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JE
MATHS

10
ADV

- Negative indices evaluation: $a^{-n} = \frac{1}{a^n}$

1. Evaluate:

   (a) 2^{-2}

   (b) $(\frac{1}{2})^{-2}$

   (c) $(2\frac{1}{2})^{-2}$

   (d) $(0.2)^{-2}$

2. Evaluate:

   $$\frac{1}{1-\frac{1}{1-2^{-1}}}+\frac{1}{1+\frac{1}{1+2^{-1}}}$$

- Negative indices simplification:

3. Change the following in the index form:

   (a) $\frac{1}{x^2}$

   (b) $-\frac{1}{2x^2}$

4. Simplify without negative indices:

   (a) $(2^x)^2 \times (2^{2x})^{-2}$

   (b) $(2^x)^{-2} \div 2^{-x}$

   (c) $2m^{-2}n^4 \times 4m^{-4}n^2$

   (d) $6(m^{-2}n^3)^{-2} \div (2m^{-2}n^3)^2$

5. Simplify expressions in terms of index number n.

(a) $2^n + 2^n$

(b) $\frac{1}{2} \times 2^{2n}$

(c) $\frac{2^{n+2} - 2^{n+1}}{2^n}$

(d) $\frac{2^{-n} \times 4^{2n}}{16^{-\frac{n}{4}}}$

- Negative indices expanding and simplify:

6. Simplify binomial expressions without negative indices:

(a) $(x - x^{-1})^2$

(b) $(x^2 + x^{-2})^2$

(c) $(x + y^{-1})^{-2}$

(d) $(x^{-1} + y^{-1})^{-2}$

- Negative indices factorisation:

7. Factorise and simplify involving index number:

(a) $\frac{9^n - 1}{3^n - 1}$

(b) $2^{3n} - 1$

- Negative indices equations:

8. Solve x involving negative index number:

(a) $(\frac{2}{3})^x = \frac{9}{4}$

(b) $(\frac{3}{5})^{-3x} = \frac{25}{9}$

(c) $4^{2-x} = 8$

(d) $(\frac{1}{4})^{x+2} = (\frac{1}{8})^{x-2}$

9. Find the values of x and y by solving the following index equation simultaneously:

(a) $2^{x-y} = 1$ and $8^{x+y} = 64$

(b) $3^{x+y} = 27$ and $4^{x-y} = 8$

10. Solve for x involving index number factorisation:

$2^{2n+2} - 2^{2n-1} = 1792$

- Fractional indices simplification: $a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$

11. Evaluate:

(a) $4^{\frac{1}{2}}$

(b) $4^{-\frac{1}{2}}$

(c) $\left(\frac{27}{8}\right)^{\frac{2}{3}}$

(d) $\left(\frac{8}{27}\right)^{-\frac{4}{3}}$

12. Simplify the following in index form:

(a) $5a^{\frac{1}{2}}b^{\frac{1}{3}} \times 3a^{-\frac{1}{3}}b^{\frac{1}{2}}$

(b) $(2x^{\frac{1}{2}}y^{-\frac{2}{3}})^6 \div (x^2y)^{-1}$

13. Write the following expression using a fractional index.

(a) $-\sqrt{x^3}$

(b) $\frac{3}{\sqrt[3]{x^2}}$

(c) $\frac{x}{\sqrt{y^3}}$

(d) $\frac{\sqrt{x^3}}{\sqrt[3]{y^2}}$

- Fractional indices expansion:

14. Simplify binomial expressions without negative indices:

(a) $(x^{\frac{1}{2}} - x^{-\frac{1}{2}})^2$

(b) $(x^{\frac{3}{2}} + x^{-\frac{3}{2}})^2$

- Fractional indices equations:

15. Solve x involving flipping the index.

(a) $x^5 = 5$

(b) $x^{\frac{5}{3}} = 243$

(c) $x^4 = 81$ (Hint: 2 solutions)

