N5 Algebraic Fractions

Expressions & Formulae

SPTA Mathematics – Topic Questions with Notes

Simplifying Algebraic Fractions

You can simplify a fraction when there is a common factor (number *or* letter) on the top *and* on the bottom.

e.g. $\frac{9xy^2}{18x^2y} = \frac{\cancel{9}^{1}\,\cancel{x}\,y^{\cancel{2}}}{\cancel{18}_{2}\,x^{\cancel{2}}\,\cancel{y}} = \frac{y}{2x}$

Exercise 1

1. Express these fractions in their simplest form:

a) $\frac{3}{6}$	**(b)** $\frac{8}{12}$	**(c)** $\frac{30}{16}$	**(d)** $\frac{54}{72}$
e) $\frac{10a}{5}$	**(f)** $\frac{9b}{6}$	**(g)** $\frac{18}{12x}$	**(h)** $\frac{25}{15y}$
i) $\frac{4c}{16c^2}$	**(j)** $\frac{32a}{8a^3}$	**(k)** $\frac{13p^2}{52p^3}$	**(l)** $\frac{36ab}{6bc}$
m) $\frac{4a}{2a^2}$	**(n)** $\frac{10x^2}{12xy}$	**(o)** $\frac{3v^2t}{9vt^2}$	**(p)** $\frac{10ab^3}{2a^2b}$
q) $\frac{30p^2q}{25pq^2}$	**(r)** $\frac{81x^2y^2}{6y^2}$	**(s)** $\frac{42mn^2}{56mn}$	**(t)** $\frac{8def^2}{10e^2f}$
u) $\frac{3ab^2c}{4a^2c}$	**(v)** $\frac{4k^2m}{28km^2}$	**(w)** $\frac{5efg^2}{10e^2fg^3}$	**(x)** $\frac{21xy^2}{36x^3}$

A factor may also be an entire bracket. In this case you can cancel the entire bracket if the entire bracket is identical on the top and the bottom. In National 5 assessments, questions will be of this form.

Example 1

Simplify the fractions **(a)** $\frac{(a+5)(a-1)}{(a-1)(a+2)}$ **(b)** $\frac{(x+3)(x-2)}{(x-2)^2}$

Solution

(a)

$$\frac{(a+5)(a-1)}{(a-1)(a+2)}$$

$$=\frac{(a+5)\cancel{(a-1)}}{\cancel{(a-1)}(a+2)}$$

$$=\frac{(a+5)}{(a+2)}$$

(b)

$$\frac{(x+3)(x-2)}{(x-2)^2}$$

$$=\frac{(x+3)\cancel{(x-2)}}{(x-2)\cancel{(x-2)}}$$

$$=\frac{(x+3)}{(x-2)}$$

Important: neither of these answers can be cancelled any further as the remaining brackets are different. You cannot cancel the *a* or the *x*, as they are not common factors.

In exam questions, if you are asked to simplify, you will need to factorise first and then cancel brackets.

Example 2

Simplify $\frac{v^2-1}{v-1}$

Solution

v^2-1 is a difference of two squares (see page 16), which factorises to be $(v+1)(v-1)$:

$$\frac{v^2-1}{v-1}=\frac{(v+1)\cancel{(v-1)}}{\cancel{(v-1)}}$$

$$=\frac{v+1}{1}$$

$$=v+1$$

Example 3

Write $\dfrac{2a^2+a-1}{2a^2+5a-3}$ **in its simplest form**

Solution

Factorising both lines gives:

$$\frac{2a^2+a-1}{2a^2+5a-3}=\frac{(2a-1)(a+1)}{(2a-1)(a+3)}$$

$$=\frac{\cancel{(2a-1)}(a+1)}{\cancel{(2a-1)}(a+3)}=\frac{a+1}{a+3}$$

Exercise 2

1. Simplify by first finding the common factor:

a) $\dfrac{3a+6b}{6}$ **(b)** $\dfrac{4x+12y}{2}$ **(c)** $\dfrac{3a+a^2}{ab}$ **(d)** $\dfrac{xy+y^2}{2y}$

e) $\dfrac{xy+x^2}{6x+xy}$ **(f)** $\dfrac{3ab+6b^2}{9b^2}$ **(g)** $\dfrac{25b^2+15b^3}{10b}$ **(h)** $\dfrac{14p+10q}{2s}$

i) $\dfrac{3a}{2ab-ac}$ **(j)** $\dfrac{6x}{9x+9y}$ **(k)** $\dfrac{2st}{6rs-2st}$ **(l)** $\dfrac{5c}{10ac+15bc}$

m) $\dfrac{14p+28p^2}{8+16p}$ **(n)** $\dfrac{8c+4d}{6ac+3ad}$ **(o)** $\dfrac{8n^2-2n}{12n-3}$ **(p)** $\dfrac{15x^2+6xy}{10x+4y}$

