

Student Name

Mathematics Stage 5 Paths

ALGEBRAIC TECHNIQUES B

Book 1 Apply the 4 operations involving algebraic fractions with pronumerals in the denominator

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OVERVIEW

SYLLABUS CONTENT

MA5-ALG-P-01 simplifies algebraic fractions involving indices, and expands and factorises algebraic expressions

Apply the 4 operations involving algebraic fractions with pronumerals in the denominator

- Simplify algebraic fractions, including those involving indices
- Simplify expressions that involve operations with algebraic fractions, including algebraic fractions that involve pronumerals in the denominator and/or indices

REVIEW OF PRIOR KNOWLEDGE

1 Simplify the following

a $\frac{8b}{2}$

b $-\frac{2a}{6}$

c $\frac{4ab}{6}$

d $\frac{7x}{7}$

e $\frac{6ab}{2}$

f $-\frac{3a}{9}$

g $\frac{4ab}{2a}$

h $-\frac{15xy}{5y}$

i $-\frac{28ab}{56b}$

j $\frac{3mn}{6n}$

k $-\frac{5xy}{20y}$

l $\frac{10st}{6t}$

m $\frac{u^2v}{u}$

n $\frac{5r^2s^2}{8rs}$

o $\frac{5ab^2}{9b}$

p $\frac{-7mn}{-3m}$

q $\frac{27pq}{-6p}$

r $\frac{24ab^2}{8ab}$

2 Simplify the following

a $x^3 \div x$

b $x^8 \div x^5$

c $x^6y^2 \div x^3$

d $x^{17} \div y^5$

e $a^3b^8c^{11} \div ab^2x^5$

f $x^6y^2 \div y^3$

3 Fill in the boxes so the fractions are equivalent.

a $\frac{2a}{3b} = \frac{4a}{\square}$

b $\frac{3b}{20} = \frac{12b}{\square}$

c $\frac{a}{b} = \frac{ac}{\square}$

d $\frac{4a}{5b} = \frac{\square}{20bc}$

e $\frac{x}{y} = \frac{\square}{5y}$

f $\frac{4de}{p} = \frac{\square}{3p}$

g $\frac{3k}{2t} = \frac{\square}{2tm}$

h $\frac{x}{y} = \frac{\square}{y^2}$

4 Add and subtract these fractions.

a $\frac{2k}{5} + \frac{3k}{7}$

b $\frac{2t}{5} - \frac{t}{3}$

c $\frac{x}{4} + \frac{3x}{8}$

d $\frac{8p}{3} - 2p$

e $\frac{3a}{5} + \frac{a}{10}$

f $k + \frac{2k}{3}$

g $\frac{4z}{5} - \frac{2z}{3}$

h $\frac{7x}{3} - \frac{2x}{8}$

5 Multiply and divide these fractions.

a $\frac{3m}{5} \times \frac{10n}{7}$

b $\frac{4w}{3} \times \frac{9z}{8}$

c $\frac{2k}{9} \times \frac{6n}{5}$

d $\frac{8a}{5} \times \frac{15b}{16}$

e $\frac{3t}{5} \times \frac{10}{9u}$

f $\frac{5y}{3} \times \frac{9}{2y}$

6 Determine the **lowest common multiple**.

a 2 and 3

b $2x$ and 3

c $2x$ and $3x$

d $2x$ and x^2

e x and y

f $2x$ and $3y$

g $2x^2$ and $3x$

h $2x^3$ and $5x^2$

i 5 and a^2

j $3y$ and $12x$

k 4 and $6x$

l $2xy$ and $3x^3$

SIMPLIFYING ALGEBRAIC FRACTIONS INVOLVING INDICES

PRODUCING EQUIVALENT ALGEBRAIC FRACTIONS

- Produce equivalent fractions by multiplying the numerator and denominator by the same term.

Example Produce equivalent algebraic fractions.

