Powers and Roots - Worksheet

Skill

Group A - Simplifying Powers using laws of indices

Simplify these without using a calculator. Leave your answers in index form.

1) $2^2 \times 2^3$

2) $5^3 \times 5^4$

3) $6^3 \times 6^{-1}$

4) $11^{13} \div 11^8$

5) $8^2 \div 8^2$

6) $15^2 \div 15$

7) $(5^2)^3$

8) $(3^5)^{-1}$

9) $(6^3)^{-4}$

10) $(\frac{3}{4^5})^2$

11) $(\frac{5^2}{7})^3$

12) $(\frac{\sqrt{2}}{2})^4$

Group B - Calculating an unknown power

Fill in the missing value x to make each equation true.

1) $2^2 \times 2^x = 2^5$

2) $20^3 \times 20^6 = 20^x$

3) $14^{10} \times 14^x = 14^5$

4) $16^5 \div 16^x = 16^3$

5) $10^{10} \div 10^x = 1$

6) $13^x \div 13^{10} = 13^{12}$

7) $(17^5)^2 = 17^x$

8) $(12^x)^3 = 12^6$

9) $(10^4)^x = 10^{-4}$

10) $(\frac{8^8}{8^4}) = 8^x$

11) $(\frac{16^{10}}{16^x}) = 16^{15}$

12) $(\frac{10^x}{10^3})^2 = 10^{-8}$

Group C - Simplifying powers including negatives and fractions

Simplify each expression. Write your answer in index form.

1) $3^5 \times 3^4 \times 3^3$

2) $2^2 \times 2^2 \times 2$

3) $8^4 \times 8 \times 8^{-2}$

4) $3^5 \times 3 \div 3^2$

5) $7^3 \times 7^{-1} \div 7^{-2}$

6) $4 \div 4 \div 4^3$

7) $9^3 \times (9^2)^5$

8) $10^3 \times (\frac{1}{10})^4$

9) $2^5 \div (2^2)^{\frac{1}{2}}$

10) $3^7 \times (\frac{3^2}{3^5})$

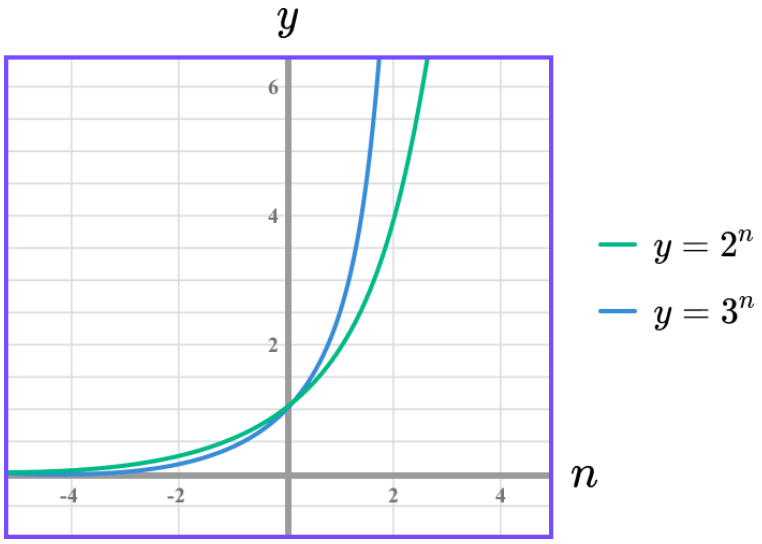
11) $7 \times (\frac{7^6}{7^{10}})$

12) $9^{-3} \div (\frac{9^2}{9^{-9}})$

Powers and Roots - Worksheet

Applied

1) Below are the graphs of two functions $y = 2^n$ and $y = 3^n$ for $-4 \leq n \leq 4$



(a) Use the graph to solve $2^n = 3^n$ for $-4 \leq n \leq 4$.

(b) Josie says "$2^n \times 3^n = 6^n$". Is she correct? Explain your answer.

2) **(a)** Which of the expressions below are equal to 1? Circle all that apply.

$4^3 \times 4^{-3}$ $\quad$ $(\frac{1}{2})^{-1}$ $\quad$ $(\sqrt{2})^2$ $\quad$ $\frac{5^2 \times 5^3}{5^5}$ $\quad$ $(p^5 + p^3)^{-8}$

(b) What power of x would make the following expression true:

$$\frac{2^4 \times 2^{10}}{2^x} = 32$$

3) **(a)** Simplify $(4^3)^4$.

