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Step 3: Complete the resource!

For PC/Mac users: To fill in the resource, click the text fields and type your answers as needed. Check boxes and radio buttons can simply be clicked on to make the selection of your choice and for anything else you will see the question mark icon which, upon being clicked, will reveal specific instructions that you respond to the corresponding question or activity. When you are finished with the resource, go to File > Save As... and save your file in a memorable location.

For smart device users: To fill in the resource, follow the same process as described above. When you are finished, simply press the back button in the top left of the appscreen and your PDF will save automatically.

Remember: Saving your PDF will overwrite the original file, so be sure to create a copy before starting if you wish to keep a blank copy of the resource on your device.

We hope you have found this information useful. If you experience any problems in following the instructions above, please contact the Beyond team at beyond@regentstudies.com and we will do our best to help with your query.

Using the Four Operations to Simplify Expressions **Answers**

1. Match each expression with the correct simplification. If there is not a matching expression, use one of the empty boxes to write a correct pair.

$4x + 2x + 5x - x$	$5xy^3$
$2x^3 \times 5x$	$10x^4$
$\frac{30x^5}{10x^2}$	$10x$
$x + x + x + x$	$12x^7y^8$
$\frac{14x^2y^2}{7xy}$	$4x$
$\frac{15xy^5}{3y^2}$	$2xy$
$6x^5y^4 \times 2x^2y^4$	$3x^3$

2. Simplify each of the following expressions:

a. $7x + 2x - 5x$

$4x$

f. $\frac{48ab}{12b}$

$4a$

b. $8a + 2b - 3b + a$

$9a - b$

g. $\frac{12x^2y^3}{4xy}$

$3xy^2$

c. $3x + 2x^2 - 5x + 7x^2$

$-2x + 9x^2$

h. $3x + 5x + 3x \times 4y^2$

$8x + 12xy^2$

d. $8m \times 2m$

$16m^2$

i. $\frac{4x^2y \times 5xy^7}{10xy^4}$

$2x^2y^4$

e. $15ab^2 \times 2ab$

$30a^2b^3$

j. $\frac{3p + 7p - p}{3p^2}$

$3p^{-1}$

3. Joe has answered three simplification problems. Each answer is wrong. Look at the answers and explain what you think Joe has done wrong, then work out the correct answer.

a. $3x + 2y + 5x - y = 9xy$

The correct answer is $8x + y$. Joe has tried to add $8x$ and $1y$ to get $9xy$, but you cannot add algebraic terms with different letters.

b. $3a^2b^3 \times 7a^3b = 10a^5b^4$

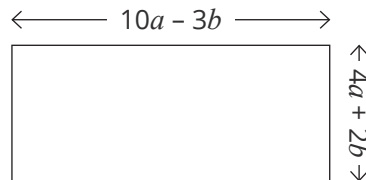
The correct answer is $21a^5b^4$. Joe has added the indices correctly, but they have also added the coefficients ($3 + 7 = 10$) rather than multiplying them ($3 \times 7 = 21$).

c. $\frac{3p^4q^{15}}{p^2q^5} = 3p^2q^3$

The correct answer is $3p^2q^{10}$. Joe has divided the indices when they should have subtracted them.

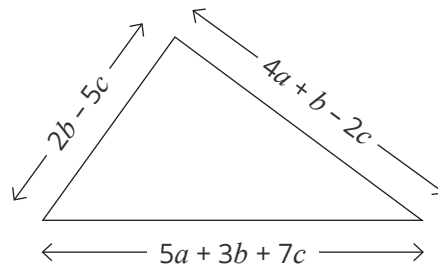
4. Write a simplified expression for the perimeter of each of the shapes below.

a.



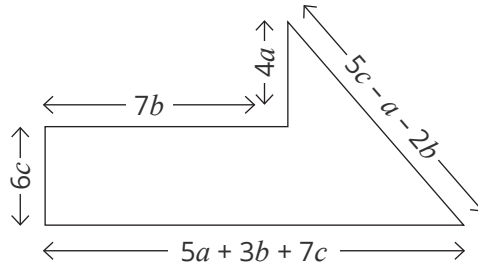
$28a - 2b$

b.



$9a + 6b$

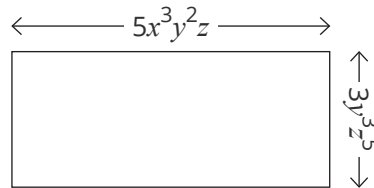
c.



$$8a + 8b + 18c$$

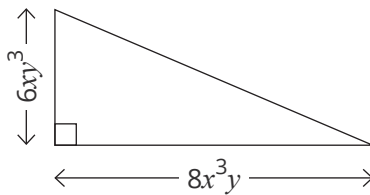
5. For each of the shapes below, find a simplified expression for the area of the shape.

a.