$\frac{3n}{7} = \frac{\quad}{14}$ $= \frac{3n \times 2}{7 \times 2}$ $= \frac{6n}{14}$	How did we know to multiply the numerator and denominator by 2? The has been multiplied by 2, so the should also be multiplied by 2 to keep the fraction
$\frac{3a}{4b^2} = \frac{\quad}{12b^7}$ $= \frac{3a \times 3b^5}{4b^2 \times 3b^5}$ $= \frac{9ab^5}{12b^7}$	How did we know to multiply by $3b^5$? The has been multiplied by $3b^5$, so the should also be multiplied by to keep the fraction

Produce equivalent fractions.

a $\frac{2y}{5} = \frac{\quad}{15}$ 6y	b $\frac{4m}{3} = \frac{\quad}{6}$ 8m	c $\frac{5a}{2} = \frac{\quad}{12}$ 30a	d $\frac{5m}{2n} = \frac{\quad}{6n}$ 15m
e $\frac{3t}{4w} = \frac{\quad}{16w}$ 12t	f $\frac{8}{5q} = \frac{\quad}{30q}$ 48	g $\frac{6x}{5y} = \frac{\quad}{5yz}$ 6xz	h $\frac{3a}{4b} = \frac{\quad}{4b^2}$ 3ab
i $\frac{7m}{9n} = \frac{\quad}{18np}$ 14mp	j $\frac{2u}{3w} = \frac{\quad}{15wx}$ 10ux	k $\frac{5a}{4bc} = \frac{\quad}{8b^2c^3}$ 10abc²	l $\frac{7w}{6xy^2z} = \frac{\quad}{18x^2y^4z^5}$ 21wxy²z⁴

SIMPLIFYING FRACTIONS INVOLVING INDICES

- To simplify fractions:
1. Divide the numerator and denominator by a common factor.
- When indices are involved, use the index law:

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

Example Simplify algebraic fractions involving indices.

$\frac{10a^5}{5a^2}$ $= \frac{10a^5 \div a^2}{5a^2 \div a^2}$ $= \frac{10a^3 \div 5}{5 \div 5}$ $= 2a^3$	How did we know to divide numerator and denominator by a^2? a^2 is a common of $10a^5$ and $5a^2$ Why does $a^5 \div a^2 = a^3$? The index law of division says that if the bases are the same, we the powers when dividing.
$\frac{8ab}{2a^2}$ $= \frac{8ab \div a}{2a^2 \div a}$ $= \frac{8b \div 2}{2a \div 2}$ $= \frac{4b}{a}$	In this example, why was a left in the denominator? We divided the numerator and denominator by the common factor, In the numerator, $8ab \div 2a = \dots\dots\dots$ In the denominator, $2a^2 \div 2a = \dots\dots\dots$ So, a was left in the denominator.

Simplify these expressions.

a $\frac{35x^2}{7x}$	b $\frac{-14x^3}{7x}$	c $-\frac{36ab^2}{4ab}$
d $\frac{8xy^3}{4x^2y}$	e $\frac{-15pq^2}{30p^2q^2}$	f $\frac{-20s}{45s^2t}$
$\frac{5x}{2y^2}$	$\frac{-2x^2}{-\frac{1}{2p}}$	$\frac{-9b}{-\frac{4}{9st}}$

Key ideas

1. Simplify fractions by dividing the and by the

1 Simplify the following:

a $\frac{x}{x}$	e $\frac{2x}{x}$	j $\frac{x}{2x}$
1	2	$\frac{1}{2}$
b $\frac{a}{a^2}$	f $\frac{3x^2}{9xy}$	k $\frac{12ab}{4a^2b}$
$\frac{1}{a}$	$\frac{x}{3y}$	$\frac{3}{a}$

2 Simplify the following:

a $\frac{3}{12}$	f $\frac{12x}{6x}$	k $\frac{10xy}{12xy^2}$
$\frac{1}{4}$	2	$\frac{5}{6y}$
b $\frac{3x}{12}$	g $\frac{12xy}{6x}$	l $\frac{10x^2y}{12xy^2}$
$\frac{x}{4}$	2y	$\frac{5x}{6y}$
c $\frac{3}{12x}$	h $\frac{6x}{12xy}$	m $\frac{10x^2y^2}{12xy^2}$
$\frac{1}{4x}$	$\frac{1}{2y}$	$\frac{5x}{6}$
d $\frac{12x}{3}$	i $\frac{10x}{12xy}$	n $\frac{10x^2y^3}{12xy^2}$
4x	$\frac{5}{6y}$	$\frac{5xy}{6}$
e $\frac{12x}{3x}$	j $\frac{10x}{12xy^2}$	o $\frac{100x^2y^4}{120xy^2}$
4	$\frac{5}{6y^2}$	$\frac{5xy^2}{6}$

