

## F Michaelmas Indices

1. Simplify fully:

- |                                   |          |                                   |            |
|-----------------------------------|----------|-----------------------------------|------------|
| (a) $x^2 \times x^3 \times x^5$ . | $x^{10}$ | (f) $4x \times (3x^{-2})^2$ .     | $36x^{-3}$ |
| (b) $2 \times (x^2)^3$ .          | $2x^6$   | (g) $\frac{(3x^2)^3}{3x^{-2}}$ .  | $9x^8$     |
| (c) $(x^{-3})^{-5}$ .             | $x^{15}$ | (h) $\frac{12x^8}{6x^4} + 6x^4$ . | $8x^4$     |
| (d) $(3x^2)^3$ .                  | $27x^6$  | (i) $2x^5(2x^5 + 2x^5)$ .         | $8x^{10}$  |
| (e) $(12x^9) \div (4x^3)$ .       | $3x^6$   |                                   |            |

2. Simplify fully:

- |   |                       |  |                    |
|---|-----------------------|--|--------------------|
| (a) $\frac{(2x^{-2})^3 \times (2x^3)^2}{6^2 \times x^{-4}}$ . | $\frac{8x^4}{9}$      | (h) $\frac{(4m^7n)^3}{8n^3m^{-7}}$ .                                     | $8m^{28}$          |
| (b) $\frac{2x^8 \times (2x)^8}{2x \times (2x)^5}$ .           | $8x^{10}$             | (i) $\frac{(uv)^2(2u^2v)^3}{(u^3v^8)^2(uv^{-1})^4}$ .                    | $\frac{8}{u^2v^7}$ |
| (c) $\frac{(3x^{-1})^3 \times (2x^{-2})^4}{(6x^2)^3}$ .       | $\frac{2}{x^{17}}$    | (j) $\frac{3x(x^4y^8)^3}{x^3(3x^5y)^2}$ .                                | $\frac{y^{22}}{3}$ |
| (d) $\frac{3x^3(2xy)^2}{6x^5y^2}$ .                           | $2$                   | (k) $\frac{6u^2v^3}{3u^{-2}v^5} \times \frac{4(u^3v^4)^2}{2uv^{-1}}$ .   | $4u^9v^7$          |
| (e) $\frac{a^3b^7}{a^{-2}b^4}$ .                              | $a^5b^3$              | (l) $\frac{(2x^3)^3y}{3x^{-2}y^3} \div \frac{4(xy)^{-8}}{(3x^{-4})^2}$ . | $6x^{11}y^6$       |
| (f) $\frac{64(x^{-3}y^7)^2x^6y}{(4x^4y^2)^2}$ .               | $\frac{4y^{11}}{x^8}$ | (m) $\frac{4x^3y}{7xy^2} \div \frac{8x(yz)^2}{14zx^2y^3}$ .              | $\frac{x^3}{z}$    |
| (g) $\frac{7pq^{-1}(2p^3q)^3}{14p(2p^2q)^2}$ .                | $\frac{q^6}{p}$       | (n) $\frac{\frac{6x}{y^2}}{(3xy^3)}$ .                                   | $\frac{2}{y^5}$    |

3. Evaluate without a calculator:

- |  |                  |   |                    |
|--|------------------|---|--------------------|
| (a) $3^{-1}$ .                         | $\frac{1}{3}$    | (i) $\left(\frac{1}{2}\right)^{-2}$ .                                   | $4$                |
| (b) $5^{-2}$ .                         | $\frac{1}{25}$   | (j) $(0.6)^{-2}$ .  | $\frac{25}{9}$     |
| (c) $4^{-3}$ .                         | $\frac{1}{64}$   | (k) $\left(\frac{2}{3}\right)^{-1} + \left(\frac{5}{2}\right)^{-1}$ .   | $\frac{19}{10}$    |
| (d) $7^0$ .                            | $1$              | (l) $\left(\frac{3}{2}\right)^{-2} + \left(\frac{3}{2}\right)^2$ .      | $\frac{97}{36}$    |
| (e) $\left(\frac{2}{3}\right)^{-1}$ .  | $\frac{3}{2}$    | (m) $\left(\frac{1}{5}\right)^{-2} - \left(\frac{2}{7}\right)^{-1}$ .   | $\frac{43}{2}$     |
| (f) $\left(\frac{4}{3}\right)^{-2}$ .  | $\frac{9}{16}$   | (n) $\left(2\frac{1}{2}\right)^{-3} + \left(3\frac{2}{3}\right)^{-1}$ . | $\frac{463}{1375}$ |
| (g) $\left(2\frac{1}{3}\right)^{-1}$ . | $\frac{3}{7}$    | (o) $(0.4)^{-2} - (0.2)^{-1}$ .   | $\frac{5}{4}$      |
| (h) $\left(1\frac{3}{4}\right)^{-3}$ . | $\frac{64}{343}$ |   |                    |

4. Evaluate without a calculator:

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|---------------------------------------|-----|----------------------------------|------|
| (a) $\frac{2^8 \times 2^{-3}}{2^4}$ . | $2$ | (c) $27^3 \div 9^4$ .            | $3$  |
| (b) $8^4 \div 4^6$ .                  | $1$ | (d) $\frac{64^2}{8 \times 16}$ . | $32$ |

5. Solve for  $x$

(a)  $2^x = 8.$

(b)  $3^x = 81.$

$x = 3$

$x = 4$

(c)  $5^x = \frac{1}{25}.$

(d)  $3^{-x} = \frac{1}{27}.$

$x = -2$

$x = 3$