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

16. Solve x involving fractional indices.

(a) $8^{x-1} = 4$

(b) $\left(\frac{8}{125}\right)^{x+2} = \left(\frac{5}{2}\right)^{x}$

(c) $4^x = \sqrt{8}$

(d) $\sqrt{18} \times 9^{x+1} = 9\sqrt{6}$

- Log laws:

17. Use the law of logarithm to solve it. ($x > 0$ and $x \neq 1$)

(a) $\log_x x^5$

(b) $\log_x \frac{1}{x^2}$

(c) $\log_x \sqrt{x}$

(d) $\log_x \frac{1}{\sqrt{x}}$

(e) $\log_x x^2\sqrt{x}$

(f) $\log_x \frac{1}{x\sqrt{x}}$

18. Use the log law to simplify:

(a) $\log_6 \frac{1}{2} + \log_6 2$

(b) $\log_2 96 - \log_2 6$

(c) $\log_3 4 + \log_3 18 - \log_3 8$

(d) $\log_2 4 - \log_2 8 - \log_2 16$

- Change of base law:

19. Use the change of base law $\log_{a^n} b^m = \frac{m}{n}\log_a b$ to simplify:

(a) $\log_{2^2} 2^3$

(b) $\log_9 27$

(c) $\log_{\sqrt{3}} \frac{1}{3}$

(d) $\log_{4^n} 8^n$

- Inverse law: $\log_a a^x = x$ and $a^{\log_a x} = x$

20. Use $a^{\log_a x} = x$ and $\log_a a^x = x$ to simplify:

(a) $\log_6 6^5$

(b) $7^{\log_7 3}$

(c) $\log_9 9^a$

(d) $11^{\log_{11} b}$

- Log simplification:

21. Express in terms of $\log_2 3$ and $\log_2 5$:

(a) $\log_2 15$

(b) $\log_2 \frac{1}{15}$

(c) $\log_2 \frac{8}{5}$

(d) $\log_2 \frac{10}{3}$

(e) $\log_2 30$

(f) $\log_2 \frac{27}{50}$

- Log simplification involving x:

22. Simplify the following log expressions:

(a) $\log_{10} 10x$

(b) $\log_3 \frac{x}{3}$

(c) $\log_2 8x^3$

(d) $\log_3 \frac{9}{27x}$

- Inverse law (hard):

23. Use $a^{\log_a x} = x$ and $\log_a a^x = x$ to simplify:

(a) $4^{\log_4 5 - \log_4 6}$

(b) $t^{a \log_a b}$

(c) $a^{x \log_a x}$

(d) $a^{\frac{\log_a x}{x}}$

- Log simplification (hard):

24. Show that the following expression can be changed in terms of $\log_2 3$ and $\log_2 5$.

(a) $\log_2 30\sqrt{3} = \log_2 5 + 1 + \frac{3}{2}\log_2 3$

(b) $\log_2 \frac{8}{25\sqrt{30}} = 3 - \frac{5}{2}\log_2 5 - \frac{1}{2}\log_2 3$.

25. Let $p = \log_x 2$, $q = \log_x 3$ and $r = \log_x 5$, show that:

(a) $\log_x \frac{24}{15x^3} = 3p - r - 3$

(b) $\log_x \frac{36}{25x} = 2p + 2q - 2r - 1$

- Log proving question:

26. Prove that $\log_{an} x = \dfrac{\log_a x}{1+\log_a n}$ by using the change of base law.

- Inverse law magic:

27. Use $x = a^{\log_a x}$ to express:

(a) 5 as a power of 3.

(b) m as a power of 3.

(c) 0.4 as a power of 2.

(d) y as a power of x.

- Log relations:

28. Rewrite the following into relations:

(a) $\frac{1}{2}\log_2 x + 1 = 3\log_2 y$

(b) $3\log_5(2x-1) = 2\log_5(2x+1)+1$

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