3 Simplify the following:

a $\frac{35x^2}{7x}$	b $-\frac{14x^2y}{7xy}$	c $\frac{-36ab^2}{4ab}$
5x	-2x	-9b
d $\frac{8xy^3}{-4xy^2}$	e $\frac{-15pq^2}{-30p^2q^2}$	f $-\frac{20s}{45s^2t}$
-2y	$\frac{1}{2p}$	$-\frac{4}{9st}$

4 Simplify by writing as a fraction first.

a $12ab \div 2$	b $-10 \div 2gh$	c $8x \div x$
$6ab$	$-\frac{5}{gh}$	8
d $-3xy \div yx$	e $7mn \div 3m$	f $-27pq \div 6p$
-3	$\frac{7n}{3}$	$-\frac{9q}{2}$
g $24ab^2 \div 8ab$	h $25x^2y \div (-5xy)$	i $9m^2n \div 18mn$
$3b$	$-5x$	$\frac{m}{2}$

5 Simplify the following expressions.

a $\frac{a^4}{a}$	b $\frac{3b^3}{9b}$	c $\frac{4ab^3}{12ab}$	d $\frac{6a^4b^2}{16a^3b}$
a^3	$\frac{b^2}{3}$	$\frac{b^2}{3}$	$\frac{3ab}{8}$
e $-\frac{2a^5}{3a^2}$	f $-\frac{8a^5}{20a^7}$	g $\frac{4a^3}{10a^8}$	h $\frac{3a^3b}{12ab^4}$
$-\frac{2a^3}{3}$	$-\frac{2}{5a^2}$	$\frac{2}{5a^5}$	$\frac{a^2}{4b^3}$
i $\frac{15a^4b^2}{5ab}$	j $\frac{28a^3b^5}{7a^4b^2}$	k $\frac{2a^5b^2}{6a^2b^3}$	l $-\frac{5a^3b^7}{10a^2b^{10}}$
$3a^3b$	$\frac{4b^3}{a}$	$\frac{a^3}{3b}$	$-\frac{a}{2b^3}$

6 Simplify the following expressions. Remember to follow the order of operations.

a $\frac{2ab \times 3bc \times 4cd}{4a \times 3bc \times 2d}$	b $\frac{12a^2b + 4a^2b}{4b+2b}$	c $\frac{7x^2y - 5yx^2}{12xy}$
bc	$\frac{8a^2}{3}$	$\frac{x}{6}$
d $\frac{8a^2b + (4a \times 2ba)}{3ba - 2ba}$	e $\frac{10abc + 5cba + 5a \times bc}{4c \times 10ab}$	f $\frac{10x^2y - (4x \times 6xy)}{7xy^2}$
$16a$	$\frac{1}{2}$	$-\frac{2x}{y}$

ADDING AND SUBTRACTING ALGEBRAIC FRACTIONS

1. Rewrite the fractions with the lowest common multiple of the denominators.
2. Add or subtract the numerators.

Example Add/subtract algebraic fractions with pronumeral denominators.

$\frac{2}{5} + \frac{3}{a^2}$ 1. Same denominators $\frac{2a^2}{5a^2} + \frac{15}{5a^2}$ 2. Add numerators $\frac{2a^2 + 15}{5a^2}$	Why did we make the denominators $5a^2$? The of 5 and a^2 is $5a^2$
$\frac{2}{3x} - \frac{3}{5x}$ 1. Same denominators $\frac{10}{15x} - \frac{9}{15x}$ 2. Subtract numerators $\frac{1}{15x}$	In this example, why <i>didn't</i> we make the common denominator $15x^2$? $15x^2$ is not the

Simplify these expressions.

