

# Indices

## Topic 5: Index laws: The zero index

QUESTION 1 Simplify the following.

- |   |                   |   |                        |   |                   |
|---|-------------------|---|------------------------|---|-------------------|
| a | $(43)^0 =$ _____  | b | $8 \times 3^0 =$ _____ | c | $x^0y^0 =$ _____  |
| d | $(85)^0 =$ _____  | e | $(xy)^0 =$ _____       | f | $9y^0 =$ _____    |
| g | $xy^0 =$ _____    | h | $3^4p^0 =$ _____       | i | $(4^3)^0 =$ _____ |
| j | $(6xy)^0 =$ _____ | k | $(9ab)^0 =$ _____      | l | $15a^0 =$ _____   |

QUESTION 2 Use your calculator to verify the following.

- |   |                               |   |  |   |                             |
|---|-------------------------------|---|--|---|-----------------------------|
| a | $9^0 = 1$ _____               | b | $73^0 = 1$ _____                       | c | $(\frac{5}{8})^0 = 1$ _____ |
| d | $(2 \cdot 3)^0 = 1$ _____     | e | $-(-6)^0 = -1$ _____                   | f | $(6 \times 12)^0 = 1$ _____ |
| g | $-5 \times 7^0 = -5$ _____    | h | $-51^0 - 3^0 - 5^0 = -3$ _____         | i | $8 \times 6^0 = 8$ _____    |
| j | $21 \times (-5)^0 = 21$ _____ | k | $6 \times 4^0 \times (-9)^0 = 6$ _____ | l | $12 \div 4^0 = 12$ _____    |

QUESTION 3 Simplify the following.

- |   |                           |   |                               |   |                                    |
|---|---------------------------|---|-------------------------------|---|------------------------------------|
| a | $5 \times 2y^0 =$ _____   | b | $(8a^0)^2 =$ _____            | c | $7^0 + 3m^0 =$ _____               |
| d | $5 \times (6a)^0 =$ _____ | e | $9 \times 4x^0 =$ _____       | f | $(-15)^0 + 3 =$ _____              |
| g | $(ab)^0 \times 7 =$ _____ | h | $16^0 + 9^0 =$ _____          | i | $-9x^0 + 12 =$ _____               |
| j | $(8 + 3)^0 =$ _____       | k | $(5a^2)^0 + (3b^2)^0 =$ _____ | l | $9(y^2)^0 \times 3(x^7)^0 =$ _____ |

QUESTION 4 Simplify the following.

- |   |                                    |   |                                 |   |                               |
|---|------------------------------------|---|---------------------------------|---|-------------------------------|
| a | $5x^0 + (5x)^0 =$ _____            | b | $\frac{10y^0}{(10y)^0} =$ _____ | c | $\frac{(6i)^0}{6i^0} =$ _____ |
| d | $-8^0 - (-8)^0 =$ _____            | e | $7(2a - 3b)^0 =$ _____          | f | $12a^4b^0 =$ _____            |
| g | $28x^0y^4 =$ _____                 | h | $2ab^0c^0 =$ _____              | i | $(8a^4)^0 =$ _____            |
| j | $(\frac{2}{3} \times 8)^0 =$ _____ | k | $(5xyz)^0 =$ _____              | l | $14 \times 7^0 =$ _____       |

QUESTION 5 Simplify the following, leaving your answers in index form.

- |   |                                     |   |                                     |   |  |
|---|-------------------------------------|---|-------------------------------------|---|--|
| a | $2^3 \times 2^0 =$ _____            | b | $3^0 \times 3^5 =$ _____            | c | $4^3 \times 4^0 =$ _____                 |
| d | $10^0 \times 10^3 =$ _____          | e | $8^3 \times 8^0 =$ _____            | f | $5^6 \times 5^0 =$ _____                 |
| g | $8^0 \times 8^7 =$ _____            | h | $5^9 \times 5^0 =$ _____            | i | $6^7 \times 6^0 =$ _____                 |
| j | $3^5 \times 3^4 \times 3^0 =$ _____ | k | $7^2 \times 7^0 \times 7^8 =$ _____ | l | $(-3)^0 \times -3^0 \times -3^0 =$ _____ |

QUESTION 6 Simplify the following.

