The Ninth Grade Math Competition Class

**Exponents** 

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1. Find 
$$5^{-3}5^{5}5^{1}$$
.

$$5^{-3+5+1}-5^3=125$$

1.  $a^{m} \cdot a^{n} = a^{m+n}$ 2.  $a^{m} = a^{m-n}$ 3.  $a^{n} = \frac{1}{a^{n}}$ 4.  $(a^{m})^{n} = a^{m}$ 

**2.** Find  $\frac{3^43^{-2}}{3^53^{-1}}$ .

$$3^{4+(-2)}-5^{-(-1)}=3^{-2}=\frac{1}{9}$$

3. Find 
$$4^{x+1}$$
 if  $2^x$  is 9.

$$2^{x} = 9 \qquad \qquad 4^{x+1} = ?$$

$$(2^{x})^{2} = 81 \qquad (2^{2})^{x+1} = 2^{2x+2}$$

$$4^{x} = 81^{4} \qquad (2^{2})^{x} = 2^{2x+2}$$

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**4.** If  $8^x = 27$ , what is  $4^{2x-3}$ .

$$8^{\times} = 27$$

$$(2^{3})^{\times} = 27$$

$$(2^{3})^{\frac{1}{2}} = 27$$

$$(2^{3})^{\frac{1}{2}} = 27^{\frac{1}{3}} = (3^{\frac{3}{3}})^{\frac{1}{3}}$$

$$2^{\times} = 3$$

$$(2^{2})^{2\times -3} = 2^{4\times -6}$$

$$2^{4\times } = 81$$

$$2^{4\times -6} = \frac{81}{2^{6}} = \frac{81}{64}$$

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

**6.** Simplify the expression  $81^{-2^{-2}}$ .

7. Find x if  $2^{16^x} = 16^{2^x}$ .

and 
$$x$$
 if  $2^{16^x} = \underline{16}^{2^x}$ .

$$2^{16^x} = (2^4)^{2^x}$$

$$2^{16^x} = 2^{16^x}$$

**8.** Solve for 
$$n: \sqrt{1 + \sqrt{2 + \sqrt{n}}} = 2$$
.

$$1+\sqrt{2+\sqrt{n}} = 4$$
 $\sqrt{2+\sqrt{n}} = 3$ 
 $2+\sqrt{n} = 9$ 
 $\sqrt{n} = 7$ 
 $n = 49$ 

9. Find, with a rational common denominator, the sum

$$4 \int_{125}^{2} + \frac{3}{2} + \frac{3}{2} + \frac{5}{2} - \frac{5}{2}$$

$$4 \int_{125}^{2} + \frac{2 \int_{6}^{2} + \frac{5}{2} - \frac{5}{2}}{12}$$

$$4 \int_{125}^{2} + \frac{2 \int_{6}^{2} + \frac{5}{2} - \frac{5}{2}}{12}$$

$$4 \int_{125}^{2} + \frac{2 \int_{6}^{2} + \frac{5}{2} - \frac{5}{2}}{12}$$

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$$4 \int_{125}^{2} + \frac{2 \int_{6}^{2} + \frac{5}{2} - \frac{5}{2}}{12}$$

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$$4 \int_{125}^{2} + \frac{2 \int_{6}^{2} + \frac{5}{2} - \frac{5}{2}}{12}$$

$$4 \int_{125}^{2} + \frac{5}{2} - \frac{5}{2}$$

$$1 \int_{125}^{2} + \frac{5}{2} - \frac{5}{2}$$

$$1 \int_{125}^{2} + \frac{5}{2} - \frac{5}{2} - \frac{5}{2}$$

$$2 \int_{125}^{2}$$

**10.** What is the difference between  $\underline{x^2 = 9}$  and  $\underline{x} = \sqrt{9}$ ?

4=3

$$\chi^{2} = 9$$

$$\chi = 3$$

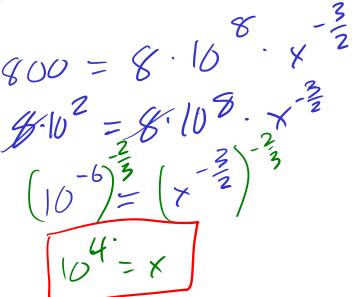
$$\chi = -3$$

11. Suppose that  $y = \frac{3}{4}x$  and  $x^y = y^x$ , the quantity x + y can be expressed as a rational number  $\frac{r}{s}$ , where r and s are relatively prime positive integers. Find r + s.

$$\begin{pmatrix} 34 \\ 4 \end{pmatrix} = \begin{pmatrix} 34 \\ 4 \end{pmatrix} \begin{pmatrix} 34 \\$$

$$| = (\frac{3}{4})^{4} \times (\frac{3}{4})^{4} = (\frac{3}{4})^{4} \times (\frac{3}{3})^{4} = (\frac{3}{3}$$

12. The formula  $N = 8 * 10^8 * x^{-\frac{3}{2}}$  gives, for a certain group, the number of individuals whose income exceeds x dollars. What is the smallest possible value of the lowest income of the wealthiest 800 individuals?



**13.** Solve for x in the equation  $2^{3333} - 2 + 2^{1113} + 2 = 2^{2223} + 1$ 

$$\frac{1}{4} \cdot \frac{333}{233} + 4 \cdot 2^{||| \times} = 2 \cdot 2^{||| \times}$$

$$\frac{1}{4} (2^{||| \times})^3 + 4 \cdot 2^{||| \times} = 2 \cdot (2^{||| \times})^2$$

$$\frac{1}{4} y^3 + 4 y = 2 y^2$$

$$\frac{1}{4} y^2 + 4 = 2y$$

$$\frac{1}{4} y^2 +$$