a $\frac{1}{a} + \frac{1}{3a}$ $= \frac{1}{3a} + \frac{1}{3a}$ $= \frac{2}{3a}$	b $\frac{1}{2x} - \frac{1}{3x}$ $= \frac{3}{6x} - \frac{2}{6x}$ $= \frac{1}{6x}$	c $\frac{2}{a} - \frac{3}{4a}$ $= \frac{8}{4a} - \frac{3}{4a}$ $= \frac{5}{4a}$
d $\frac{3}{5x} - \frac{1}{2x}$ $= \frac{6}{10x} - \frac{5}{10x}$ $= \frac{1}{10x}$	e $\frac{5}{a} + \frac{2}{a^3}$ $= \frac{5a^2}{a^3} + \frac{2}{a^3}$ $= \frac{5a^2 + 2}{a^3}$	f $\frac{1}{x^2} - \frac{1}{y}$ $= \frac{y}{x^2y} - \frac{x^2}{x^2y}$ $= \frac{y - x^2}{x^2y}$

Key ideas

1. To add and subtract two fractions, the must be the same.
2. First, we find the of the denominators.
3. To change the denominator to the common multiple, we the numerator and denominator by the same
4. Once the denominators are the same, we or the numerators.

1 Add and subtract these fractions.

a i $\frac{3}{5} + \frac{1}{10}$	ii $\frac{3}{40} + \frac{1}{20}$	iii $\frac{3}{z} + \frac{1}{2z}$	iv $\frac{3}{2x} + \frac{1}{x}$
$\frac{7}{10}$	$\frac{1}{8}$	$\frac{7}{2z}$	$\frac{5}{2x}$
b i $\frac{3}{5} - \frac{1}{10}$	ii $\frac{3}{40} - \frac{1}{20}$	iii $\frac{3}{z} - \frac{1}{2z}$	iv $\frac{3}{2x} - \frac{1}{x}$
$\frac{1}{2}$	$\frac{1}{40}$	$\frac{5}{2z}$	$\frac{1}{2x}$

2 Simplify the following.

a $\frac{3}{x} + \frac{5}{2x}$	b $\frac{7}{3x} - \frac{2}{x}$	c $\frac{7}{4x} - \frac{5}{2x}$
$\frac{11}{2x}$	$\frac{1}{3x}$	$-\frac{3}{4x}$
d $\frac{4}{3x} + \frac{2}{9x}$	e $\frac{3}{4x} - \frac{2}{5x}$	f $\frac{2}{3x} + \frac{1}{5x}$
$\frac{14}{9x}$	$\frac{7}{20x}$	$\frac{13}{15x}$
g $\frac{-3}{4x} - \frac{7}{x}$	h $\frac{-5}{3x} - \frac{3}{4x}$	i $\frac{5}{3x} + \frac{3}{4x}$
$-\frac{31}{4x}$	$-\frac{29}{12x}$	$\frac{29}{12x}$
j $\frac{17}{100x} - \frac{7}{50x}$	k $\frac{113}{4y} + \frac{1}{2y} - \frac{3}{y}$	l $\frac{97}{6k} - \frac{5}{3k} + \frac{1}{k}$
$\frac{3}{100x}$	$\frac{103}{4y}$	$\frac{31}{2k}$

3 Simplify the following.

a $\frac{3}{x} + \frac{2}{x^2}$	b $\frac{5}{x^2} + \frac{4}{x}$	c $\frac{7}{x} + \frac{3}{x^2}$
$\frac{3x+2}{x^2}$	$\frac{5+4x}{x^2}$	$\frac{7x+3}{x^2}$
d $\frac{4}{x} - \frac{5}{x^2}$	e $\frac{3}{x^2} - \frac{8}{x}$	f $-\frac{4}{x^2} + \frac{1}{x}$
$\frac{4x-5}{x^2}$	$\frac{3-8x}{x^2}$	$\frac{x-4}{x^2}$
g $\frac{3}{x} - \frac{7}{2x^2}$	h $\frac{-2}{3x} + \frac{3}{x^2}$	i $-\frac{5}{x^2} - \frac{3}{4x}$
$\frac{6x-7}{2x^2}$	$\frac{-2x+9}{3x^2}$	$\frac{-20-3x}{4x^2}$

