

# Solutions

Page 222 #s 3, 4, 5acegi, 6bdf,  
7acegi, 8de, 9bc, 10, 11ab, 12ac,  
15af, 16, 18

3. State the value that should be placed in each box.

a)  $2^3 \times 2^4 = 2^{\square}$

$$3 + 4 = 7$$

b)  $(x^5)(x^2) = x^{\square}$

$$5 + 2 = 7$$

c)  $5(5^{11}) = 5^{\square}$

$$5^1 \times 5^{11}$$

$$1 + 11 = 12$$

d)  $(10^6)(10^2)(10) = 10^{\square}$

$$10^6 \times 10^2 \times 10^1$$

$$6 + 2 + 1 = 9$$

e)  $(-6)^7(-6)^8 = \square^{15}$

$$7 + 8 = 15$$

$\Rightarrow$

$$\text{Base} = -6$$

f)  $x^{14}x^{\square} = x^{26}$

$$14 + ? = 26$$

$$? = 26 - 14$$

$$? = 12$$

4. State the value that should be placed in each box.

$$\text{a) } 3^9 \div 3^4 = 3^{\square}$$

$$9 - 4 = 5$$

$$\text{b) } \frac{a^{12}}{a^{10}} = a^{\square}$$

$$12 - 10 = 2$$

$$\text{c) } \frac{y^8}{y} = y^{\square}$$

$$\frac{y^8}{y^1}$$

$$8 - 1 = 7$$

$$\text{d) } \frac{6^{15}}{6^{11}} = \square^4$$

$$15 - 11 = 4$$

$$\Rightarrow$$

$$\text{Base} = 6$$

$$\text{e) } \frac{2^{18}}{\square^5} = 2^{13}$$

$$18 - 5 = 13$$

$$\Rightarrow$$

$$\text{Base} = 2$$

5. Express each of the following as a single power.

$$\text{a) } 5^2 \times 5^{10}$$

$$= 5^{2+10}$$

$$= 5^{12}$$

$$\text{c) } (x^{15})(x^3)$$

$$= x^{15+3}$$

$$= x^{18}$$

$$\text{e) } m^3(m^6)$$

$$= m^{3+6}$$

$$= m^9$$

5. Express each of the following as a single power.

$$g) (7^5)(7^3)(7^4)$$

$$= 7^{5+3+4}$$

$$= 7^{12}$$

$$i) \left(\frac{1}{6}\right)^2 \left(\frac{1}{6}\right)^5 \left(\frac{1}{6}\right)^7 \left(\frac{1}{6}\right)^3$$

$$= \left(\frac{1}{6}\right)^{2+5+7+3}$$

$$= \left(\frac{1}{6}\right)^{17}$$

6. Express each of the following as a single power.

$$b) \frac{(-8)^{10}}{(-8)^3}$$

$$= (-8)^{10-3}$$

$$= (-8)^7$$

$$d) \left(\frac{3}{7}\right)^{10} \div \left(\frac{3}{7}\right)^4$$

$$= \left(\frac{3}{7}\right)^{10-4}$$

$$= \left(\frac{3}{7}\right)^6$$

$$f) \frac{\left(\frac{1}{3}\right)^7}{\left(\frac{1}{3}\right)^3}$$

$$= \left(\frac{1}{3}\right)^{7-3}$$

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

7. Simplify.

a)  $\frac{(5^8)(5^9)}{5^7}$

$$\begin{aligned}
 &= \frac{5^{8+9}}{5^7} \\
 &= \frac{5^{17}}{5^7} \\
 &= 5^{17-7} \\
 &= 5^{10}
 \end{aligned}$$

c)  $\frac{\left(\frac{5}{6}\right)^{17}}{\left(\frac{5}{6}\right)^8 \left(\frac{5}{6}\right)^4}$

$$\begin{aligned}
 &= \frac{\left(\frac{5}{6}\right)^{17}}{\left(\frac{5}{6}\right)^{8+4}} \\
 &= \frac{\left(\frac{5}{6}\right)^{17}}{\left(\frac{5}{6}\right)^{12}} \\
 &= \left(\frac{5}{6}\right)^{17-12} \\
 &= \left(\frac{5}{6}\right)^5
 \end{aligned}$$

e)  $\frac{y^4 y^5}{y^6 y^2}$

$$\begin{aligned}
 &= \frac{y^{4+5}}{y^{6+2}} \\
 &= \frac{y^9}{y^8} \\
 &= y^{9-8} \\
 &= y^1 \\
 &= y
 \end{aligned}$$

7. Simplify.

g)  $\frac{(-6)^{12}}{-6(-6)^2(-6)^3}$

$$\begin{aligned}
 &= \frac{(-6)^{12}}{(-6)^1(-6)^2(-6)^3} \\
 &= \frac{(-6)^{12}}{(-6)^{1+2+3}} \\
 &= \frac{(-6)^{12}}{(-6)^6} \\
 &= (-6)^{12-6} \\
 &= (-6)^6
 \end{aligned}$$

i)  $\left(\frac{x^{20}}{x^{14}}\right)\left(\frac{x^{18}}{x^{15}}\right)$

$$\begin{aligned}
 &= (x^{20-14})(x^{18-15}) \\
 &= (x^6)(x^3) \\
 &= x^{6+3} \\
 &= x^9
 \end{aligned}$$