- |   |  |   |   |   |   |
|---|--|---|---|---|---|
| a | $(6y)^0 \times 6y^0 =$ _____               | b | $\frac{9a^2b^0}{3a^0b} =$ _____               | c | $\frac{(5x^2)^3 \times xy}{25x^7} =$ _____  |
| d | $\frac{3a^4 \times 2a^5b}{(ab)^9} =$ _____ | e | $\frac{5a^2 \times (2a^3)^2}{20a^8} =$ _____  | f | $(6y)^0 + 6y^0 - y^1 =$ _____               |
| g | $\frac{9x^2 \times (5x)^0}{3x^0} =$ _____  | h | $\frac{16m^2np^0}{8mn^0} =$ _____             | i | $\frac{(4p^3)^2 \times 2pq}{32p^7} =$ _____ |
| j | $8y^0 \times (3y)^0 + 4y^0 =$ _____        | k | $\frac{2a^2 \times 3a^3b^2}{(2ab)^0} =$ _____ | l | $5x^0 \times (5x)^0 =$ _____                |

Page 5 1 a 1 b 8 c 1 d 1 e 1 f 9 g x h 81 i 1 j 1 k 1 l 15 3 a 10 b 64 c 4 d 5 e 36 f 4 g 7 h 2 i 3 j 1 k 2 l 127  
 4 a 6 b 10 c 1 d -2 e 7 f 12 g 28 h 4 i 2 a 1 j 1 k 1 l 14 5 a 2 b 35 c 43 d 103 e 83 f 56 g 87 h 59 i 67 j 39 k 70 l 1  
 6 a 6 b  $\frac{2c}{b}$  c 5y d  $\frac{5}{b^2}$  e 1 f 7 - y g 3x^2 h 2mn i q j 2 k 6a^5g 1 5

# Indices

## Topic 6: Negative indices

QUESTION 1 Write the following with positive indices.

- |   |                     |   |                            |   |                              |
|---|---------------------|---|----------------------------|---|------------------------------|
| a | $2^{-5} =$ _____    | b | $7^{-2} =$ _____           | c | $3^{-4} =$ _____             |
| d | $5^{-6} =$ _____    | e | $8^{-3} =$ _____           | f | $10^{-8} =$ _____            |
| g | $x^{-4} =$ _____    | h | $a^{-2} =$ _____           | i | $9m^{-4} =$ _____            |
| j | $(-7)^{-3} =$ _____ | k | $\frac{1}{2^{-4}} =$ _____ | l | $(\frac{1}{6})^{-2} =$ _____ |

QUESTION 2 Evaluate the following.

- |   |                              |   |                              |   |                              |
|---|------------------------------|---|------------------------------|---|------------------------------|
| a | $3^{-2} =$ _____             | b | $2^{-3} =$ _____             | c | $4^{-3} =$ _____             |
| d | $5^{-3} =$ _____             | e | $10^{-5} =$ _____            | f | $(3^{-1})^3 =$ _____         |
| g | $(\frac{2}{3})^{-2} =$ _____ | h | $(\frac{3}{2})^{-3} =$ _____ | i | $(\frac{1}{4})^{-2} =$ _____ |
| j | $(\frac{1}{2})^{-4} =$ _____ | k | $(\frac{1}{3})^{-3} =$ _____ | l | $(\frac{5}{6})^{-2} =$ _____ |

QUESTION 3 Write the following with negative indices.

- |   |                         |   |                          |   |                           |
|---|-------------------------|---|--------------------------|---|---------------------------|
| a | $\frac{1}{9} =$ _____   | b | $\frac{1}{3^5} =$ _____  | c | $\frac{1}{a} =$ _____     |
| d | $\frac{1}{y^2} =$ _____ | e | $\frac{4}{x^3} =$ _____  | f | $\frac{8}{x^5} =$ _____   |
| g | $\frac{7}{y} =$ _____   | h | $\frac{6}{a^4} =$ _____  | i | $\frac{7}{3x^4} =$ _____  |
| j | $\frac{a}{5^3} =$ _____ | k | $\frac{1}{5m^2} =$ _____ | l | $\frac{2n}{3m^3} =$ _____ |

QUESTION 4 Simplify the following, giving your answers as fractions.