4 Simplify the following. You will need to rewrite the fractions with a common denominator.

a $\frac{2}{x} + \frac{x}{4}$

b $\frac{-5}{x} + \frac{x}{2}$

c $\frac{-2}{x} - \frac{4x}{3}$

$$\frac{8+x^2}{4x}$$

$$\frac{-10+x^2}{2x}$$

$$\frac{-6-4x^2}{3x}$$

d $\frac{3}{2x} - \frac{5x}{4}$

e $\frac{3x}{4} - \frac{5}{6x}$

f $\frac{1}{3x} - \frac{x}{9}$

$$\frac{6-5x^2}{4x}$$

$$\frac{9x^2-10}{12x}$$

$$\frac{3-x^2}{9x}$$

g $-\frac{2}{5x} + \frac{3x}{2}$

h $\frac{-5}{4x} - \frac{3x}{10}$

i $-\frac{6x}{4} - \frac{5}{3x}$

$$\frac{-4+15x^2}{10x}$$

$$\frac{-25-6x^2}{20x}$$

$$\frac{-9x^2-10}{6x}$$

5 Simplify these expressions.

a $\frac{3x}{2} + \frac{4x}{5}$

f $\frac{5x}{5} - \frac{x}{2}$

k $\frac{6}{2xy} + \frac{2}{x}$

$$\frac{23x}{10}$$

$$\frac{x}{2}$$

$$\frac{3+2y}{xy}$$

b $\frac{x}{2} + \frac{4x}{5}$

g $\frac{5}{x} + \frac{2}{x}$

l $\frac{6}{2xy} + \frac{2}{3x}$

$$\frac{13x}{10}$$

$$\frac{7}{x}$$

$$\frac{9+2y}{3xy}$$

c $\frac{x}{2} + \frac{x}{5}$

h $\frac{5}{x^2} + \frac{2}{x}$

m $\frac{6}{2xy} - \frac{2}{3x^2}$

$$\frac{7x}{10}$$

$$\frac{5+2x}{x^2}$$

$$\frac{9x-2y}{3x^2y}$$

d $\frac{x}{2} - \frac{x}{5}$

i $\frac{5}{2x^2} - \frac{2}{x}$

n $\frac{6y}{2xy} + \frac{2}{3x^2}$

$$\frac{3x}{10}$$

$$\frac{5-4x}{2x^2}$$

$$\frac{9x+2}{3x^2}$$

e $\frac{x}{5} - \frac{x}{2}$

j $\frac{6}{2x^2} + \frac{2}{x}$

o $\frac{y}{2xy} - \frac{2}{3x^3}$

$$\frac{-3x}{10}$$

$$\frac{3+2x}{x^2}$$

$$\frac{3x^2-4}{6x^3}$$

6 Simplify these expressions.

a $\frac{2}{3x} + \frac{5}{x} - \frac{1}{x}$

$$\frac{14}{3x}$$

b $-\frac{1}{2x} + \frac{2}{x} - \frac{4}{3x}$

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

c $-\frac{4}{5x} - \frac{1}{2x} + \frac{3}{4x}$

$$-\frac{11}{20x}$$

d $\frac{4}{x^2} + \frac{3}{2x} - \frac{5}{3x}$

$$\frac{24-x}{6x^2}$$

e $\frac{5}{x} - \frac{3}{2x^2} - \frac{5}{7x}$

$$\frac{60x-21}{14x^2}$$

f $\frac{2}{x^2} - \frac{4}{9x} - \frac{5}{3x^2}$

$$\frac{3-4x}{9x^2}$$

g $\frac{2}{x} + \frac{x}{5} - \frac{x}{3}$

$$\frac{30-2x^2}{15x}$$

h $\frac{3x}{2} - \frac{1}{2x} + \frac{x}{3}$

$$\frac{11x^2-3}{6x}$$

i $-\frac{4x}{9} + \frac{2}{5x} + \frac{2x}{5}$

$$\frac{18-2x^2}{45x}$$

MULTIPLYING AND DIVIDING ALGEBRAIC FRACTIONS

Rule for Multiplying Fractions

$$\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$$

Example Multiply algebraic fractions.