(b) Express part (a) as a power of 2.

4) **(a)** Given that $a = \frac{1}{\sqrt{5}}$, express a as a single power of 5.

(b) Calculate $a \times 5^{\frac{1}{2}}$.

Powers and Roots - Exam Questions

1) **(a)** Simplify $12x^3 \div 3x^5$

.....

(2)

(b) Evaluate 5^{-3}. Write your answer as a fraction.

.....

(1)

(3 marks)

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2) **(a)** Show that $4^2 = 2^4$ using laws of indices.

.....

(1)

(b) Let $x \geq 0$. State 3 more values of x where 2^x is a power of 4.

.....

(1)

(2 marks)

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3) **(a)** Calculate the value of $(100^2 \div 10^3)^3$.
Express your answer as a power of 10.

.....

(2)

(b) Calculate $(3 \times 10^4) \times (4 \times 10^{-1})$.Write your answer in standard form.

.....

(2)

(4 marks)

Powers and Roots - Exam Questions

4) **(a)** Evaluate $\left(\frac{4}{25}\right)^{-\frac{1}{2}}$

.....

(2)

(b) Let $x = \frac{27}{64}$. Calculate $x^{\frac{2}{3}}$.

.....

(2)

(4 marks)

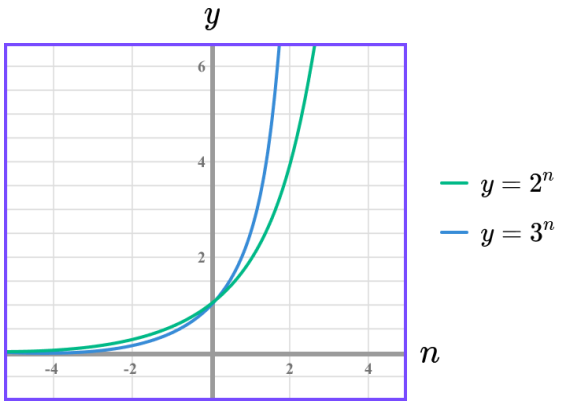
Powers and Roots - Answers

	Question	Answer
	Skill Questions	
Group A	Simplify these without using a calculator. Leave your answers in index form. **1)** $2^2 \times 2^3$ **2)** $5^3 \times 5^4$ **3)** $6^3 \times 6^{-1}$ **4)** $11^{13} \div 11^8$ **5)** $8^2 \div 8^2$ **6)** $15^2 \div 15$ **7)** $(5^2)^3$ **8)** $(3^5)^{-1}$ **9)** $(6^3)^{-4}$ **10)** $(\frac{3}{4^5})^2$ **11)** $(\frac{5^2}{7})^3$ **12)** $(\frac{\sqrt{2}}{2})^4$	**1)** 2^5 **2)** 5^7 **3)** 6^2 **4)** 11^5 **5)** $8^0 = 1$ **6)** $15^1 = 15$ **7)** 5^6 **8)** 3^{-5} **9)** 6^{-12} **10)** $\frac{3^2}{4^{10}}$ **11)** $\frac{5^6}{7^3}$ **12)** $\frac{2^2}{2^4} = 2^{-2}$
Group B	Fill in the missing value x to make each equation true. **1)** $2^2 \times 2^x = 2^5$ **2)** $20^3 \times 20^6 = 20^x$ **3)** $14^{10} \times 14^x = 14^5$ **4)** $16^5 \div 16^x = 16^3$ **5)** $10^{10} \div 10^x = 1$	**1)** $x = 3$ **2)** $x = 9$ **3)** $x = -5$ **4)** $x = 2$ **5)** $x = 10$