- |   |                                |   |                            |   |                            |
|---|--------------------------------|---|----------------------------|---|----------------------------|
| a | $5^{-2} =$ _____               | b | $6^{-3} =$ _____           | c | $2^{-6} =$ _____           |
| d | $3^{-2} \times 2^{-1} =$ _____ | e | $7 \times 2^{-3} =$ _____  | f | $8^{-1} =$ _____           |
| g | $5^{-3} \times 5^0 =$ _____    | h | $8 \times 10^{-2} =$ _____ | i | $5 \times 10^{-3} =$ _____ |
| j | $2^{-3} \times 3^{-1} =$ _____ | k | $5^{-7} + 5^{-9} =$ _____  | l | $(3^{-1})^3 =$ _____       |

QUESTION 5 Find the value of  $x$  in the following.

- |   |   |   |                                  |   |  |
|---|---|---|----------------------------------|---|--|
| a | $10^{-3} = 10^x$ _____  | b | $10^{-3} = \frac{1}{10^x}$ _____ | c | $\frac{1}{9} = 9^x$ _____              |
| d | $5^3 \times 5^{-7} = 5^x$ _____                                     | e | $10^7 \div 10^{-4} = 10^x$ _____ | f | $3^8 \times \frac{1}{3^4} = 3^x$ _____ |
| g | $(\frac{3}{2})^7 \times (\frac{2}{3})^{-3} = (\frac{3}{2})^x$ _____ | h | $5^{-6} + 5^3 = 5^x$ _____       | i | $\frac{1}{8^{-3}} = 8^x$ _____         |
| j | $6^5 \times 6^{-3} = 6^x$ _____                                     | k | $7^8 \div 7^5 = 7^x$ _____       | l | $5^{-3} \div 5^2 = 5^x$ _____          |

QUESTION 6 Simplify the following.

- |   |   |   |  |   |  |
|---|---|---|--|---|--|
| a | $3^8 \times 3^{-4} \times 3^{-2} =$ _____ | b | $2^8 \div 2^2 \div 2^3 =$ _____                  | c | $5^7 + 5^8 + 5^2 =$ _____              |
| d | $(8^2)^{-7} =$ _____                      | e | $7^4 \times 7^8 \div 7^5 =$ _____                | f | $(6^3)^{-2} \times (6^2)^{-5} =$ _____ |
| g | $(7^2)^{-3} \div 7^8 =$ _____             | h | $(4^7)^{-3} =$ _____                             | i | $8^5 \times 8^3 + 8^{10} =$ _____      |
| j | $(4^5)^{-2} \times 4 =$ _____             | k | $\frac{(x^3)^2 \div (x^{-1})^3}{x^{-2}} =$ _____ | l | $a^5 \times a^{-4} =$ _____            |

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 1 a  $\frac{1}{25}$  b  $\frac{1}{72}$  c  $\frac{1}{32}$  d  $\frac{1}{56}$  e  $\frac{1}{32}$  f  $\frac{1}{108}$  g  $\frac{1}{x^4}$  h  $\frac{1}{108}$  i  $\frac{1}{83}$  j  $\frac{1}{108}$  k  $\frac{1}{108}$  l  $\frac{1}{108}$   
 2 a  $\frac{1}{9}$  b  $\frac{1}{27}$  c  $\frac{1}{64}$  d  $\frac{1}{125}$  e  $\frac{1}{100000}$  f  $\frac{1}{27}$  g  $\frac{1}{27}$  h  $\frac{1}{27}$  i  $\frac{1}{27}$  j  $\frac{1}{27}$  k  $\frac{1}{27}$  l  $\frac{1}{27}$   
 3 a  $\frac{1}{9}$  b  $\frac{1}{3^5}$  c  $\frac{1}{a}$  d  $\frac{1}{y^2}$  e  $\frac{4}{x^3}$  f  $\frac{8}{x^5}$  g  $\frac{7}{y}$  h  $\frac{6}{a^4}$  i  $\frac{7}{3x^4}$  j  $\frac{a}{5^3}$  k  $\frac{1}{5m^2}$  l  $\frac{2n}{3m^3}$   
 4 a  $\frac{1}{25}$  b  $\frac{1}{72}$  c  $\frac{1}{32}$  d  $\frac{1}{56}$  e  $\frac{1}{32}$  f  $\frac{1}{108}$  g  $\frac{1}{83}$  h  $\frac{1}{108}$  i  $\frac{1}{83}$  j  $\frac{1}{108}$  k  $\frac{1}{108}$  l  $\frac{1}{108}$   
 5 a  $\frac{1}{27}$  b  $\frac{1}{27}$  c  $\frac{1}{27}$  d  $\frac{1}{27}$  e  $\frac{1}{27}$  f  $\frac{1}{27}$  g  $\frac{1}{27}$  h  $\frac{1}{27}$  i  $\frac{1}{27}$  j  $\frac{1}{27}$  k  $\frac{1}{27}$  l  $\frac{1}{27}$   
 6 a  $\frac{1}{25}$  b  $\frac{1}{72}$  c  $\frac{1}{32}$  d  $\frac{1}{56}$  e  $\frac{1}{32}$  f  $\frac{1}{108}$  g  $\frac{1}{83}$  h  $\frac{1}{108}$  i  $\frac{1}{83}$  j  $\frac{1}{108}$  k  $\frac{1}{108}$  l  $\frac{1}{108}$

