

Indices practice

Skill 4.1 Numbers and indices

Write these numbers in simplest index form:

- 1 25 2 8 3 216 4 64
 5 27 6 10 000 7 343 8 121
 9 243 10 625

Evaluate these expressions:

- 11 $3^5 + 2^2$ 12 $(7^2 - 3^2)^2$
 13 $5^4 \times 3^5$ 14 $\frac{6^3 + 2^5}{3^2}$
 15 $4^3 - 3^3$ 16 $4^2(7^2 - 2^5)$
 17 $(1^2 + 2^2 + 3^2)^3$ 18 $\frac{5^2 - 2^3}{3^2}$
 19 $(2^3 - 3^3 + 4^3)^2$ 20 $\frac{1 + 2^2 + 3^3 + 4^4}{12^2}$

Skill 4.2 Multiplying index expressions

Simplify:

- 1 $a^4 \times a^3$ 2 $a^2b^3 \times b^4$
 3 $3a^4b \times 2a^4$ 4 $6a^2b^2 \times 2b^3$
 5 $-2a^2 \times 3a^4$ 6 $-8a^2b \times 3a^4$
 7 $-2a^2 \times -8b^4$ 8 $6a \times 2a^4$
 9 $-3a^2b \times 6a^4$ 10 $3a^2b^4 \times -6a^4$

Skill 4.3 Dividing index expressions

Simplify:

- 1 $a^6 \div a^4$ 2 $a^9b^2 \div 3a^4$
 3 $2a^6b \div 3ab^2$ 4 $12a^4b^2 \div 3ab$
 5 $6a^4b^3 \div 4ab$ 6 $a^{12} \div 3a^4b^2$
 7 $7a^{11}b^2 \div 8ab^4$ 8 $5a^4b^3 \div 2ab^5$
 9 $11a^4b^7 \div 12ab^2$ 10 $12ab^6 \div 24a^2b^5$

Skill 4.4 Multiplying and dividing index terms

- 1 $\frac{12a^5b^4}{18a^3b^2} \times \frac{a^4b^5}{3}$ 2 $\frac{12x^2y^3}{x^7y^5} \times \frac{x^6y^4}{4}$
 3 $\frac{3x^7}{2x^6} \times \frac{3x^2}{15x}$ 4 $\frac{5a^3b^4}{a^8b^8} \times \frac{6a^7b^5}{15ab^4}$
 5 $\frac{4a^3b^2}{a^4b} \div \frac{3a^2b}{2ab^4}$ 6 $\frac{6a^2b^4}{5ab^3} \div \frac{12ab^2}{10ab^4}$
 7 $\frac{12a^2b}{4a^3b} \times \frac{2a^4b}{a^5} \div \frac{3a^2b^4}{2ab^5}$

- 17 $x^5 = 1.2$ 18 $x^9 = 2.4$ 19 $x^3 = 4.02$
 20 $x^4 = 3.8$

Use the logarithm method solve these for x to two decimal places:

- 21 $3^x = 11$ 22 $4^x = 10$ 23 $2^x = 6$
 24 $5^x = 14$ 25 $3^x = 21$ 26 $10^x = 14$
 27 $2^x = 40$ 28 $3^x = 50$ 29 $2^x = 24$
 30 $5^x = 36$

Skill 4.5 Expanding brackets with indices

Simplify:

- 1 $\left(\frac{2a^2}{b}\right)^3$ 2 $\left(\frac{3^2a^4}{b}\right)^3$ 3 $\left(\frac{a^4b^3}{c^5}\right)^2$
 4 $\left(\frac{6a^2}{bc^3}\right)^3$ 5 $\left(\frac{a^4b^2}{3c}\right)^3$ 6 $\left(\frac{3a^4}{2b^4}\right)^2$

Skill 4.6 Negative powers

Express these with positive powers:

- 1 $3^{-3}b^2c^{-2}$ 2 $5^{-2}a^{-2}$ 3 $4^{-2}ab^{-2}$
 4 $5^{-2}bc^{-4}$ 5 $10a^{-2}b$ 6 $7a^{-2}b^3$

Expand the brackets and express the positive powers:

- 7 $(4ay^{-3})^{-1}$ 8 $\left(\frac{13a^2}{6c^3}\right)^{-1}$ 9 $\left(\frac{5^2a^{-3}}{2b}\right)^{-2}$
 10 $\left(\frac{3a^2}{2c^{-4}}\right)^{-2}$

Skill 4.7 Fractional powers

Evaluate:

- 1 $36^{\frac{1}{2}} - 3$ 2 $27^{\frac{1}{3}} + 10$
 3 $(-27)^{\frac{1}{3}} - 2$ 4 $(4 \times 25)^{\frac{1}{2}} + 8$

Simplify:

- 5 $\left(\frac{49a^4b^2}{64c^8}\right)^{\frac{1}{2}}$ 6 $\left(\frac{100a^8}{49b^{10}}\right)^{\frac{1}{2}}$
 7 $\left(\frac{8a^9}{27}\right)^{\frac{1}{3}}$ 8 $\left(\frac{64a^{12}}{27b^9}\right)^{\frac{1}{3}}$

Skill 4.8 Solving indicial equations

Solve these for x:

- 1 $x^3 = 216$ 2 $x^4 = 625$ 3 $x^2 = 169$
 4 $x^5 = 243$ 5 $x^3 = 729$ 6 $3^x = 81$
 7 $5^x = 625$ 8 $2^x = 1024$ 9 $4^x = 256$
 10 $3^x = 243$

