

Indices practice

Skill 3.1 Multiplying index expressions

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|-----------------------------------|------------------------------------|
| 1 $a^3 \times a^4$ | 2 $3a^2 \times 4a$ |
| 3 $5ab \times b^2$ | 4 $6a^3 \times 2a^4$ |
| 5 $6a^2 \times 3b$ | 6 $7a^2 \times 3ab$ |
| 7 $9a^2 \times 3ab^2$ | 8 $9a^2b^4 \times 5ab^2$ |
| 9 $7a^2b^4 \times 3a \times 2a^2$ | 10 $9ab^2 \times 3ab \times 2a^4$ |
| 11 $4a^2b \times 3a \times 4b^3$ | 12 $7a^2b \times 8ab^2 \times b^3$ |

Skill 3.2 Dividing index expressions

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|------------------------------|-----------------------------|----------------------------|
| 1 $\frac{a^4b^2}{a^3b}$ | 2 $\frac{a^2b^3}{4b^2}$ | 3 $\frac{5ab^4}{2ab}$ |
| 4 $\frac{15a^2b^3}{3ab}$ | 5 $\frac{168a^2b^4}{2ab^5}$ | 6 $\frac{9a^2b^4}{18a^3}$ |
| 7 $\frac{21a^3b^4}{28ab^5}$ | 8 $\frac{121a^4b}{ab^3}$ | 9 $\frac{15a^2b^4}{3ab^5}$ |
| 10 $\frac{16a^3b^4}{30a^4b}$ | | |

Skill 3.3 Simplifying fraction expressions

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|---|--|
| 1 $\frac{a^4b}{a} \times \frac{a^2b}{b^3}$ | 2 $\frac{4a^3b^2}{ab} \times \frac{8a}{b}$ |
| 3 $\frac{9a^2b}{3b^3} \times 2ab$ | 4 $\frac{a^2b^4}{8ab} \times \frac{3a}{b^4}$ |
| 5 $\frac{a^2b}{3a} \div \frac{2ab}{7}$ | 6 $\frac{4a^2b^4}{11ab^2} \div \frac{a^4b}{a}$ |
| 7 $\frac{4a^4b^4}{16a^2b} \div \frac{a}{b}$ | 8 $\frac{13a^2b^4}{6a} \div \frac{a^4}{b^5}$ |

Skill 3.4 Expanding brackets with indices

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|--|--|---------------------------------------|
| 1 $(a^4b^3)^2$ | 2 $(ab^4c^3)^2$ | 3 $(a^2b^3c^4)^3$ |
| 4 $\left(\frac{a^2}{b^4}\right)^3$ | 5 $\left(\frac{3a^4}{b}\right)^2$ | 6 $\left(\frac{4a^2}{b^2}\right)^3$ |
| 7 $(11ab^2)^3$ | 8 $\left(\frac{9a^2b^4}{c^4}\right)^2$ | 9 $\left(\frac{12a^2b}{c^3}\right)^2$ |
| 10 $\left(\frac{8a^2b^4}{7c^5}\right)^2$ | | |

Skill 3.5 Zero index

Evaluate:

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|--------------------------------------|-----------------------|----------------------------|
| 1 $5a^0$ | 2 $6b^0$ | 3 $(4a)^0$ |
| 4 17^0 | 5 $\frac{a^2b}{ab}$ | 6 $\frac{4a^2b^3}{a^2b^3}$ |
| 7 $\frac{15a^4b^2}{a^4b^2}$ | 8 $\frac{4a^2b}{a^2}$ | 9 $\frac{15^0a^0}{b^0}$ |
| 10 $\left(\frac{3a^2}{b^4}\right)^0$ | | |

Skill 3.6 Prime factors

Express as a product of prime factors:

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|-------|--------|----------|----------|
| 1 72 | 2 48 | 3 288 | 4 432 |
| 5 275 | 6 1125 | 7 22 500 | 8 11 664 |

Skill 3.7 Negative indices

Rewrite with positive indices:

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|-------------------|------------------------|---------------------|
| 1 a^{-2} | 2 $a^{-3}b$ | 3 $3^{-2}b$ |
| 4 $6^{-2}ab^{-3}$ | 5 $6^{-1}a^2b^{-3}$ | 6 $4^{-3}a^{-2}b$ |
| 7 $2^{-1}a^{-1}$ | 8 $9^{-2}a^2b^{-4}c^3$ | 9 $2^{-3}a^{-2}b^3$ |
| 10 $3^{-4}c^{-8}$ | | |

Skill 3.8 Fractional indices

(a) Evaluate:

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|---|-------------------------------|--|
| 1 $25^{\frac{1}{2}}$ | 2 $8^{\frac{1}{3}}$ | 3 $144^{\frac{1}{2}}$ |
| 4 $27^{\frac{1}{3}}$ | 5 $36^{\frac{1}{2}} - 8$ | 6 $100^{\frac{1}{2}} - 1000^{\frac{1}{3}}$ |
| 7 $64^{\frac{1}{3}} + 12$ | 8 $49^{\frac{1}{2}} \times 3$ | 9 $1^{\frac{1}{2}} \times 21$ |
| 10 $81 \times 2 + 3 \times 8^{\frac{1}{3}}$ | | |

