

GCSE & High School Topic Questions

Fractional & Negative Indices

Part 1

Fractional Indices

When the index is a fraction:

- The denominator is the root of the number or letter.
- We raise the answer to the power of the numerator.

$$a^{\frac{m}{n}} = \sqrt[n]{a^m}$$

Example

$$8^{\frac{2}{3}} = \sqrt[3]{8^2} = 2^2 = 4$$

Negative Indices

Negative indices are powers with minus sign.

If a number or expression is raised to a negative power, we find its reciprocal.

$$a^{-m} = a^{\frac{1}{m}}$$

Reciprocal means multiplicative inverse.
The reciprocal of 5 is $\frac{1}{5}$ because $5 \times \frac{1}{5} = 1$

Example

$$a^{-2} = a^{\frac{1}{2}}$$

This means the reciprocal of a^{-2} , which is $a^{\frac{1}{2}}$

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Part 1

1 Find the reciprocal of 4.

(1 mark)

2 Find the value of 2^{-1}

(1 mark)

3 Find the value of 6^{-2}

(1 mark)

4 Find the value of $25^{\frac{1}{2}}$

(1 mark)

5 Find the value of $100^{\frac{1}{2}}$

(1 mark)

6 Find the value of $64^{\frac{1}{2}}$

(1 mark)

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7 Find the value of $49^{-\frac{1}{2}}$

(1 mark)

8 Find the value of $125^{-\frac{1}{3}}$

(1 mark)

9 Find the value of $27^{-\frac{1}{3}}$

(1 mark)

10 Find the value of $64^{-\frac{1}{3}}$

(1 mark)

11 Find the value of $8^{\frac{1}{3}}$

(1 mark)

12 Find the value of $216^{\frac{1}{3}}$

(1 mark)

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Part 1

13 Find the value of $64^{\frac{1}{3}}$

(1 mark)

14 Find the value of $36^{-\frac{1}{2}}$

(1 mark)

15 Find the value of $(27)^{\frac{2}{3}}$

(2 marks)

16 Find the value of $(64)^{-\frac{2}{3}}$

(2 marks)

17 Find the value of $(8)^{\frac{2}{3}}$

(2 marks)

18 Find the value of $(125)^{-\frac{2}{3}}$

(2 marks)

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19 Find the value of $(27a^9)^{\frac{2}{3}}$

(2 marks)

20 Find the value of $\left[\frac{4}{9}\right]^{\frac{-3}{2}}$

(2 marks)

21 Find the value of $\left[\frac{64}{125}\right]^{\frac{2}{3}}$

(2 marks)

22 Find the value of $\left[\frac{16}{25}\right]^{\frac{-3}{2}}$

(2 marks)

23 Find the value of $\left[\frac{27}{64}\right]^{\frac{-2}{3}}$

(2 marks)

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Fractional & Negative Indices

Part 1: Answers

- 1 Find the reciprocal of 4.

Solution: reciprocal of 4 = $\frac{1}{4}$

- 2 Find the value of 2^{-1}

Solution: $2^{-1} = \frac{1}{2}$

- 3 Find the value of 6^{-2}

Solution: $6^{-2} = \frac{1}{6^2} = \frac{1}{36}$

- 4 Find the value of $25^{\frac{1}{2}}$

Solution: $25^{\frac{1}{2}} = 5$ (Square root of 25)

- 5 Find the value of $100^{\frac{1}{2}}$

Solution: $100^{\frac{1}{2}} = 10$ (Square root of 100)

- 6 Find the value of $64^{\frac{1}{2}}$

Solution: $64^{\frac{1}{2}} = 8$ (Square root of 64)

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Part 1:Answers

7 Find the value of $49^{-\frac{1}{2}}$

Solution:
$$\left[49\right]^{-\frac{1}{2}} = \left[-\frac{1}{49}\right]^{\frac{1}{2}} = -\frac{1}{7} \quad (\text{Square root \& flip})$$

8 Find the value of $125^{-\frac{1}{3}}$

Solution:
$$\left[125\right]^{-\frac{1}{3}} = \left[-\frac{1}{125}\right]^{\frac{1}{3}} = -\frac{1}{5} \quad (\text{Cube root \& flip})$$