2. Simplify the following by first factorising the numerator and/or denominator:

(a) $\dfrac{b^2-4}{b+2}$ **(b)** $\dfrac{x^2-81}{x-9}$ **(c)** $\dfrac{a^2-25}{a+5}$ **(d)** $\dfrac{y^2-36}{y+6}$

(e) $\dfrac{c^2-49}{2c-14}$ **(f)** $\dfrac{a^2-64}{2a+16}$ **(g)** $\dfrac{p^2-1}{5p-5}$ **(h)** $\dfrac{q^2-9}{3q+9}$

(i) $\dfrac{a^2-b^2}{3a+3b}$ **(j)** $\dfrac{x^2-y^2}{5x-5y}$ **(k)** $\dfrac{2m^2-18}{2m+6}$ **(l)** $\dfrac{3d^2-48}{12d-48}$

(m) $\dfrac{x^2+3x+2}{x+1}$ **(n)** $\dfrac{p-1}{p^2-2p+1}$ **(o)** $\dfrac{ax-5a}{x^2-25}$ **(p)** $\dfrac{a^2-1}{a^2+2a+1}$

(q) $\dfrac{b^2+6p-9}{b^2-9}$ **(r)** $\dfrac{c^2+2c-15}{c^2-25}$ **(s)** $\dfrac{3x^2+5x-2}{x^2-4}$

(t) $\dfrac{y^2+6y+8}{y^2+y-12}$ **(u)** $\dfrac{p^2-4p-5}{p^2+2p+1}$ **(v)** $\dfrac{c^2+4c-32}{c^2+c-56}$

(w) $\dfrac{2x^2+13x+6}{x^2+9x+18}$ **(x)** $\dfrac{6a^2-13a-5}{3a^2-11a-4}$ **(y)** $\dfrac{10b^2-33b-7}{10b^2-37b+7}$

Multiplying and Dividing Algebraic Fractions

We multiply and divide fractions in the same way as we do for numerical fractions (shown on page 81). Multiplying fractions is a straightforward procedure – you **multiply the tops and multiply the bottoms**.

e.g. $\dfrac{3}{5}\times\dfrac{2}{7}=\dfrac{3\times 2}{5\times 7}=\dfrac{6}{35}$ $\dfrac{a}{c}\times\dfrac{b}{c}=\dfrac{ab}{c^2}$

It is easiest to cancel <u>before</u> you multiply. You are allowed to cancel *anything* from the top row with *anything* from the bottom row.

<u>Example 1</u>

Write a single fraction in its simplest form: $\dfrac{a^2}{15b}\times\dfrac{10}{a}$ $a,b\neq 0$

Solution

Cancelling gives: $\dfrac{a^{\cancel{2}}}{\cancel{15}_3 b}\times\dfrac{\cancel{10}^2}{\cancel{a}}=\dfrac{a}{3b}\times\dfrac{2}{1}=\dfrac{2a}{3b}$. **Answer:** $\dfrac{2a}{3b}$

To divide two fractions, you:

1. flip the second fraction upside down
2. and change the sum to be a multiply sum:

e.g. $\frac{3}{5} \div \frac{2}{7} = \frac{3}{5} \times \frac{7}{2} = \frac{21}{10}$ $\frac{x}{y} \div \frac{a}{x} = \frac{x}{y} \times \frac{x}{a} = \frac{x^2}{ay}$

<u>Example 2</u>

Write as a single fraction in its simplest form: $\frac{6b}{ay} \div \frac{3ab}{x}$, $a, x, y \neq 0$

Solution

Flip the second fraction upside down and multiply: the 'new' sum becomes $\frac{6b}{ay} \times \frac{x}{3ab}$

$$\frac{\overset{2}{\cancel{6}}\,\cancel{b}}{ay} \times \frac{x}{\underset{1}{\cancel{3}}\,a\,\cancel{b}}$$ (cancelling common factors)

$$= \frac{2}{ay} \times \frac{x}{a}$$

$$= \underline{\underline{\frac{2x}{a^2 y}}}$$ (multiplying the tops, and multiplying the bottoms)