$\frac{2a}{5} \times \frac{3b}{7}$ $= \frac{2a \times 3b}{5 \times 7}$ $= \frac{6ab}{35}$	What is the rule for multiplying fractions? <i>Multiply the and multiply the</i>
$\frac{4x}{15} \times \frac{3}{2x}$ $= \frac{4x \times 3}{15 \times 2x}$ $= \frac{12x}{30x} = \frac{2}{5}$	It is a good idea to simplify before you multiply. Repeat this question but “cancel” the fractions before multiplying. $\frac{4x}{15} \times \frac{3}{2x}$

Simplify these expressions.

a $\frac{x}{3} \times \frac{2}{5}$ $\frac{2x}{15}$	b $\frac{2}{3} \times \frac{4a}{5}$ $\frac{8a}{15}$	c $\frac{6x}{5} \times \frac{7y}{6}$ $\frac{7xy}{5}$
d $\frac{8a}{5} \times \frac{3b}{4c}$ $\frac{6ab}{5c}$	e $\frac{3x}{2} \times 6$ $9x$	f $\frac{10x}{3} \times \frac{3}{10x}$ 1

Key ideas

- To multiply two fractions, we multiply the and

DIVIDING ALGEBRAIC FRACTIONS

Rule for Dividing Fractions

$$\frac{a}{b} \div \frac{c}{d}$$

$$= \frac{a}{b} \times \frac{d}{c}$$

Example Divide algebraic fractions.

$\frac{3a}{8} \div \frac{b}{5}$ $= \frac{3a}{8} \times \frac{5}{b}$ $= \frac{15a}{8b}$	What is the rule when dividing by a fraction? <i>Dividing by a fraction is the same as multiplying by its</i>
$\frac{u}{4} \div \frac{15p}{2}$ $= \frac{u}{4} \times \frac{2}{15p}$ $= \frac{2u}{60p}$ $= \frac{u}{30p}$	When you reach the multiplication step, you can simplify before you multiply. Repeat the question by “cancelling” first. $\frac{u}{4} \times \frac{2}{15p}$

Simplify these expressions.