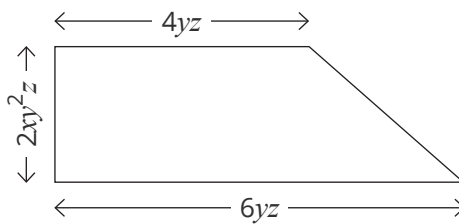
$$15x^3y^5z^6$$

b.



$$24x^4y^4$$

c.



$$10xy^3z^2$$

Challenge

The following expressions show how much money Emma and Peter each managed to save, each month, from January to March:

	Emma	Peter
January	$10x - 3y$	$10a^6 \times 2b^2$
February	$3x - 5y$	$3a^2b^5 \times 5a^4b^{-3}$
March	$7x - 4y$	$11ab^2 \times 5a^5$

1. Write an expression for the amount of money Emma saved.

$$20x - 12y$$

2. Write an expression for the amount of money Peter saved.

$$\text{Jan} - 20a^6b^2$$

$$\text{Feb} - 15a^6b^2$$

$$\text{Mar} - 55a^6b^2$$

$$\text{Total} = 90a^6b^2$$

3. Emma is given $\frac{21a^7b^3}{7ab}$ and Peter is given $y - 4x$. Write an expression for the amount of money Emma and Peter have in total, including the money they were given.

$$\frac{21a^7b^3}{7ab} = 3a^6b^2$$

$$\text{Total} = 20x - 12y + 90a^6b^2 + 3a^6b^2 + y - 4x$$

$$= 16x - 11y + 93a^6b^2$$

Using the Four Operations to Simplify Expressions

Prior Knowledge:

- Using index laws for multiplication and division.
- Using the four operations with positive and negative integers.

Simplifying an expression can mean anything from collecting like terms to simplifying fractions. It is important to remember these three rules:

$$3ab \text{ means } 3 \times a \times b$$

$$a^m \times a^n = a^{m+n}$$

$$a^m \div a^n = a^{m-n}$$

Example 1

Simplify $8a - 4 + 3a + 10$

Here, we have a mixture of terms. Some have an algebraic variable, a , and some are constants (ordinary numbers without a letter). To simplify this expression, we want to collect the algebraic terms together and collect the constant terms together. It can help to circle or highlight the like terms – make sure you also include the sign before the term:

$$\boxed{8a} \quad \boxed{-4} \quad \boxed{+3a} \quad \boxed{+10}$$

$$\boxed{8a + 3a} = 11a$$

$$\boxed{-4 + 10} = 6$$

$$8a - 4 + 3a + 10 = 11a + 6$$

Example 2

Simplify $7m + 2n - m - 7n + 8mn$

In this case, we have two variables, m and n . As before, we highlight the like terms and combine them, including the sign before the term.

There are two things we need to be careful about here. First, $+8mn$ can't be grouped with the " m " terms or the " n " terms. Second, $-m$ can be written as $-1m$.

$$\boxed{7m} \quad \boxed{+2n} \quad \boxed{-m} \quad \boxed{-7n} \quad \boxed{+8mn}$$

$$\boxed{7m - m} = 6m$$

$$\boxed{2n - 7n} = -5n$$

$$7m + 2n - m - 7n + 8mn = 6m - 5n + 8mn$$

Using the Four Operations to Simplify Expressions

We often need to use multiplication to simplify.

Example 3

Simplify $3xz \times 2xy$

It doesn't matter which order we multiply our terms. It can be helpful to consider the coefficients (the numbers) then each variable in turn:

$$3 \times 2 = 6$$

$$x \times x = x^2$$

$$z = z$$

$$y = y$$

y and z have no like terms, so we haven't simplified them. Bringing these together gives:

$$3xz \times 2xy = 6 \times x^2 \times y \times z$$

$$\mathbf{3xz \times 2xy = 6x^2yz}$$

Notice that we've written the variables in alphabetical order. We do this to keep our work neat and organised and to make it easier to compare terms.

Example 4

Simplify $5ab^2c \times ab^3c^2$

In this case, it's important to remember that when multiplying indices, we add the powers. Let's consider each part of the multiplication in turn:

$$5 \times 1 = 5$$

$$a \times a = a^2$$

$$b^2 \times b^3 = b^{2+3} = b^5$$

$$c \times c^2 = c^{1+2} = c^3 \quad (\text{remember } c \text{ is the same as } c^1)$$

Putting this together gives:

$$\mathbf{5ab^2c \times ab^3c^2 = 5a^2b^5c^3}$$

Sometimes, expressions will involve division; these divisions will usually be written as fractions. While it can look daunting to have fractions in algebra, we just need to remember that we are simply dividing the numerator by the denominator.

