# Math 8 Unit 1 quiz 1: Multiplying and dividing powers with the same base, Powers of powers, products and quotients, Zero and negative exponents (answer key)

8 questions, 19 points

**ANSWERS AT A GLANCE**

1. (a) $a^{10}$ (b) $m^9$ (c) $t^7$
2. The exponents on top were multiplied instead of added. Correct: $5^2 = 25$
3. $9x^4y^8 = (3x^2y^4)^2$
4. $9x^2$
5. (a) $\frac{1}{2}$ (b) $\frac{1}{4}$
6. $\frac{6}{x^3}$
7. The second is larger: $\frac{3^{12}}{27 \cdot 3^2} = 3^7$ and $9 \cdot 3^4 \cdot 3^2 = 3^8$, so it is 3 times as large.
8. (a) 243 (b) 16

**WORKED SOLUTIONS**

**1.** Simplify to a single power. The letters stand for nonzero numbers. (3 points)

(a) $a \cdot a^5 \cdot a \cdot a^3$ (b) $\frac{m^9 \cdot m^9}{m^9}$ (c) $\frac{t^{15}}{t^4 \cdot t^3 \cdot t}$

**ANSWER**

(a) $a^{10}$ (b) $m^9$ (c) $t^7$

**SOLUTION**

(a) Each lone $a$ is $a^1$: 1 + 5 + 1 + 3 = 10, so $a^{10}$.

(b) The top is $m^{9+9} = m^{18}$, and 18 − 9 = 9, so $m^9$. (Canceling one $m^9$ from top and bottom gives the same answer.)

(c) The bottom is $t^{4+3+1} = t^8$, and 15 − 8 = 7, so $t^7$.

**SCORING**

1 point for each correct part.

**2.** Isaac simplifies $\frac{5^6 \cdot 5^6}{5^{10}}$ and gets $5^{26}$. Find the mistake. Then write the expression as the correct single power and find its value. (2 points)

**ANSWER**

The exponents on top were multiplied instead of added. Correct: $5^2 = 25$

**SOLUTION**

Isaac multiplied the exponents on top, 6 · 6 = 36, and then subtracted 10 to get 26. But the top is a row of 6 factors of 5 followed by 6 more, so it has 6 + 6 = 12 factors: it is $5^{12}$.

Then the bases match and 12 > 10, so the exponents subtract: 12 − 10 = 2.

$$\frac{5^{12}}{5^{10}} = 5^2 = 25$$

**3.** Find the monomial, with a positive coefficient, that makes this true for every $x$ and $y$:

$$9x^4y^8 = (_____)^2$$


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(2 points)

**ANSWER**
$9x^4y^8 = (3x^2y^4)^2$

**SOLUTION**
Raising a monomial to the power 2 raises its coefficient to the power 2 and multiplies each exponent by 2. So undo both steps.

Coefficient: the positive number whose power 2 is 9 is 3, since $3^2 = 9$.

Exponents: divide by 2. For $x$, $4 \div 2 = 2$; for $y$, $8 \div 2 = 4$.

Check: $(3x^2y^4)^2 = 3^2(x^2)^2(y^4)^2 = 9x^4y^8$.

**SCORING**
1 point for the coefficient 3; 1 point for both exponents 2 and 4.

**4.** Simplify $\left(\frac{3}{x^2}\right)^2 \cdot (x^3)^2$, where $x \neq 0$. (2 points)

**ANSWER**
$9x^2$

**SOLUTION**
Apply each exponent before multiplying. The square of the quotient goes to the top and the bottom: $\left(\frac{3}{x^2}\right)^2 = \frac{9}{x^4}$. The second factor is a power of a power: $(x^3)^2 = x^6$. Then

$$\frac{9}{x^4} \cdot x^6 = \frac{9x^6}{x^4} = 9x^{6-4} = 9x^2$$

**SCORING**
1 point for $\frac{9}{x^4}$ and $x^6$; 1 point for $9x^2$.

**5.** Find the value of each.

(a) $\frac{2^{-3}}{4^{-1}}$ (b) $(3^{-1} \cdot 6)^{-2}$ (2 points)