[could also add exponents and then subtract]

8. Simplify and evaluate.

d)  $\frac{5.8^{11}}{(5.8^6)(5.8^4)}$

$$= \frac{5.8^{11}}{5.8^{6+4}}$$

$$= \frac{5.8^{11}}{5.8^{10}}$$

$$= 5.8^{11-10}$$

$$= 5.8^1$$

$$= 5.8$$

e)  $\frac{\left(\frac{2}{3}\right)^2 \left(\frac{2}{3}\right)^5}{\left(\frac{2}{3}\right)^4 \left(\frac{2}{3}\right)}$

$$= \frac{\left(\frac{2}{3}\right)^{2+5}}{\left(\frac{2}{3}\right)^{4+1}}$$

$$= \frac{\left(\frac{2}{3}\right)^7}{\left(\frac{2}{3}\right)^5}$$

$$= \left(\frac{2}{3}\right)^{7-5}$$

$$= \left(\frac{2}{3}\right)^2 \Rightarrow \frac{4}{9}$$

9. Simplify and then evaluate for  $x=2$  and  $y=3$ .

b)  $\frac{(x^5)(x^4)(x^{10})}{(x^6)(x^8)}$

$$= \frac{x^{5+4+10}}{x^{6+8}}$$

$$= \frac{x^{19}}{x^{14}}$$

$$= x^5$$

c)  $y^2 \left(\frac{y^8}{y^7}\right)$

$$= y^2 (y^{8-7})$$

$$= y^2 (y^1)$$

$$= y^{2+1}$$

$$= y^3$$

10. The product of two powers is  $5^{12}$ . The quotient of the same two powers is  $5^6$ . Find the two powers.

Product  $\rightarrow$  multiply

Quotient  $\rightarrow$  divide

$$(5^x)(5^y) = 5^{12}$$

$$(5^x) \div (5^y) = 5^6$$

$$\Rightarrow x + y = 12$$

$$+ x - y = 6$$

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$$2x = 18$$

$$\frac{2x}{2} = \frac{18}{2}$$

$$x = 9$$

If  $x = 9$ , then

$$y = 3.$$

Check  $9 + 3 = 12 \checkmark$

$9 - 3 = 6 \checkmark$

11. Write as a single power and then evaluate. Express all answers in exact form.

a)  $2^5 \times 2^{-3}$

b)  $(3^{-4})(3^7)$

$$= 2^{5 + (-3)}$$

$$= 2^2$$

$$\Rightarrow 4$$

$$= 3^{-4 + 7}$$

$$= 3^3$$

$$\Rightarrow 27$$

12. Write as a single power and then evaluate. Express all answers in exact form.

a)  $\frac{4^{10}}{4^{12}}$

$$= 4^{10-12}$$

$$= 4^{-2}$$

$$\Rightarrow \frac{1}{4^2}$$

$$= \frac{1}{16}$$

c)  $\frac{2^{-2}}{2^3}$

$$= 2^{(-2)-3}$$

$$= 2^{-5}$$

$$\Rightarrow \frac{1}{2^5}$$

$$= \frac{1}{32}$$

15. Simplify. Express all answers using positive exponents.

a)  $(a^{-3})(a^5)$

$$= a^{(-3)+5}$$

$$= a^2$$

f)  $\frac{x^{-15}}{x^{-9}}$

$$= x^{(-15)-(-9)}$$

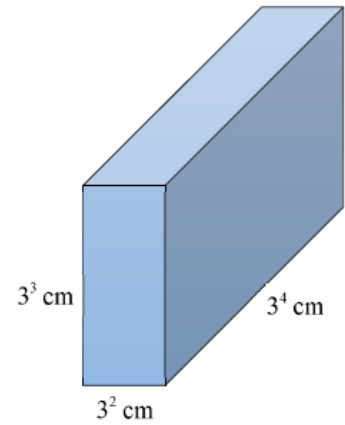
$$= x^{-6}$$

$$\Rightarrow \left(\frac{1}{x}\right)^6$$

$$= \frac{1}{x^6}$$

16. Determine the volume of the rectangular prism shown below. Express your answer as a power.

$$\begin{aligned}
 \text{Vol} &= \text{length} \times \text{width} \times \text{height} \\
 &= 3^4 \times 3^2 \times 3^3 \\
 &= 3^{4+2+3} \\
 &= 3^9 \text{ cm}^3
 \end{aligned}$$



18. Determine the area of the triangle shown below. Express your answer as a power.

$$\begin{aligned}
 \text{Area} &= \frac{\text{base} \times \text{height}}{2} \\
 &= \frac{2^6 \times 2^5}{2} \\
 &= \frac{2^{6+5}}{2^1} \\
 &= \frac{2^{11}}{2^1} \\
 &= 2^{11-1} \\
 &= 2^{10} \text{ mm}^2
 \end{aligned}$$

