

# Indices practice

## Skill 3.1 Multiplying index expressions

- |                                   |                                    |
|-----------------------------------|------------------------------------|
| 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

- |                              |                             |                            |
|------------------------------|-----------------------------|----------------------------|
| 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

- |   |  |
|---|--|
| 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

- |  |  |                                       |
|--|--|---------------------------------------|
| 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:

- |                                      |                       |                            |
|--------------------------------------|-----------------------|----------------------------|
| 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:

- |       |        |          |          |
|-------|--------|----------|----------|
| 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:

- |                   |                        |                     |
|-------------------|------------------------|---------------------|
| 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:

- |   |                               |  |
|---|-------------------------------|--|
| 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 $12^{\frac{1}{2}} \times 21$             |
| 10 $81 \times 2 + 3 \times 8^{\frac{1}{3}}$ |                               |  |

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

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

## Skill 3.9 Evaluating integer powers

Evaluate:

- |                     |                   |                        |
|---------------------|-------------------|------------------------|
| 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

- |               |               |               |
|---------------|---------------|---------------|
| 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

- |                   |                       |                     |                        |
|-------------------|-----------------------|---------------------|------------------------|
| 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

- |                                |                      |                    |                        |
|--------------------------------|----------------------|--------------------|------------------------|
| 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

- |                                |                          |                           |
|--------------------------------|--------------------------|---------------------------|
| 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

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

### Skill 3.6

- |                               |                    |                    |
|-------------------------------|--------------------|--------------------|
| 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

- |                      |                      |                  |                          |
|----------------------|----------------------|------------------|--------------------------|
| 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

- |           |           |           |      |
|-----------|-----------|-----------|------|
| 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

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