**ANSWER**
(a) $\frac{1}{2}$ (b) $\frac{1}{4}$

**SOLUTION**
(a) The bases differ, so work from the values: $2^{-3} = \frac{1}{8}$ and $4^{-1} = \frac{1}{4}$, so the quotient is $\frac{1}{8} \div \frac{1}{4} = \frac{4}{8} = \frac{1}{2}$. (Or write $4^{-1} = 2^{-2}$ and subtract exponents: $2^{-3-(-2)} = 2^{-1}$.)

(b) Inside first: $3^{-1} \cdot 6 = \frac{6}{3} = 2$. Then $2^{-2} = \frac{1}{4}$.

**SCORING**
1 point for each part.


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**6.** Find the missing factor, written with positive exponents, that makes this true for all nonzero $x$ and $y$:

$$3x^2y^4 \cdot _____ = 18x^{-1}y^4$$

(2 points)

**ANSWER**

$$\frac{6}{x^3}$$

**SOLUTION**

The missing factor is the right side divided by the known factor:

$$\frac{18x^{-1}y^4}{3x^2y^4}$$

Divide the numbers and each letter separately. Coefficients: $\frac{18}{3} = 6$. For $x$, subtract the exponents: $x^{-1-2} = x^{-3}$. For $y$: $y^{4-4} = y^0 = 1$.

$$6 \cdot x^{-3} \cdot 1 = \frac{6}{x^3}$$

**SCORING**

1 point for $x^{-3}$ and $y^0 = 1$; 1 point for the final answer $\frac{6}{x^3}$ with positive exponents.

**7.** Which is larger, $\frac{3^{12}}{27 \cdot 3^2}$ or $9 \cdot 3^4 \cdot 3^2$? Decide by writing each as a single power of 3, then say how many times as large it is. (3 points)

**ANSWER**

The second is larger: $\frac{3^{12}}{27 \cdot 3^2} = 3^7$ and $9 \cdot 3^4 \cdot 3^2 = 3^8$, so it is 3 times as large.

**SOLUTION**

$27 = 3^3$, so the bottom of the first is $3^3 \cdot 3^2 = 3^5$, and

$$\frac{3^{12}}{27 \cdot 3^2} = \frac{3^{12}}{3^5} = 3^7$$

$9 = 3^2$, so

$$9 \cdot 3^4 \cdot 3^2 = 3^{2+4+2} = 3^8$$

The second has one more factor of 3, so it is larger, and $\frac{3^8}{3^7} = 3^1 = 3$: it is 3 times as large. Check: $3^7 = 2187$ and $3^8 = 6561 = 3 \cdot 2187$.

**SCORING**

1 point for $3^7$; 1 point for $3^8$; 1 point for choosing the second and saying it is 3 times as large.

**8.** Find each value without working out any power larger than $3^5$. (3 points)

(a) $\frac{6^5}{2^5}$


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(b) $\left(\frac{2}{3}\right)^4 \cdot 3^4$

**ANSWER**

(a) 243 (b) 16

**SOLUTION**

(a) Read the power of a quotient from right to left: the top and bottom share the exponent 5, so

$$\frac{6^5}{2^5} = \left(\frac{6}{2}\right)^5 = 3^5 = 243$$

(b) The power of a quotient gives $\left(\frac{2}{3}\right)^4 = \frac{2^4}{3^4}$, and the $3^4$ cancels:

$$\frac{2^4}{3^4} \cdot 3^4 = 2^4 = 16$$

(Or, by the power of a product read backward: $\left(\frac{2}{3} \cdot 3\right)^4 = 2^4$.)

**SCORING**

(a) 1 point for rewriting as $\left(\frac{6}{2}\right)^5$ or $3^5$, and 1 point for 243. (b) 1 point for 16 with a correct use of the rules.


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