(b) Evaluate using a calculator (answers given to 3 decimal places):

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|---------------------------|------------------------------------|-------------------------------|
| 11 $6^{\frac{1}{2}}$ | 12 $18^{\frac{1}{2}}$ | 13 $6 \times 3^{\frac{1}{2}}$ |
| 14 $2 + 19^{\frac{1}{2}}$ | 15 $31^{\frac{1}{2}} \times 2 + 3$ | |

Skill 3.9 Evaluating integer powers

Evaluate:

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|---------------------|-------------------|------------------------|
| 1 $2^4 + 3^2$ | 2 $2^3 + 2^4$ | 3 $8^2 + 2^4$ |
| 4 $(3^2 - 1^4)^2$ | 5 $(2^2 - 1^3)^2$ | 6 $2 \times 3^2 + 2^4$ |
| 7 $5^2 \times 2^3$ | 8 $(3^2 + 2^2)^2$ | 9 $(5^2 \times 2)^2$ |
| 10 $3^2 \times 2^4$ | 11 $3^4 + 2^3$ | 12 $3^2 + 2^2 + 4^2$ |

Answers

3 Indices

Skill 3.1

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|---------------|---------------|---------------|
| 1 a^7 | 2 $12a^3$ | 3 $5ab^3$ |
| 4 $12a^7$ | 5 $18a^2b$ | 6 $21a^3b$ |
| 7 $27a^3b^2$ | 8 $45a^3b^6$ | 9 $42a^5b^4$ |
| 10 $54a^6b^3$ | 11 $48a^3b^4$ | 12 $56a^3b^6$ |

Skill 3.2

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|-------------------|-----------------------|---------------------|------------------------|
| 1 ab | 2 $\frac{a^2b}{4}$ | 3 $\frac{5b^3}{2}$ | 4 $5ab^2$ |
| 5 $\frac{84a}{b}$ | 6 $\frac{b^4}{2a}$ | 7 $\frac{3a^2}{4b}$ | 8 $\frac{121a^3}{b^2}$ |
| 9 $\frac{5a}{b}$ | 10 $\frac{8b^3}{15a}$ | | |

Skill 3.3

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|--------------------------------|----------------------|--------------------|------------------------|
| 1 $\frac{a^5}{b}$ | 2 $32a^3$ | 3 $\frac{6a^3}{b}$ | 4 $\frac{3a^2}{8b}$ |
| 5 $\frac{7}{6} = 1\frac{1}{6}$ | 6 $\frac{4b}{11a^2}$ | 7 $\frac{ab^4}{4}$ | 8 $\frac{13b^9}{6a^3}$ |

Skill 3.4

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|--------------------------------|--------------------------|---------------------------|
| 1 a^8b^6 | 2 $a^2b^8c^6$ | 3 $a^6b^9c^{12}$ |
| 4 $\frac{a^6}{b^{12}}$ | 5 $\frac{9a^8}{b^2}$ | 6 $\frac{64a^6}{b^6}$ |
| 7 $1331a^3b^6$ | 8 $\frac{81a^4b^8}{c^8}$ | 9 $\frac{144a^4b^2}{c^6}$ |
| 10 $\frac{64a^4b^8}{49c^{10}}$ | | |

Skill 3.5

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|-----|------|------|-----|------|
| 1 5 | 2 6 | 3 1 | 4 1 | 5 a |
| 6 4 | 7 15 | 8 4b | 9 1 | 10 1 |

Skill 3.6

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|-------------------------------|--------------------|--------------------|
| 1 $2^3 \times 3^2$ | 2 $2^4 \times 3$ | 3 $2^5 \times 3^2$ |
| 4 $2^4 \times 3^3$ | 5 $5^2 \times 11$ | 6 $3^2 \times 5^3$ |
| 7 $2^2 \times 3^2 \times 5^4$ | 8 $2^4 \times 3^6$ | |

Skill 3.7

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|----------------------|----------------------|------------------|--------------------------|
| 1 $\frac{1}{a^2}$ | 2 $\frac{b}{a^3}$ | 3 $\frac{b}{9}$ | 4 $\frac{a}{36b^3}$ |
| 5 $\frac{a^2}{6b^3}$ | 6 $\frac{b}{64a^2}$ | 7 $\frac{1}{2a}$ | 8 $\frac{a^2c^3}{81b^4}$ |
| 9 $\frac{b^3}{8a^2}$ | 10 $\frac{1}{81c^8}$ | | |

Skill 3.8

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|-----------|-----------|-----------|------|
| 1 5 | 2 2 | 3 12 | 4 3 |
| 5 -2 | 6 0 | 7 16 | 8 21 |
| 9 21 | 10 168 | | |
| 11 2.449 | 12 4.243 | 13 10.392 | |
| 14 21.359 | 15 14.136 | | |

Skill 3.9

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|--------|--------|-------|-------|
| 1 25 | 2 24 | 3 80 | 4 64 |
| 5 9 | 6 34 | 7 200 | 8 169 |
| 9 2500 | 10 144 | 11 89 | 12 29 |