C7

# Indices and standard form

CHAPTER ASSIGNMENT · 118 MARKS

Name _____ Class _____ No. _____ Date _____

Answer every question in the space given. Work without a calculator unless a question says otherwise. Write standard form answers as $A \times 10^n$ with $1 \le A < 10$.

Practice questions from *Cambridge IGCSE Mathematics Core and Extended* (4th edition), Chapter 7 (Indices and standard form), for classroom use. The Check yourself and Chapter quiz questions are Guru Jazzy's own.

## Exercise 7.1 · Positive indices

**7.1.1** Simplify using indices.

| $3 \times 3 \times 3$ | $2 \times 2 \times 2 \times 2 \times 2$ | $4 \times 4$ | $6 \times 6 \times 6 \times 6$ | $2 \times 2 \times 2 \times 3 \times 3$ | $2 \times 7 \times 7 \times 7 \times 7$ |
|---|---|---|---|---|---|
| | | | | | |

**7.1.4** Work out the value of each.

| $2^5$ | $3^4$ | $8^2$ | $6^3$ | $10^6$ | $4^4$ | $2^3 \times 3^2$ | $10^3 \times 5^3$ |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## Exercise 7.2 · Laws of indices

**7.2.1** Simplify using indices.

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

**7.2.2** Simplify.

| $4^6 \div 4^2$ | $5^7 \div 5^4$ | $2^5 \div 2^4$ | $6^5 \div 6^2$ | $8^6 \div 8^5$ | $3^9 \div 3^2$ |
|---|---|---|---|---|---|
| | | | | | |

**7.2.3** Simplify.

| $(5^2)^2$ | $(4^3)^4$ | $(10^2)^5$ | $(3^3)^5$ | $(6^2)^4$ | $(8^2)^3$ |
|---|---|---|---|---|---|
| | | | | | |

**7.2.4** Simplify: (a) $(2^4 \times 2^2) \div 2^3$ · (b) $(3^4 \times 3^2) \div 3^5$ · (c) $(5^6 \times 5^7) \div (5^2 \times 5^8)$ · (d) $((4^2)^5 \times 4^2) \div 4^7$ [8]

## Exercise 7.3 · Zero and negative indices

**7.3.1** Evaluate.

| $2^3 \times 2^0$ | $5^2 \div 6^0$ | $5^2 \times 5^{-2}$ | $6^3 \times 6^{-3}$ | $(4^0)^2$ | $4^0 \div 2^2$ |
|---|---|---|---|---|---|
| | | | | | |

**7.3.2** Evaluate.

| $4^{-1}$ | $3^{-2}$ | $6 \times 10^{-2}$ | $5 \times 10^{-3}$ | $100 \times 10^{-2}$ | $10^{-3}$ |
|---|---|---|---|---|---|
| | | | | | |
| $9 \times 3^{-2}$ | $16 \times 2^{-3}$ | $64 \times 2^{-4}$ | $4 \times 2^{-3}$ | $36 \times 6^{-3}$ | $100 \times 10^{-1}$ |
| | | | | | |

**7.3.4** Evaluate: (a) $3 \div 2^{-2}$ · (b) $4 \div 2^{-3}$ · (c) $7^{-3} \div 7^{-4}$ · (d) $8^{-6} \div 8^{-8}$ **[4]**

## Exercise 7.4 · Exponential equations

**7.4.1** Find x.

| $2^x = 4$ | $2^x = 16$ | $4^x = 64$ | $10^x = 1000$ | $5^x = 625$ | $3^x = 1$ |
|---|---|---|---|---|---|
| | | | | | |

**7.4.2** Find z: (a) $2^{z-1} = 8$ · (b) $3^{z+2} = 27$ · (c) $4^{2z} = 64$ · (d) $10^{z+1} = 1$ · (e) $3^z = 9^{z-1}$ **[10]**

**7.4.4** Find x: (a) $3^{-x} = 27$ · (b) $2^{-x} = 128$ · (c) $2^{-x+3} = 64$ · (d) $4^{-x} = 1/16$ · (e) $2^{-x} = 1/256$ **[10]**

## Exercise 7.5 · Standard form for large numbers

**7.5.1** Which of these are **not** in standard form? $6.2 \times 10^5$ · $7.834 \times 10^{16}$ · $8.0 \times 10^5$ · $0.46 \times 10^7$ · $82.3 \times 10^6$ · $6.75 \times 10^1$ [3]

