Index Laws: Simplifying Powers

Practice Worksheet (Foundation · Target Grade 5)

I Do

(a) Simplify $p^6 \times p^4$.

..... *(1 mark)*

(b) Simplify $(3q)^3$.

..... *(1 mark)*

(c) Simplify $\dfrac{r^4}{r^9}$
Give your answer as a single power of r.

..... *(1 mark)*

(Total for Question is 3 marks)

We Do

(a) Simplify $a^5 \times a^7$.

..... *(1 mark)*

(b) Simplify $(2b)^4$.

..... *(1 mark)*

(c) Simplify $\dfrac{c^3}{c^8}$
Give your answer as a single power of c.

..... *(1 mark)*

(Total for Question is 3 marks)

You Do 1

(a) Simplify $m^8 \times m^3$.

..... *(1 mark)*

(b) Simplify $(4n)^2$.

..... *(1 mark)*

(c) Simplify $\frac{k^5}{k^7}$
Give your answer as a single power of k.

..... *(1 mark)*

(Total for Question is 3 marks)

You Do 2

(a) Simplify $x^9 \times x^{-3}$.

..... *(1 mark)*

(b) Simplify $(5y^2)^3$.

..... *(1 mark)*

(c) Simplify $\frac{w^2}{w^6}$
Give your answer as a single power of w.

..... *(1 mark)*

(Total for Question is 3 marks)

You Do 3

(a) Simplify $d^4 \times d^5 \times d$.

..... *(1 mark)*

(b) Simplify $(2t^3)^4$.

..... *(1 mark)*

(c) Simplify $\dfrac{h^7 \times h^2}{h^{12}}$
Give your answer as a single power of h.

..... *(2 marks)*

(Total for Question is 4 marks)

Challenge 1

(a) Simplify fully

$$\frac{12p^5 \times 3p^4}{9p^{11}}$$

Give your answer in the form ap^n, where a and n are integers.

..... *(2 marks)*

(b) Find the value of k such that

$$(2x^k)^3 \times x^4 = 8x^{19}$$

Show all of your algebraic working clearly.

$k =$ ..... *(2 marks)*

(Total for Question is 4 marks)

Challenge 2

(a) Write $\dfrac{3^7 \times 3^{-2}}{3^8}$ as a single power of 3.

..... *(1 mark)*

(b) Given that $\dfrac{5^n \times 5^3}{5^8} = 5^{-2}$, find the value of n.

$n =$ ..... *(2 marks)*

(c) Simplify fully $\dfrac{(4m^3)^2}{8m^9}$.
Give your answer in the form am^b, where a and b are integers.

..... *(2 marks)*

(Total for Question is 5 marks)

Extreme Challenge

p is a non-zero number, and a and b are integers such that

$$\frac{(2p^a)^3 \times p^b}{4p^7} = 2p^{10} \qquad \text{and} \qquad \frac{p^a}{p^b} = p^3$$

(a) Show that $3a + b = 17$.

(2 marks)

(b) Hence, find the value of a and the value of b.
You must show all of your algebraic working clearly.

$a =$ ..... $b =$ ..... *(3 marks)*

(Total for Question is 5 marks)

Worked Answers

I Do
(a) Add the powers: $p^{6+4} = \mathbf{p^{10}}$.
(b) Cube both the coefficient and the variable: $3^3 \times q^3 = \mathbf{27q^3}$.
(c) Subtract the powers: $r^{4-9} = \mathbf{r^{-5}}$.

We Do
(a) $a^{5+7} = \mathbf{a^{12}}$.
(b) $2^4 \times b^4 = \mathbf{16b^4}$.
(c) $c^{3-8} = \mathbf{c^{-5}}$.

You Do 1
(a) $m^{8+3} = \mathbf{m^{11}}$.
(b) $4^2 \times n^2 = \mathbf{16n^2}$.
(c) $k^{5-7} = \mathbf{k^{-2}}$.

You Do 2
(a) $x^{9+(-3)} = \mathbf{x^6}$.
(b) $5^3 \times (y^2)^3 = \mathbf{125y^6}$.
(c) $w^{2-6} = \mathbf{w^{-4}}$.

You Do 3
(a) Remember that $d = d^1$: $d^{4+5+1} = \mathbf{d^{10}}$.
(b) $2^4 \times (t^3)^4 = \mathbf{16t^{12}}$.
(c) $\dfrac{h^{7+2}}{h^{12}} = \dfrac{h^9}{h^{12}} = h^{9-12} = \mathbf{h^{-3}}$.

Challenge 1

(a) Simplify the numerator first: $12p^5 \times 3p^4 = 36p^9$.
Divide by $9p^{11}$: $\dfrac{36p^9}{9p^{11}} = (36 \div 9)p^{9-11} = \mathbf{4p^{-2}}$.

(b) Expand the bracket: $(2x^k)^3 = 2^3x^{3k} = 8x^{3k}$.
Multiply by x^4: $8x^{3k} \times x^4 = 8x^{3k+4}$.
Equate powers of x:
$3k + 4 = 19$
$3k = 15 \implies \mathbf{k = 5}$.

Challenge 2

(a) Numerator: $3^{7+(-2)} = 3^5$.
Divide by 3^8: $3^{5-8} = \mathbf{3^{-3}}$.

(b) Simplify the left-hand side: $5^{n+3-8} = 5^{n-5}$.
Equate powers of 5:
$n - 5 = -2 \implies \mathbf{n = 3}$.

(c) Expand the numerator: $(4m^3)^2 = 16m^6$.
Divide by $8m^9$: $\dfrac{16m^6}{8m^9} = 2m^{6-9} = \mathbf{2m^{-3}}$.

Extreme Challenge

(a) Simplify the left-hand side of the first equation:
$(2p^a)^3 = 8p^{3a}$, so the numerator is $8p^{3a} \times p^b = 8p^{3a+b}$.
Divide by $4p^7$:
$\dfrac{8p^{3a+b}}{4p^7} = 2p^{3a+b-7}$.
Since this equals $2p^{10}$, equate the powers of p:
$3a + b - 7 = 10 \implies 3a + b = 17$. ***(Shown)***

(b) From the second equation $\dfrac{p^a}{p^b} = p^3$:
$p^{a-b} = p^3 \implies a - b = 3$.
Add the two simultaneous equations:
$(3a + b) + (a - b) = 17 + 3$
$4a = 20 \implies \mathbf{a = 5}$.
Substitute $a = 5$ into $a - b = 3$:
$5 - b = 3 \implies \mathbf{b = 2}$.