# Indices

## Topic 7: Fractional Indices

**QUESTION 1** Express the following in root form.

- |   |                            |   |                             |   |                             |
|---|----------------------------|---|-----------------------------|---|-----------------------------|
| a | $9^{\frac{1}{2}} =$ _____  | b | $27^{\frac{1}{3}} =$ _____  | c | $4^{\frac{1}{2}} =$ _____   |
| d | $16^{\frac{1}{4}} =$ _____ | e | $25^{\frac{1}{2}} =$ _____  | f | $a^{\frac{1}{2}} =$ _____   |
| g | $x^{\frac{1}{3}} =$ _____  | h | $8^{\frac{1}{3}} =$ _____   | i | $32^{\frac{1}{5}} =$ _____  |
| j | $y^{\frac{1}{7}} =$ _____  | k | $49^{-\frac{1}{2}} =$ _____ | l | $64^{-\frac{1}{2}} =$ _____ |

**QUESTION 2** Write the following in index form.

- |   |                        |   |                         |   |                        |
|---|------------------------|---|-------------------------|---|------------------------|
| a | $\sqrt{5} =$ _____     | b | $\sqrt{3} =$ _____      | c | $\sqrt{15} =$ _____    |
| d | $\sqrt{43} =$ _____    | e | $\sqrt{7} =$ _____      | f | $\sqrt[3]{6} =$ _____  |
| g | $\sqrt[3]{28} =$ _____ | h | $\sqrt[3]{240} =$ _____ | i | $\sqrt[4]{10} =$ _____ |
| j | $\sqrt[3]{37} =$ _____ | k | $\sqrt[8]{23} =$ _____  | l | $\sqrt[4]{14} =$ _____ |

**QUESTION 3** Simplify the following.

- |   |                            |   |                            |   |                             |
|---|----------------------------|---|----------------------------|---|-----------------------------|
| a | $\sqrt{4} =$ _____         | b | $\sqrt{25} =$ _____        | c | $\sqrt{49} =$ _____         |
| d | $\sqrt{81} =$ _____        | e | $\sqrt[3]{27} =$ _____     | f | $\sqrt[3]{64} =$ _____      |
| g | $64^{\frac{1}{2}} =$ _____ | h | $9^{\frac{1}{2}} =$ _____  | i | $36^{\frac{1}{2}} =$ _____  |
| j | $8^{\frac{1}{3}} =$ _____  | k | $64^{\frac{1}{3}} =$ _____ | l | $125^{\frac{1}{3}} =$ _____ |

**QUESTION 4** Simplify the following.

- |   |                                |   |                                |   |                                 |
|---|--------------------------------|---|--------------------------------|---|---------------------------------|
| a | $16^{\frac{1}{4}} =$ _____     | b | $8^{\frac{2}{3}} =$ _____      | c | $(81a^4)^{\frac{1}{2}} =$ _____ |
| d | $(27^{\frac{1}{3}})^2 =$ _____ | e | $9^{\frac{3}{2}} =$ _____      | f | $(9x^3)^2 =$ _____              |
| g | $(125)^{\frac{2}{3}} =$ _____  | h | $(25^2)^{\frac{1}{2}} =$ _____ | i | $(x^9)^{\frac{1}{3}} =$ _____   |
| j | $25^{\frac{3}{2}} =$ _____     | k | $16^{\frac{3}{4}} =$ _____     | l | $(y^9)^{\frac{2}{3}} =$ _____   |