**7.5.2** Write in standard form.

| 600 000 | 48 000 000 | 784 000 000 000 | 534 000 | 7 million | 8.5 million |
|---|---|---|---|---|---|
| | | | | | |
| $68 \times 10^5$ | $720 \times 10^6$ | $8 \times 10^5$ | $0.75 \times 10^8$ | $0.4 \times 10^{10}$ | $50 \times 10^6$ |
| | | | | | |

**7.5.4** Write as ordinary numbers: (a) $3.8 \times 10^3$ · (b) $4.25 \times 10^6$ · (c) $9.003 \times 10^7$ · (d) $1.01 \times 10^5$ [4]

**7.5.6** Light from the Sun takes about 8 minutes to reach Earth. Light travels at $3 \times 10^8$ m/s. Find the distance from the Sun to the Earth to 3 s.f. (Calculator allowed.) [3]

**7.5.7** Give each answer in standard form.

| $(4.4 \times 10^3) \times (2 \times 10^5)$ | $(6.8 \times 10^7) \times (3 \times 10^3)$ | $(4 \times 10^5) \times (8.3 \times 10^5)$ | $(5.0 \times 10^{12})^2$ |
|---|---|---|---|
| | | | |
| $(3.8 \times 10^8) \div (1.9 \times 10^6)$ | $(6.75 \times 10^9) \div (2.25 \times 10^4)$ | $(9.6 \times 10^{11}) \div (2.4 \times 10^5)$ | $(2.4 \times 10^8) \div (6.0 \times 10^3)$ |
| | | | |
| $(3.8 \times 10^5) + (4.6 \times 10^4)$ | $(7.9 \times 10^9) + (5.8 \times 10^8)$ | $(5.3 \times 10^8) - (8.0 \times 10^7)$ | $(6.5 \times 10^7) - (4.9 \times 10^6)$ |
| | | | |

## Exercise 7.6 · Standard form for small numbers

**7.6.1** Write in standard form.

| 0.0006 | 0.000 053 | 0.000 864 | 0.000 000 088 | 0.000 000 7 | 0.000 414 5 |
|---|---|---|---|---|---|
| | | | | | |
| $68 \times 10^{-5}$ | $750 \times 10^{-9}$ | $42 \times 10^{-11}$ | $0.08 \times 10^{-7}$ | $0.057 \times 10^{-9}$ | $0.4 \times 10^{-10}$ |
| | | | | | |

**7.6.3** Write as ordinary numbers: (a) $8 \times 10^{-3}$ · (b) $4.2 \times 10^{-4}$ · (c) $9.03 \times 10^{-2}$ · (d) $1.01 \times 10^{-5}$ **[4]**

**7.6.4** Find n: (a) $0.000\,25 = 2.5 \times 10^{n}$ · (b) $0.003\,57 = 3.57 \times 10^{n}$ · (c) $0.000\,000\,06 = 6 \times 10^{n}$ **[3]**

**7.6.5** Write in order of size, largest first: $3.2 \times 10^{-4}$ · $6.8 \times 10^{5}$ · $5.57 \times 10^{-9}$ · $6.2 \times 10^{3}$ · $5.8 \times 10^{-7}$ · $6.741 \times 10^{-4}$ · $8.414 \times 10^{2}$ **[3]**

## Exercises 7.7 and 7.8 · Fractional indices (Extended)

**7.7.1** Evaluate.

| $16^{1/2}$ | $25^{1/2}$ | $100^{1/2}$ | $27^{1/3}$ | $81^{1/2}$ | $1000^{1/3}$ |
|---|---|---|---|---|---|
| | | | | | |
| $16^{1/4}$ | $81^{1/4}$ | $32^{1/5}$ | $64^{1/6}$ | $216^{1/3}$ | $256^{1/4}$ |
| | | | | | |
| $4^{3/2}$ | $4^{5/2}$ | $9^{3/2}$ | $16^{3/2}$ | $1^{5/2}$ | $27^{2/3}$ |
| | | | | | |
| $125^{2/3}$ | $32^{3/5}$ | $64^{5/6}$ | $1000^{2/3}$ | $16^{5/4}$ | $81^{3/4}$ |
| | | | | | |

**7.7.5** Solve: (a) $16^x = 4$ · (b) $8^x = 2$ · (c) $9^x = 3$ · (d) $27^x = 3$ · (e) $100^x = 10$ · (f) $64^x = 2$ **[6]**

**7.8** Evaluate: (a) $5^{2/3} \times 5^{4/3}$ · (b) $4^{1/4} \times 4^{1/4}$ · (c) $8 \times 2^{-2}$ · (d) $2^{-2} \times 16$ · (e) $8^{1/3} + 27^{1/3}$ **[8]**