Consider the fraction $\frac{30}{15}$. This simply means $30 \div 15$, which we know is 2. We will use the exact same method when simplifying with algebra.

Example 5Simplify $\frac{10xy^3}{5x}$ fully.

Let's consider the coefficients and variables one by one:

$$\frac{10}{5} = 10 \div 5 = 2$$

$$\frac{x}{x} = x \div x = 1$$

 y^3 can't be simplified as there's no y term on the denominator.

Bringing these three together gives:

$$\begin{aligned} \frac{10xy^3}{5x} &= 2 \times 1 \times y^3 \\ &= 2y^3 \end{aligned}$$

Note that we are still multiplying the numbers and algebraic terms to get our final answer. This is because we simplified by dividing, so the division part of the original expression has already been carried out.

Example 6Simplify fully $\frac{27a^5b^3}{9a^2b}$

This fraction looks more complicated than the previous one but by breaking it down into each part, we can simplify it. Remember, when dividing indices, we subtract the powers.

$$\frac{27}{9} = 27 \div 9 = 3$$

$$\frac{a^5}{a^2} = a^5 \div a^2$$

$$= a^{5-2} = a^3$$

$$\frac{b^3}{b} = b^3 \div b$$

$$= b^{3-1} = b^2$$

Bringing all this together gives:

$$\frac{27a^5b^3}{9a^2b} = 3a^3b^2$$

Your turn

1. Match each expression with the correct simplification. If there is not a matching expression, use one of the empty boxes to write a correct pair.

$4x + 2x + 5x - x$	=	<input style="width: 50px; height: 30px;" type="text"/>		a.	$5xy^3$
$2x^3 \times 5x$	=	<input style="width: 50px; height: 30px;" type="text"/>		b.	<input style="width: 100%; height: 30px;" type="text"/>
$\frac{30x^5}{10x^2}$	=	<input style="width: 50px; height: 30px;" type="text"/>		c.	$10x$
$x + x + x + x$	=	<input style="width: 50px; height: 30px;" type="text"/>		d.	$12x^7y^8$
$\frac{14x^2y^2}{7xy}$	=	<input style="width: 50px; height: 30px;" type="text"/>		e.	<input style="width: 100%; height: 30px;" type="text"/>
$\frac{15xy^5}{3y^2}$	=	<input style="width: 50px; height: 30px;" type="text"/>		f.	$2xy$
$6x^5y^4 \times 2x^2y^4$	=	<input style="width: 50px; height: 30px;" type="text"/>		g.	$3x^3$

2. Simplify each of the following expressions:

a. $7x + 2x - 5x$

b. $8a + 2b - 3b + a$

c. $3x + 2x^2 - 5x + 7x^2$

d. $8m \times 2m$

e. $15ab^2 \times 2ab$

f. $\frac{48ab}{12b}$

g. $\frac{12x^2y^3}{4xy}$

h. $3x + 5x + 3x \times 4y^2$

i. $\frac{4x^2y \times 5xy^7}{10xy^4}$

j. $\frac{3p + 7p - p}{3p^2}$

Using the Four Operations to Simplify Expressions

3. Joe has answered three simplification problems. Each answer is wrong. Look at the answers and explain what you think Joe has done wrong, then work out the correct answer.

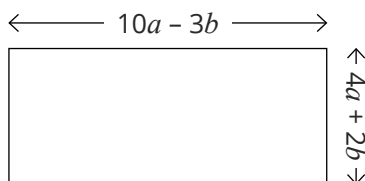
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b. $3a^2b^3 \times 7a^3b = 10a^5b^4$

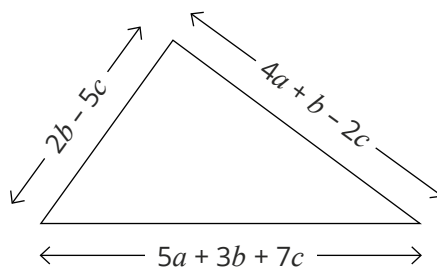
c. $\frac{3p^4q^{15}}{p^2q^5} = 3p^2q^3$

4. Write a simplified expression for the perimeter of each of the shapes below.

a.

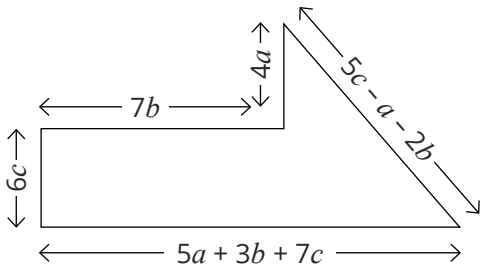


b.