a $\frac{3a}{5} \div \frac{1}{5}$

b $\frac{9a}{10} \div \frac{1}{4}$

c $\frac{4}{5} \div \frac{2y}{3}$

d $\frac{4a}{7} \div \frac{2}{5}$

e $\frac{4x}{5} \div 3$

f $2 \div \frac{x}{5}$

$\frac{3a}{5}$

$\frac{18a}{5}$

$\frac{6}{5y}$

$\frac{10a}{7}$

$\frac{4x}{15}$

$\frac{10}{x}$

Key ideas

1. Dividing by a fraction is the same as multiplying by the

1 Simplify these products. Remember to simplify before you multiply.

a $\frac{6x}{5} \times \frac{7y}{6}$

$$\frac{7xy}{5}$$

b $\frac{2b}{5} \times \frac{7d}{6}$

$$\frac{7bd}{15}$$

c $\frac{8a}{5} \times \frac{3b}{4c}$

$$\frac{6ab}{5c}$$

d $\frac{9d}{2} \times \frac{4e}{7}$

$$\frac{18de}{7}$$

e $\frac{3x}{2} \times \frac{1}{6x}$

$$\frac{1}{4}$$

f $\frac{4}{9k} \times \frac{3k}{2}$

$$\frac{2}{3}$$

2 Simplify these divisions. Remember to simplify before you multiply.

a $\frac{3a}{4} \div \frac{1}{5}$
 $= \frac{3a}{4} \times \frac{5}{1} =$

$$\frac{15a}{4}$$

b $\frac{2x}{5} \div \frac{3}{7}$

$$\frac{4x}{15}$$

c $\frac{9a}{10} \div \frac{1}{4}$

$$\frac{18a}{5}$$

d $\frac{2}{3} \div \frac{4x}{7}$

$$\frac{7}{6x}$$

e $\frac{4}{5} \div \frac{2y}{3}$

$$\frac{6}{5y}$$

f $\frac{1}{7} \div \frac{2}{x}$

$$\frac{x}{14}$$

g $\frac{4a}{7} \div \frac{2}{5}$

$$\frac{10a}{7}$$

h $\frac{4b}{7} \div \frac{2c}{5}$

$$\frac{10b}{7c}$$

i $\frac{2x}{5} \div \frac{4y}{3}$

$$\frac{3x}{10y}$$

j $\frac{2y}{x} \div \frac{3}{y}$

$$\frac{2y^2}{3x}$$

k $\frac{5}{12x} \div \frac{7x}{2}$

$$\frac{5}{42x^2}$$

l $\frac{4a}{5} \div \frac{2b}{7a}$

$$\frac{14a^2}{5b}$$

3 Simplify the following.

a $3 \times \frac{4x}{5}$

$$\frac{12x}{5}$$

b $\frac{4x}{5} \div 3$

$$\frac{4x}{15}$$

c $2 \div \frac{x}{5}$

$$\frac{10}{x}$$

d $4 \times \frac{a}{3}$

$$\frac{4a}{3}$$

e $5 \times \frac{7}{10x}$

$$\frac{7}{2x}$$

f $1 \div \frac{x}{2}$

$$\frac{2}{x}$$

4 Simplify these expressions.

a $\frac{3}{5} \times \frac{x}{y}$

g $\frac{7x}{xy} \times \frac{3}{6y}$

l $\frac{7x}{xy} \div \frac{6y}{3} \div \frac{4y}{14}$

b $\frac{x}{y} \times \frac{3}{5}$

$$\frac{3x}{5y}$$

h $\frac{7x}{xy} \div \frac{3}{6y}$

$$\frac{7}{2y^2}$$

m $\frac{7x^2}{xy} \div \frac{6y}{3} \div \frac{4y}{14}$

$$\frac{49}{4y^3}$$

c $\frac{x}{y} \times \frac{3}{6}$

$$\frac{3x}{5y}$$

i $\frac{7x}{xy} \div \frac{6y}{3}$

$$14$$

n $\frac{7x^2}{xy} \div \left(\frac{6y}{3} \div \frac{4y}{14} \right)$

$$\frac{49x}{4y^3}$$

d $\frac{x}{y} \times \frac{3}{6x}$

$$\frac{x}{2y}$$

j $\frac{7x}{xy} \times \frac{6y}{3}$

$$\frac{7}{2y^2}$$

o $\frac{7x^2}{xy} \div \left(\frac{6y}{3} \times \frac{4y}{14} \right)$

$$\frac{x}{y}$$

e $\frac{x}{xy} \times \frac{3}{6}$

$$\frac{1}{2y}$$

k $\frac{7x}{xy} \times \frac{6y}{3} \times \frac{4y}{14}$

$$14$$

p $\frac{7x^2}{xy} \div \left(\frac{6y}{9} \times \frac{4y}{14} \right)$

$$\frac{49x}{4y^3}$$

f $\frac{7x}{xy} \times \frac{3}{6}$

$$\frac{1}{2y}$$

l $\frac{7x}{xy} \div \frac{6y}{3} \times \frac{4y}{14}$

$$4y$$

q $\frac{7x^2}{xy} \times \left(\frac{6y}{9} \div \frac{4y}{14} \right)$

$$\frac{147x}{4y^3}$$

$$\frac{7}{2y}$$

$$\frac{1}{y}$$

$$\frac{49x}{3y}$$

5 The width of a rectangle is $\frac{3x}{5}$ cm. Its length is four times its width.
Write an expression for the area of the rectangle.

6 Simplify these expressions.

a	$x \times \frac{1}{x}$	b	$x \div \frac{1}{x}$	c	$x \div 3$
1		x^2		$\frac{x}{3}$	
d	$\frac{a}{b} \div c$	e	$a \div \frac{b}{c}$	f	$x \div \frac{x}{y}$
$\frac{a}{bc}$		$\frac{ac}{b}$		y	

7 HSC Advanced Sample Question Band 3

Find the reciprocal of $\frac{1}{a} + \frac{1}{b} - \frac{c}{ab}$

$$\frac{ab}{a + b - c}$$

8 HSC Advanced Sample Question Band 4

Worker A picks a bucket of blueberries in a hours.
Worker B picks a bucket of blueberries in b hours.

Write an algebraic expression for the fraction of a bucket of blueberries that could be picked in one hour if A and B worked together.

$$\frac{a + b}{ab}$$

What does the reciprocal of this fraction represent?

$\frac{a+b}{ab}$ represents blueberry buckets per hour

So, the reciprocal represents hours per bucket of blueberries

ALGEBRAIC FRACTIONS WITH INDICES

- When working with algebraic fractions with indices, it is helpful to write out every line of working out. Messy work leads to more mistakes.

Example Multiply and divide algebraic fractions involving indices.

