]{32}}{16^n}$ can be written in the form 2^a . Express a in terms of n .

Manipulating powers (3)

Review Exercise (Answers)

- Express 25^{4x} as a power of 5 in terms of x . 5^{8x}
- Express 16×128^{2x} as a power of 2 in terms of x . 2^{14x+4} or 2^{4+14x}
- Express $9 \times \frac{1}{81^{3x}}$ as a power of 3 in terms of x . 3^{-12x+2} or 3^{2-12x}
- Express $64 \times 8^{x-4}$ as a power of 2 in terms of x . 2^{3x-6} or 2^{-6+3x}
- $64^m \times 16^n$ can be written in the form 2^a . Express a in terms of m and n . $a=6m+4n$ or $a=4n+6m$
- $\frac{27}{\sqrt[6]{(9^n)}}$ can be written in the form 3^a . Express a in terms of n . $a=-\frac{n}{3}+3$ or $a=3-\frac{n}{3}$

Extra Practice

- $8^m \div 32^n$ can be written in the form 2^a . Express a in terms of m and n . $a=3m-5n$ or $a=-5n+3m$
- $(27^m)^{4n}$ can be written in the form 3^a . Express a in terms of m and n . $a=12mn$ or $a=12nm$
- $\sqrt[3]{9} \times 81^n$ can be written in the form 3^a . Express a in terms of n . $a=\frac{2}{3}+4n$ or $a=4n+\frac{2}{3}$
- $\frac{\sqrt[3]{32}}{16^n}$ can be written in the form 2^a . Express a in terms of n . $a=\frac{5}{3}-4n$ or $a=-4n+\frac{5}{3}$