Exercise 3

1. Express each product as a fraction in its simplest form

(a) $\frac{x}{3}\times\frac{x}{6}$ **(b)** $\frac{y}{2}\times\frac{y}{4}$ **(c)** $\frac{a}{2}\times\frac{b}{7}$ **(d)** $\frac{p}{3}\times\frac{q}{8}$

e) $\frac{c^2}{5}\times\frac{c}{6}$ **(f)** $\frac{6}{a}\times\frac{2}{a}$ **(g)** $\frac{3}{x}\times\frac{10}{y}$ **(h)** $\frac{3}{p}\times\frac{4}{p}$

i) $\frac{2}{3m}\times\frac{4}{5m}$ **(j)** $\frac{1}{b}\times\frac{11}{3c}$ **(k)** $\frac{5m}{6}\times\frac{3}{2m}$ **(l)** $\frac{5}{7x}\times\frac{4x}{3}$

m) $\frac{2y}{9}\times\frac{12}{5y^2}$ **(n)** $\frac{2}{3a}\times\frac{3}{7a^2}$ **(o)** $\frac{5}{3p}\times\frac{2}{p^3}$ **(p)** $\frac{3t^2}{5s}\times\frac{2s^2}{6t^3}$

q) $\frac{5pq}{2}\times\frac{3}{4pq^2}$ **(r)** $\frac{7ab^2}{6c}\times\frac{2c^3}{3a^2}$ **(s)** $\frac{4}{5mn}\times\frac{2m^4}{n^2}$

t) $\frac{4yz}{9x}\times\frac{3xz}{2y^3}$ **(u)** $\frac{5ab^3}{3c}\times\frac{3a}{2bc^2}$ **(v)** $\frac{2cd}{7a}\times\frac{3a^2}{4cd^2}$

w) $\frac{10xy^2}{3}\times\frac{12xy}{5y^2}$ **(x)** $\frac{3}{8s^3}\times\frac{4st}{t^3}$ **(y)** $\frac{4pq^2}{3a}\times\frac{6a^2}{5p^3}$

2. Express as a single fraction:

a) $\frac{a}{4}\div\frac{a}{2}$ **(b)** $\frac{x}{2}\div\frac{y}{2}$ **(c)** $\frac{ab}{5}\div\frac{a}{2}$

d) $\frac{p^2}{10}\div\frac{p}{5}$ **(e)** $\frac{2c}{3}\div\frac{c^2}{6}$ **(f)** $\frac{3}{t}\div\frac{6}{t}$

g) $\frac{2}{k}\div\frac{4}{m}$ **(h)** $\frac{3}{y}\div\frac{9}{y^2}$ **(i)** $\frac{4}{bc}\div\frac{2}{c}$

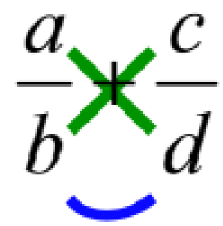
j) $\frac{3}{2x}\div\frac{12}{x^2}$ **(k)** $\frac{24xy}{35z}\div\frac{20xy}{21z}$ **(l)** $\frac{6q^2}{25p}\div\frac{9q}{20p^2}$

m) $\frac{8ab}{21c}\div\frac{9b}{14ac}$ **(n)** $\frac{10m}{21n^2}\div\frac{8mn}{9}$ **(o)** $\frac{20ax}{33y}\div\frac{15x}{44ay^2}$

Adding and Subtracting Algebraic Fractions

You can only add and subtract fractions when the denominators are the same. When they are not the same, we have to change the fractions into another fraction that *is* the same.

A quick method for doing this, and the one used in these notes, is known as the **'kiss and smile'** method because of the shape formed when you draw lines between the terms you are combining:



$$\frac{a}{b}+\frac{c}{d}=\frac{\quad}{bd}$$

<u>Step One</u> (the "smile") – Multiply the two bottom numbers together to get the "new" denominator, which will be the same for each fraction.

$$\frac{a}{b}+\frac{c}{d}=\frac{ad}{\quad}$$

<u>Step 2a</u> (the first part of the "kiss")

Multiply diagonally the top left and bottom right terms

$$\frac{a}{b}+\frac{c}{d}=\frac{\quad bc}{\quad}$$

<u>Step 2b</u> (the final part of the "kiss")

Multiply diagonally the top right and bottom left terms

$$\frac{a}{b}+\frac{c}{d}=\frac{ad+bc}{bd}$$

<u>Step 3</u> –

Insert the add (or take away) sign between the two terms on the top row to get the final answer

Example 1

Add, giving your answer as a single fraction in its simplest form:

$$\frac{m}{5}+\frac{3}{m}, \qquad m \neq 0$$

Solution

Step one (smile)

$$\frac{m}{5}+\frac{3}{m}$$

Step two (kiss)

$$\frac{m}{5}+\frac{3}{m}$$

$$\frac{m}{5}+\frac{3}{m}=\frac{\quad}{5m}$$

$$=\frac{m^2+15}{5m}$$

Final answer: $\frac{m^2+15}{5m}$

Taking away works in exactly the same way as adding. The only difference is that the final answer has a take away sign in place of the add sign.