**QUESTION 5** Without using a calculator, evaluate the following.

- |   |   |   |  |   |   |
|---|---|---|--|---|---|
| a | $36^{\frac{1}{2}} \times 2 \times 36^{\frac{1}{2}} =$ _____                                       | b | $8^{\frac{1}{3}} \times 8^{\frac{1}{3}} \times 25^{\frac{1}{2}} \times 25^{\frac{1}{2}} =$ _____ | c | $(7^{\frac{1}{3}})^{\frac{1}{2}} =$ _____                               |
| d | $\left(\frac{4}{25}\right)^{\frac{1}{2}} \times \left(\frac{8}{27}\right)^{\frac{1}{3}} =$ _____  | e | $(\sqrt{10})^2 =$ _____  | f | $(\sqrt[3]{27})^2 =$ _____  |
| g | $8^0 \times (8^{\frac{1}{3}})^3 =$ _____  | h | $4^{\frac{1}{2}} \times 4^{\frac{1}{2}} + 8^{\frac{1}{3}} \times 27^{\frac{1}{3}} =$ _____       | i | $(5^{\frac{1}{3}})^3 + \left(\frac{4}{25}\right)^{\frac{1}{2}} =$ _____ |
| j | $\left(\frac{64}{25}\right)^{\frac{1}{2}} \times \left(\frac{8}{27}\right)^{\frac{1}{3}} =$ _____ | k | $25^{\frac{1}{2}} \times 25^{\frac{2}{3}} + 16^{\frac{1}{4}} \times 8^{\frac{1}{3}} =$ _____     | l | $(\sqrt[3]{9})^{\frac{2}{3}} =$ _____                                   |

**QUESTION 6** Simplify the following.

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
| a | $x^{\frac{1}{3}} \times x^{\frac{1}{3}} \times x^{\frac{1}{3}} =$ _____ | b | $y^{\frac{1}{2}} \times y^{\frac{1}{2}} \times y^{\frac{1}{2}} =$ _____ | c | $m^{\frac{1}{3}} \times m^{\frac{1}{3}} \times m^{\frac{1}{3}} =$ _____ |
| d | $8x^{\frac{1}{2}} \times 3x^{\frac{1}{4}} =$ _____                      | e | $p^{\frac{2}{3}} \times p^{\frac{1}{3}} \times p^{\frac{1}{3}} =$ _____ | f | $(x^{\frac{1}{2}})^{\frac{1}{2}} =$ _____                               |
| g | $8^{\frac{1}{3}} =$ _____   | h | $2y^{\frac{1}{3}} \times 8y^{\frac{1}{3}} =$ _____                      | i | $(a^{16}b^8)^{\frac{1}{4}} =$ _____                                     |
| j | $(64a^{16})^{\frac{1}{2}} =$ _____                                      | k | $(49a^8b^{12})^{\frac{1}{2}} =$ _____                                   | l | $\left(\frac{y^{15}}{y^7}\right)^{\frac{1}{3}} =$ _____                 |

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Page 7 1 a 9 b 3 27 c 4 d 16 e 25 f 4 g 3 4 h 3 8 i 5 32 j 7 10 k 1 1 2 a 5 b 3 c 15 d 43 e 7 f 64  
g 28 h 240 i 10 j 37 k 25 l 14 3 a 2 b 5 c 7 d 9 e 3 f 4 g 8 h 3 i 6 j 2 k 4 l 5 4 a 2 b 4 c 9 d 81 e 27 f 81 g  
g 25 h 25 i x j 125 k 8 l 15 a 72 b 100 c 7 d 15 e 10 f 9 g 64 h 10 i 52 j 16 k 629 l 36 a x b y i c m d 24 x e p f l x f  
g 128 h 16 y i a 4 b 2 j 8 e k 7 a 2 b 1 y 3