$\frac{a^2b^4}{6} \times \frac{9}{a^2b^2}$ $= \frac{9a^2b^4}{6a^2b^2}$ $= \frac{9b^2}{6}$ $= \frac{3b^2}{2}$	$\frac{3x^2}{8y^5} \div \frac{15x^3}{4y}$ $= \frac{3x^2}{8y^5} \times \frac{4y}{15x^3}$ $= \frac{12x^2y}{120x^3y^5}$ $= \frac{12}{120xy^4}$ $= \frac{1}{10xy^4}$
--	--

Simplify these expressions.

a $\frac{x^4}{n^2} \times \frac{m}{n^3}$

b $\frac{x}{y} \times \frac{y^2}{x}$

c $\frac{xz}{5} \div \frac{x}{10z}$

$$\frac{mx^4}{n^5}$$

$$y$$

$$2z^2$$

d $\frac{2x}{5y} \times \frac{2y}{5x^2}$

e $\frac{3}{4y^3x} \times \frac{3x^2}{y^2}$

f $\frac{3x^2}{5y^2} \div \frac{2x}{3y}$

$$\frac{4}{25x}$$

$$\frac{9x}{4y^5}$$

$$\frac{9x}{10y}$$

1 Simplify.

a $\frac{5a^2}{3} \times \frac{6}{2a}$

b $\frac{2x^5}{2z^3} \times \frac{7z}{6x^9}$

c $\frac{a^2b^4}{8} \times \frac{12}{a^2b^2}$

$5a$

$\frac{7}{6x^4z^2}$

$\frac{3b^2}{2}$

d $\frac{4m^3}{3n^7} \div \frac{5m^8}{6n^2}$

e $\frac{3x^2}{8y^5} \div \frac{15x^3}{4y}$

f $\frac{p^5q^4}{6} \div \frac{p^2q^2}{9}$

$\frac{8}{5m^5n^5}$

$\frac{1}{10xy^4}$

$\frac{3p^3q^2}{2}$

2 Simplify.

a $\frac{12a}{3c^3} \times \frac{6a^4}{4c^4}$

b $\frac{24m^7n^5}{5m^3n} \times \frac{5m^2n^4}{8mn^2}$

c $\frac{p^4q^3}{p^2q} \div \frac{p^3q^2}{p^6q^4}$

$\frac{6a^5}{c^7}$

$3m^5n^6$

p^5q^4

d $\frac{8k^4m^5}{5km^3} \times \frac{15km}{4k}$

e $\frac{12x^7y^3}{5x^4y} \div \frac{8xy^4}{25x^2y^3}$

f $\frac{9m^5n^2}{12mn} \times \frac{4mn^3}{m^4n^2} \div \frac{2m^2n}{m^3n^2}$

$6k^3m^3$

$\frac{15x^4y}{2}$

$\frac{3m^2n^3}{2}$

CHECK YOUR UNDERSTANDING

Adding subtracting algebraic fractions

1	$\frac{3}{x} + \frac{4}{x}$				
	a $\frac{12}{x^2}$	b $\frac{7x}{x^2}$	c $\frac{7}{x}$	d $\frac{7}{2x}$	
2	$\frac{3}{2x} + \frac{4}{x}$				
	a $\frac{11}{2x}$	b $\frac{7}{3x}$	c $\frac{11}{x}$	d $\frac{7}{2x}$	
3	$\frac{2}{3x} + \frac{3}{x}$				
	a $\frac{11}{3x}$	b $\frac{6}{3x^2}$	c $\frac{5}{4x}$	d $\frac{5}{3x}$	
4	$\frac{1}{s} - \frac{t}{2}$				
	a $\frac{2-st}{2s}$	b $\frac{1-t}{s-2}$	c $\frac{1-t}{2s}$	d $\frac{s-2t}{2s}$	
5	$\frac{3y}{2x} - \frac{5y}{6x}$				
	a $\frac{7y}{3x}$	b $\frac{8y}{8x}$	c $\frac{y}{x}$	d $\frac{14y}{6x}$	
6	$\frac{1}{2x} + \frac{1}{3x}$				
	a $\frac{2}{5x}$	b $\frac{1}{6x^2}$	c $\frac{5x}{6}$	d $\frac{5}{6x}$	