9 Find the value of $27^{-\frac{1}{3}}$

Solution:
$$\left[27\right]^{-\frac{1}{3}} = \left[-\frac{1}{27}\right]^{\frac{1}{3}} = -\frac{1}{3} \quad (\text{Cube root \& flip})$$

10 Find the value of $64^{-\frac{1}{3}}$

Solution:
$$\left[64\right]^{-\frac{1}{3}} = \left[-\frac{1}{64}\right]^{\frac{1}{3}} = -\frac{1}{4} \quad (\text{Cube root \& flip})$$

11 Find the value of $8^{\frac{1}{3}}$

Solution:
$$(8)^{\frac{1}{3}} = (2^3)^{\frac{1}{3}} = 2$$

12 Find the value of $216^{\frac{1}{3}}$

Solution:
$$(216)^{\frac{1}{3}} = (6^3)^{\frac{1}{3}} = 6$$

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Part 1: Answers

13 Find the value of $64^{\frac{1}{3}}$

Solution:

$$(64)^{\frac{1}{3}} = (4^3)^{\frac{1}{3}} = 4$$

14 Find the value of $36^{-\frac{1}{2}}$

Solution:

$$[36]^{-\frac{1}{2}} = \left[\frac{1}{36} \right]^{\frac{1}{2}} = \frac{1}{6} \quad (\text{Square root \& flip})$$

15 Find the value of $(27)^{\frac{2}{3}}$

Solution:

$$(27)^{\frac{2}{3}} = (3^3)^{\frac{2}{3}} = (3)^2 = 9$$

16 Find the value of $(64)^{-\frac{2}{3}}$

Solution:

$$(64)^{-\frac{2}{3}} = (4^3)^{-\frac{2}{3}} = (4)^{-2} = (16)^{-1} = \frac{1}{16}$$

17 Find the value of $(8)^{\frac{2}{3}}$

Solution:

$$(8)^{\frac{2}{3}} = (2^3)^{\frac{2}{3}} = (2)^2 = 4$$

18 Find the value of $(125)^{-\frac{2}{3}}$

Solution:

$$(125)^{-\frac{2}{3}} = (5^3)^{-\frac{2}{3}} = (5)^{-2} = (25)^{-1} = \frac{1}{25}$$

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Part 1: Answers

19 Find the value of $(27a^9)^{\frac{2}{3}}$

Solution:

$$(27a^9)^{\frac{2}{3}} = (3a^3)^2 = 9a^6$$

20 Find the value of $\left[\frac{4}{9}\right]^{\frac{-3}{2}}$

Solution:

$$\begin{aligned} \left[\frac{4}{9}\right]^{\frac{-3}{2}} &= \left[\frac{2^2}{3^2}\right]^{\frac{-3}{2}} = \left[\frac{2}{3}\right]^{-3} \\ &= \left[\frac{8}{27}\right]^{-1} = \frac{27}{8} \end{aligned}$$

21 Find the value of $\left[\frac{64}{125}\right]^{\frac{2}{3}}$

Solution:

$$\begin{aligned} \left[\frac{64}{125}\right]^{\frac{2}{3}} &= \left[\frac{4^3}{5^3}\right]^{\frac{2}{3}} = \left[\frac{4}{5}\right]^2 \\ &= \frac{16}{25} \end{aligned}$$

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Part 1: Answers

22 Find the value of $\left[\frac{16}{25}\right]^{\frac{-3}{2}}$
Solution:

$$\begin{aligned}\left[\frac{16}{25}\right]^{\frac{-3}{2}} &= \left[\frac{4^2}{5^2}\right]^{\frac{-3}{2}} = \left[\frac{4}{5}\right]^{-3} \\ &= \left[\frac{64}{125}\right]^{-1} = \frac{125}{64}\end{aligned}$$

23 Find the value of $\left[\frac{27}{64}\right]^{\frac{-2}{3}}$

Solution:

$$\begin{aligned}\left[\frac{27}{64}\right]^{\frac{-2}{3}} &= \left[\frac{3^3}{4^3}\right]^{\frac{-2}{3}} = \left[\frac{3}{4}\right]^{-2} \\ &= \left[\frac{9}{16}\right]^{-1} = \frac{16}{9}\end{aligned}$$