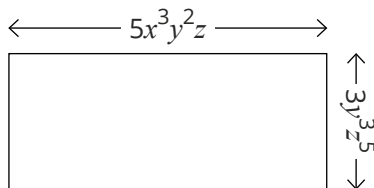
Using the Four Operations to Simplify Expressions

c.

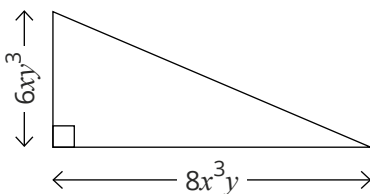


5. For each of the shapes below, find a simplified expression for the area of the shape.

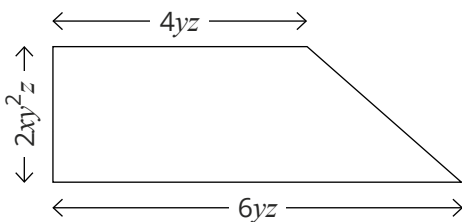
a.



b.



c.



Challenge

The following expressions show how much money Emma and Peter each managed to save, each month, from January to March:

	Emma	Peter
January	$10x - 3y$	$10a^6 \times 2b^2$
February	$3x - 5y$	$3a^2b^5 \times 5a^4b^{-3}$
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1. Write an expression for the amount of money Emma saved.

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3. Emma is given $\frac{21a^7b^3}{7ab}$ and Peter is given $y - 4x$. Write an expression for the amount of money Emma and Peter have in total, including the money they were given.

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Simplify $7m + 2n - m - 7n + 8mn$

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This fraction looks more complicated than the previous one but by breaking it down into each part, we can simplify it. Remember, when dividing indices, we subtract the powers.

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$$\frac{a^5}{a^2} = a^5 \div a^2$$

$$= a^{5-2} = a^3$$

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Bringing all this together gives:

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Your turn

1. Match each expression with the correct simplification. If there is not a matching expression, use one of the empty boxes to write a correct pair.

$$4x + 2x + 5x - x$$

$$2x^3 \times 5x$$

$$\frac{30x^5}{10x^2}$$

$$x + x + x + x$$

$$\frac{14x^2y^2}{7xy}$$

$$\frac{15xy^5}{3y^2}$$

$$6x^5y^4 \times 2x^2y^4$$

$$5xy^3$$

$$$$

$$10x$$

$$12x^7y^8$$

$$$$

$$2xy$$

$$3x^3$$

2. Simplify each of the following expressions:

a. $7x + 2x - 5x$

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i. $\frac{4x^2y \times 5xy^7}{10xy^4}$

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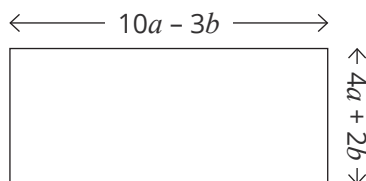
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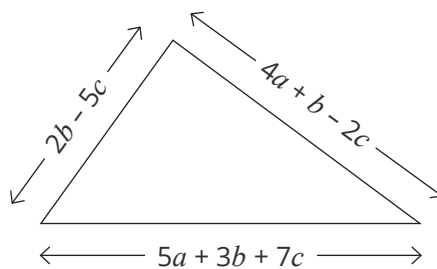
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a.

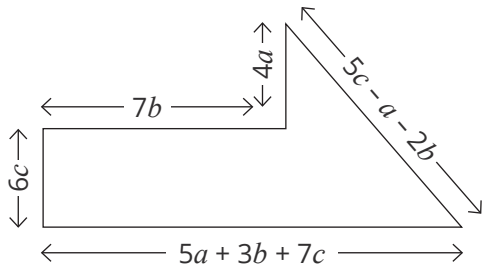


b.



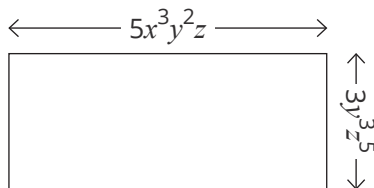
Using the Four Operations to Simplify Expressions

c.

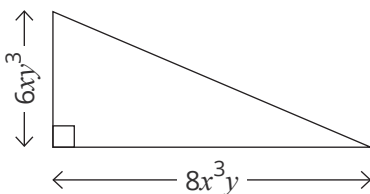


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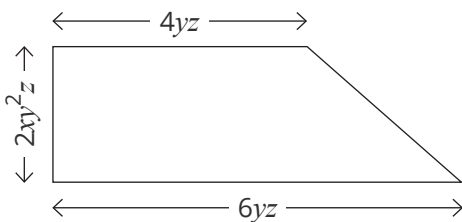
a.



b.



c.



Challenge

The following expressions show how much money Emma and Peter each managed to save, each month, from January to March:

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February	$3x - 5y$	$3a^2b^5 \times 5a^4b^{-3}$
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