## Student assessment 1

**A1.1** Simplify using indices: (a) $3 \times 2 \times 2 \times 3 \times 27$ · (b) $2 \times 2 \times 4 \times 4 \times 4 \times 2 \times 32$ **[2]**

**A1.2** Write out in full: (a) $6^5$ · (b) $2^{-5}$ **[2]**

**A1.3** Work out: (a) $3^3 \times 10^3$ · (b) $1^{-4} \times 5^3$ **[2]**

**A1.4** Simplify: (a) $2^4 \times 2^3$ · (b) $7^5 \times 7^2 \times 3^4 \times 3^8$ · (c) $4^{10} \div 2^8$ · (d) $(3^3)^4 \div 27^3$ **[8]**

**A1.5** Evaluate: (a) $5^2 \times 5^{-1}$ · (b) $4^5 \div 4^3$ · (c) $7^{-5} \div 7^{-7}$ **[3]**

**A1.6** Find x: (a) $2^{2x + 2} = 128$ · (b) $3^{-x + 4} = 81$ **[4]**

## Student assessment 2

**A2.1** Write in standard form: (a) 6 million · (b) 0.0045 · (c) 3 800 000 000 · (d) 0.000 000 361 · (e) 460 million · (f) 3 **[6]**

**A2.2** Write as ordinary numbers: (a) $8.112 \times 10^6$ · (b) $4.4 \times 10^5$ · (c) $3.05 \times 10^{-4}$ **[3]**

**A2.3** Write in order of size, largest first: $3.6 \times 10^2$ · $2.1 \times 10^{-3}$ · $9 \times 10^1$ · $4.05 \times 10^8$ · $1.5 \times 10^{-2}$ · $7.2 \times 10^{-3}$ **[3]**

**A2.6** Give each answer in standard form: (a) $50\,000 \times 2400$ · (b) $(3.7 \times 10^6) \times (4.0 \times 10^4)$ · (c) $(5.8 \times 10^7) + (9.3 \times 10^6)$ · (d) $(4.7 \times 10^6) - (8.2 \times 10^5)$ **[8]**

**A2.7** Light travels at $3 \times 10^8$ m/s. Jupiter is 778 million km from the Sun. How many minutes does sunlight take to reach Jupiter? (Calculator allowed.) **[3]**

## Student assessment 3 (Extended)

**A3.1** Evaluate.

| $81^{1/2}$ | $27^{1/3}$ | $9^{1/2}$ | $625^{3/4}$ | $343^{2/3}$ | $16^{-1/4}$ |
|---|---|---|---|---|---|
| | | | | | |

## Check yourself

**1** Explain why $2^3 \times 3^2$ cannot be simplified using the laws of indices. **[2]**

**2** A student says $2^{-3} = -8$. Explain the mistake and give the correct value. **[2]**

**3** Explain why $31 \times 10^2$ is not in standard form, and write it correctly. **[2]**

**4** Explain why it is easier to take the root first when working out $25^{3/2}$. **[2]**

## Chapter quiz

**Q1** Simplify $4^3 \times 4^2$.

| A | B | C | D |
|---|---|---|---|
| $4^5$ | $4^6$ | $16^5$ | $8^5$ |

**Q2** Simplify $(4^2)^3$.

| A | B | C | D |
|---|---|---|---|
| $4^5$ | $4^6$ | $4^8$ | $12^2$ |

**Q3** What is the value of $7^0$?

| A | B | C | D |
|---|---|---|---|
| 0 | 1 | 7 | 70 |

**Q4** What is the value of $2^{-3}$?

| A | B | C | D |
|---|---|---|---|
| −8 | −6 | 1/8 | 1/6 |

**Q5** Solve 3^(m − 1) = 81.

| A | B | C | D |
|---|---|---|---|
| m = 3 | m = 4 | m = 5 | m = 27 |

**Q6** What is 72 000 in standard form?

| A | B | C | D |
|---|---|---|---|
| $72 \times 10^3$ | $7.2 \times 10^3$ | $7.2 \times 10^4$ | $0.72 \times 10^5$ |

**Q7** What is $(2.4 \times 10^4) \times (5 \times 10^7)$ in standard form?

| A | B | C | D |
|---|---|---|---|
| $1.2 \times 10^{11}$ | $12 \times 10^{11}$ | $1.2 \times 10^{12}$ | $7.4 \times 10^{11}$ |

**Q8** What is 25^(3/2)?

| A | B | C | D |
|---|---|---|---|
| 15 | 37.5 | 125 | 625 |