Year 9 index laws worksheet

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Name: _____ Date: _____

Question 1

Evaluate $2^3 \times 3^2$.

Answer: _____

Question 2

Simplify each expression.

(a) $x^3 \times x^5$

(b) $(y^8)/(y^3)$

(c) $3a^4 \times 2a^2$

Answer: _____

Question 3

Simplify each expression.

(a) $(m^3)^4$

(b) $(2p^2)^3$

(c) $5x^0 + (3y)^0$

Answer: _____

Question 4

A rectangular garden bed has a length of $4b^4$ metres and a width of $3b$ metres.

(a) Write a simplified expression for the area of the garden bed in square metres.

(b) A second garden bed has area $(2b^2)^3$ square metres. Write a simplified expression for how many times larger the second garden bed's area is than the first garden bed's area.

Answer: _____

Question 5

Write each expression using positive indices only.

(a) 5^{-2} (b) x^{-3} (c) $3a^{-4}$

Answer: _____

Question 6

Find the value of n in each equation.

(a) $3^n = 243$

(b) $10^n = 1{,}000{,}000$

Answer: _____

Question 7

Simplify $5m^3n^2 \times 4m^2n^5$.

Answer: _____

Question 8

Simplify $((m^3)^4)/(m^5)$, giving your answer as a power of m.

Answer: _____

Question 9

Simplify each expression.

(a) $(3k^3)^2$

(b) $((3k^3)^2)/(3k^4)$

Answer: _____

Question 10

Evaluate without a calculator:

(a) 2^{-3} (b) $(\frac{1}{3})^{-2}$ (c) $4^{-1} + 2^{-2}$

Answer: _____

Year 9 index laws: answers and worked solutions

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Question 1

Key idea: Work out each power first, then multiply.

1. $2^3 = 2 \times 2 \times 2 = 8$ 2. $3^2 = 3 \times 3 = 9$ 3. $8 \times 9 = 72$

Answer: 72

Question 2

Key idea: When multiplying powers with the same base, add the exponents. When dividing, subtract the exponents.

1. (a) $x^3 \times x^5 = x^{3+5} = x^8$ 2. (b) $(y^8)/(y^3) = y^{8-3} = y^5$ 3. (c) Multiply the coefficients and ap ply the product law to the variable: $3a^4 \times 2a^2 = (3 \times 2)a^{4+2} = 6a^6$

Answer: (a) x^8 (b) y^5 (c) $6a^6$

Question 3

Key idea: For a power of a power, multiply the exponents. Any non-zero base raised to the power of zero equals 1.

1. (a) $(m^3)^4 = m^{(3 \times 4)} = m^{12}$ 2. (b) Apply the power to both the coefficient and the va riable: $(2p^2)^3 = 2^3 \times p^{(2 \times 3)} = 8p^6$ 3. (c) $x^0 = 1$ and $(3y)^0 = 1$, so $5x^0 + (3y)^0 = 5(1) + 1 = 6$

Answer: (a) m^{12} (b) $8p^6$ (c) 6

Question 4

Key idea: Find each area using the exponent laws, then divide to find the ratio.

1. (a) Area of first garden bed: $4b^4 \times 3b = 12b^5$ m² 2. (b) Area of second garden bed: $(2 b^2)^3 = 2^3 \times b^{(2 \times 3)} = 8b^6$ m² 3. Divide the second area by the first:\ $(8b^6)/(12b^5) = 8/1 2 \times b^{6-5} = \frac{2}{3}b$ 4. The second garden bed's area is 2b/3 times that of the first.

Answer: (a) $12b^5$ m² (b) 2b/3 times larger

Question 5

Key idea: A negative index means a reciprocal: $a^{-n} = (1)/(a^n)$. The index applies only to the base it is attached to.

1. (a) $5^{-2} = (1)/(5^2) = 1/25$ 2. (b) $x^{-3} = (1)/(x^3)$ 3. (c) Only a has the negative index, so $3a^{-4} = 3 \times (1)/(a^4) = (3)/(a^4)$

Answer: (a) $(1)/(5^2) = 1/25$ (b) $(1)/(x^3)$ (c) $(3)/(a^4)$

Question 6

Key idea: Write the number as a power of the given base.

1. $3 \times 3 \times 3 \times 3 \times 3 = 243$, so $3^5 = 243$ and $n = 5$ 2. 1,000,000 has six zeros, so $10^6 = 1{,}000{,}000$ and $n = 6$

Answer: (a) $n = 5$ (b) $n = 6$

Question 7

Key idea: Multiply the coefficients and add the indices of matching bases.

1. Coefficients: $5 \times 4 = 20$ 2. $m^3 \times m^2 = m^5$ and $n^2 \times n^5 = n^7$

Answer: $20m^5n^7$

Question 8

Key idea: Apply the power-of-a-power law $(a^m)^n = a^{mn}$ first, then the quotient law $a^m \div a^n = a^{m-n}$.

1. Simplify the numerator: $(m^3)^4 = m^{(3 \times 4)} = m^{12}$ 2. Rewrite the expression: $(m^{12})/(m^5)$ 3. Apply the quotient law: $m^{12} \div m^5 = m^{12-5}$ 4. Evaluate the exponent: 12 - 5 = 7

Answer: m^7

Question 9

Key idea: Apply the power-of-a-power law first, then use the quotient law.

1. (a) Raise both the coefficient and the variable to the power of 2: $(3k^3)^2 = 3^2 \times k^{(3 \times 2)} = 9k^6$ 2. (b) Substitute the result from (a) into the numerator:\ $(9k^6)/(3k^4) = 9/3 \times k^{6-4} = 3k^2$

Answer: (a) $9k^6$ (b) $3k^2$

Question 10

Key idea: $a^{-n} = (1)/(a^n)$, and a fraction raised to a negative power is its reciprocal raised to the positive power.

1. (a) $2^{-3} = (1)/(2^3) = ⅛$ 2. (b) $(⅓)^{-2} = 3^2 = 9$ 3. (c) $4^{-1} = ¼$ and $2^{-2} = ¼$, so the sum is 2/4 = ½

Answer: (a) ⅛ (b) 9 (c) ½