Powers and Roots - Answers

Group B contd	**6)** $13^{x} \div 13^{10} = 13^{12}$	**6)** $x = 22$
	7) $(17^{5})^{2} = 17^{x}$	**7)** $x = 10$
	8) $(12^{x})^{3} = 12^{6}$	**8)** $x = 2$
	9) $(10^{4})^{x} = 10^{-4}$	**9)** $x = -1$
	10) $(\frac{8^{8}}{8^{4}}) = 8^{x}$	**10)** $x = 4$
	11) $(\frac{16^{10}}{16^{x}}) = 16^{15}$	**11)** $x = -5$
	12) $(\frac{10^{x}}{10^{3}})^{2} = 10^{-8}$	**12)** $x = -1$
Group C	Simplify each expression. Write your answer in index form	
	1) $3^{5} \times 3^{4} \times 3^{3}$	**1)** 3^{12}
	2) $2^{2} \times 2^{2} \times 2$	**2)** 2^{5}
	3) $8^{4} \times 8 \times 8^{-2}$	**3)** 8^{3}
	4) $3^{5} \times 3 \div 3^{2}$	**4)** 3^{4}
	5) $7^{3} \times 7^{-1} \div 7^{-2}$	**5)** 7^{4}
	6) $4 \div 4 \div 4^{3}$	**6)** 4^{-3}
	7) $9^{3} \times (9^{2})^{5}$	**7)** 9^{13}
	8) $10^{3} \times (\frac{1}{10})^{4}$	**8)** 10^{-1}
	9) $2^{5} \div (2^{2})^{\frac{1}{2}}$	**9)** 2^{4}
	10) $3^{7} \times (\frac{3^{2}}{3^{5}})$	**10)** 3^{4}
	11) $7 \times (\frac{7^{6}}{7^{10}})$	**11)** 7^{-3}
	12) $9^{-3} \div (\frac{9^{2}}{9^{-9}})$	**12)** 9^{-14}

Powers and Roots - Answers

	Question	Answer
	Applied Questions	
1)	Below are the graphs of two functions $y = 2^n$ and $y = 3^n$ for $-4 \leq n \leq 4$ 	
	a) Use the graph to solve $2^n = 3^n$ for $-4 \leq n \leq 4$.	**a)** $n = 0$
	b) Josie says "$2^n \times 3^n = 6^n$". Is she correct? Explain your answer.	**b)** Yes. $2^n \times 3^n = (2 \times 3)^n = 6^n$
2)	**a)** Which of the expressions below are equal to 1 ? Circle all that apply. $4^3 \times 4^{-3}$ $(\frac{1}{2})^{-1}$ $(\sqrt{2})^2$ $\frac{5^2 \times 5^3}{5^5}$ $(p^5 + p^3)^{-8}$	**a)** $4^3 \times 4^{-3}$ $\frac{5^2 \times 5^3}{5^5}$
	b) What power of x would make the following expression true $\frac{2^4 \times 2^{10}}{2^x} = 32$	**b)** $x = 9$
3)	**a)** Simplify $(4^3)^4$.	**a)** 4^{12}
	b) Express part a) as a power of 2.	**b)** $(2^2)^{12} = 2^{24}$
4)	**a)** Given that $a = \frac{1}{\sqrt{5}}$, express a as a single power of 5.	**a)** $1 \div 5^{\frac{1}{2}} = 5^0 \div 5^{\frac{1}{2}} = 5^{-\frac{1}{2}}$
	b) Calculate $a \times 5^{\frac{1}{2}}$.	**b)** $5^{-\frac{1}{2}} \times 5^{\frac{1}{2}}$ $5^0 = 1$

Powers and Roots - Mark Scheme

	Question	Answer	
	Exam Questions		
1) (a)	Simplify $12x^3 \div 3x^5$	(a) $12x^3 \div 3x^5 = 4x^{3-5}$ $4x^{-2}$ or $\frac{4}{x^2}$	(1) (1)
(b)	Evaluate 5^{-3}. Write your answer as a fraction.	(b) $5^{-3} = \frac{1}{5^3} = \frac{1}{125}$	(1)
2) (a)	Show that $4^2 = 2^4$ using laws of indices.	(a) $4^2 = (2^2)^2 = 2^4$	(1)
(b)	Let $x \geq 0$. State 3 more values of x where 2^x is a power of 4.	(b) Any 3 positive even numbers, excluding 4	(1)
3) (a)	Calculate the value of $(100^2 \div 10^3)^3$. Express your answer as a power of 10.	(a) $((10^2)^2 \div 10^3)^3 = (10^4 \div 10^3)^3$ $= (10^{4-3})^3 = 10^3$	(1) (1)
(b)	Calculate $(3 \times 10^4) \times (4 \times 10^{-1})$. Write your answer in standard form.	(b) 12×10^3 1.2×10^4	(1) (1)
4) (a)	Evaluate $(\frac{4}{25})^{-\frac{1}{2}}$	(a) $\frac{4}{25} = (\frac{2}{5})^{-1}$ $= \frac{5}{2} = 2.5$	(1) (1)
(b)	Let $x = \frac{27}{64}$. Calculate $x^{\frac{2}{3}}$.	(b) $(\frac{3}{4})^2$ $\frac{9}{16}$	(1) (1)