Use the remove the power method to solve these for x to two decimal places:

- 11 $x^5 = 3$ 12 $x^4 = 2$ 13 $x^3 = 11$
 14 $x^5 = 3$ 15 $x^3 = 12$ 16 $x^4 = 5$

Skill 4.9 Working with numbers expressed in scientific notation

Calculate the following:

- 1 $2 \times 10^5 \times 3 \times 10^4$ 7 $8 \times 10^9 \div 4 \times 10^3$
 2 $6 \times 10^3 \times 4 \times 10^5$ 8 $6.8 \times 10^{12} \div 2 \times 10^{-4}$
 3 $6.1 \times 10^2 \times 2 \times 10^{-5}$ 9 $5.5 \times 10^{-2} \div 5 \times 10^8$
 4 $7 \times 10^{-3} \times 3 \times 10^4$ 10 $1.75 \times 10^3 \div 5 \times 10^{10}$
 5 $8 \times 10^{-9} \times 2 \times 10^{-11}$
 6 $4 \times 10^{12} \div 2 \times 10^8$

Indices

Skill 4.1

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|---------------|------------------------------------|----------------------------------|
| 1 5^2 | 2 2^3 | 3 6^3 |
| 4 $8^2 = 2^6$ | 5 3^3 | 6 10^4 |
| 7 7^3 | 8 11^2 | 9 3^5 |
| 10 5^4 | 11 247 | 12 1600 |
| 13 151 875 | 14 $\frac{248}{9} = 27\frac{5}{9}$ | 15 37 |
| 16 272 | 17 2744 | 18 $\frac{17}{9} = 1\frac{8}{9}$ |
| 19 2025 | 20 2 | |

Skill 4.2

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|-------------|----------------|--------------|--------------|
| 1 a^7 | 2 a^2b^7 | 3 $6a^3b$ | 4 $12a^2b^5$ |
| 5 $-6a^6$ | 6 $-24a^3b$ | 7 $16a^2b^4$ | 8 $12a^5$ |
| 9 $-18a^6b$ | 10 $-18a^6b^4$ | | |

Skill 4.3

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|-------------------------|----------------------|--------------------------|-----------------------|
| 1 a^2 | 2 $\frac{a^5b^2}{3}$ | 3 $\frac{2a^5}{3b}$ | 4 $4a^3b$ |
| 5 $\frac{3a^3b^2}{2}$ | 6 $\frac{a^8}{3b^2}$ | 7 $\frac{7a^{10}}{8b^2}$ | 8 $\frac{5a^3}{2b^2}$ |
| 9 $\frac{11a^3b^5}{12}$ | 10 $\frac{b}{2a}$ | | |

Skill 4.4

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|-----------------------|-----------|----------------------|--------------------|
| 1 $\frac{2a^6b^7}{9}$ | 2 $3xy^2$ | 3 $\frac{3x^2}{10}$ | 4 $\frac{2a}{b^3}$ |
| 5 $\frac{8b^4}{3a^2}$ | 6 ab^3 | 7 $\frac{4b^2}{a^3}$ | |

Skill 4.5

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|-----------------------------|---------------------------|---------------------------|---------------------------|
| 1 $\frac{8a^6}{b^3}$ | 2 $\frac{729a^{12}}{b^3}$ | 3 $\frac{a^8b^6}{c^{10}}$ | 4 $\frac{216a^6}{b^3c^9}$ |
| 5 $\frac{a^{12}b^6}{27c^3}$ | 6 $\frac{9a^8}{4b^8}$ | | |

Skill 4.6

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|-------------------------|------------------------|---------------------|------------------------|
| 1 $\frac{b^2}{27c^2}$ | 2 $\frac{1}{25a^2}$ | 3 $\frac{a}{16b^2}$ | 4 $\frac{b}{25c^4}$ |
| 5 $\frac{10b}{a^2}$ | 6 $\frac{7b^3}{a^2}$ | 7 $\frac{y^3}{4a}$ | 8 $\frac{6c^3}{13a^2}$ |
| 9 $\frac{4a^6b^2}{625}$ | 10 $\frac{4}{9a^4c^8}$ | | |

Skill 4.7

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|------------------------|------------------------|--------------------|-----------------------|
| 1 3 | 2 13 | 3 -5 | 4 18 |
| 5 $\frac{7a^2b}{8c^4}$ | 6 $\frac{10a^4}{7b^5}$ | 7 $\frac{2a^3}{3}$ | 8 $\frac{4a^4}{3b^3}$ |

Skill 4.8

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|---------|---------|---------|---------|------|
| 1 6 | 2 5 | 3 13 | 4 3 | 5 9 |
| 6 4 | 7 4 | 8 10 | 9 4 | 10 5 |
| 11 1.25 | 12 1.19 | 13 2.22 | 14 1.25 | |
| 15 2.29 | 16 1.50 | 17 1.04 | 18 1.10 | |
| 19 1.59 | 20 1.40 | | | |
| 21 2.18 | 22 1.66 | 23 2.58 | 24 1.64 | |
| 25 2.77 | 26 1.15 | 27 5.32 | 28 3.56 | |
| 29 4.58 | 30 2.23 | | | |

Skill 4.9

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|-------------------------|-------------------------|-------------------------|
| 1 6×10^9 | 2 2.4×10^9 | 3 0.0122 |
| 4 210 | 5 1.6×10^{-19} | 6 20 000 |
| 7 2×10^6 | 8 3.4×10^{16} | 9 1.1×10^{-10} |
| 10 3.5×10^{-8} | | |