Example 2

Take away, giving your answer as a single fraction in its simplest form:

$$\frac{4a}{5}-\frac{3b}{x}, \qquad x \neq 0$$

Solution

$$\frac{4a}{5}-\frac{3b}{x}=\frac{\quad}{5x} \qquad \text{(smile)}$$

$$=\frac{4ax-15b}{5x} \qquad \text{(kiss)}$$

$$\frac{4a}{5}\quad\frac{3b}{x}$$

Exercise 4

1. Express each sum as a fraction in its simplest form:

a) $\frac{a}{5}+\frac{a}{5}$ **(b)** $\frac{2b}{5}+\frac{b}{10}$ **(c)** $\frac{3x}{4}+\frac{x}{8}$ **(d)** $\frac{p}{6}+\frac{2p}{3}$

e) $\frac{y}{9}+\frac{2y}{3}$ **(f)** $\frac{3}{m}+\frac{2}{m}$ **(g)** $\frac{5}{x}+\frac{1}{x}$ **(h)** $\frac{2}{a}+\frac{5}{2a}$

i) $\frac{4}{3y}+\frac{3}{y}$ **(j)** $\frac{8}{p}+\frac{3}{5p}$ **(k)** $\frac{3}{a}+\frac{2}{b}$ **(l)** $\frac{5}{x}+\frac{3}{y}$

m) $\frac{2}{m}+\frac{7}{n}$ **(n)** $\frac{4}{p}+\frac{3}{q}$ **(o)** $\frac{9}{c}+\frac{7}{d}$ **(p)** $\frac{3}{2x}+\frac{2}{3y}$

q) $\frac{4}{3a}+\frac{5}{2b}$ **(r)** $\frac{2}{3a}+\frac{9}{3b}$ **(s)** $\frac{5}{4m}+\frac{3}{2n}$ **(t)** $\frac{7}{3p}+\frac{2}{6q}$

u) $\frac{1}{a}+\frac{2}{a^2}$ **(v)** $\frac{5}{x^2}+\frac{3}{x}$ **(w)** $\frac{3}{3b}+\frac{4}{b^2}$ **(x)** $\frac{8}{2m}+\frac{5}{3m^2}$

2. Express each difference as a fraction in its simplest form:

a) $\frac{3a}{5}-\frac{a}{5}$ **(b)** $\frac{2b}{5}-\frac{b}{10}$ **(c)** $\frac{3x}{4}-\frac{x}{8}$ **(d)** $\frac{5p}{6}-\frac{2p}{3}$

e) $\frac{8y}{9}+\frac{2y}{3}$ **(f)** $\frac{5}{m}-\frac{2}{m}$ **(g)** $\frac{7}{x}-\frac{3}{x}$ **(h)** $\frac{5}{a}-\frac{1}{2a}$

i) $\frac{8}{3y}-\frac{2}{y}$ **(j)** $\frac{8}{p}-\frac{3}{5p}$ **(k)** $\frac{3}{a}-\frac{2}{b}$ **(l)** $\frac{5}{x}-\frac{3}{y}$

m) $\frac{7}{m}-\frac{2}{n}$ **(n)** $\frac{4}{p}-\frac{3}{q}$ **(o)** $\frac{9}{c}-\frac{7}{d}$ **(p)** $\frac{3}{2x}-\frac{2}{3y}$

q) $\frac{5}{3a}-\frac{3}{2b}$ **(r)** $\frac{5}{3a}-\frac{2}{3b}$ **(s)** $\frac{5}{4m}-\frac{3}{2n}$ **(t)** $\frac{7}{3p}-\frac{2}{6q}$

u) $\frac{1}{a}-\frac{2}{a^2}$ **(v)** $\frac{7}{x^2}-\frac{3}{x}$ **(w)** $\frac{4}{3b}-\frac{3}{b^2}$ **(x)** $\frac{7}{2p^2}-\frac{4}{3p}$

When a fraction has more than one term on the top or bottom (e.g. $x+2$ rather than just x or 2), you need to introduce **brackets** (i.e. $x+2$ becomes $(x+2)$). You then perform kiss and smile, thinking of the bracket as a single object.

<u>Example 3 – brackets</u>

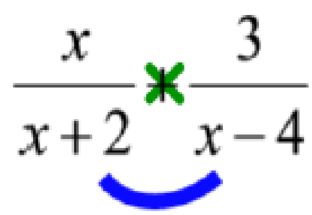
Add, giving your answer as a single fraction in its simplest form:

$$\frac{x}{x+2}+\frac{3}{x-4}, \qquad x\neq -2, x\neq 4$$

Solution

$$\frac{x}{x+2}+\frac{3}{x-4}=\frac{x}{(x+2)}+\frac{3}{(x-4)}$$

$$=\frac{\qquad}{(x+2)(x-4)} \qquad \text{(smile)}$$



$$=\frac{x(x-4)+3(x+2)}{(x+2)(x-4)} \qquad \text{(kiss)}$$

$$=\frac{x^2-4x+3x+6}{(x+2)(x-4)} \qquad \text{(multiplying out brackets on top line)}$$

$$=\frac{x^2-x+6}{(x+2)(x-4)} \qquad \text{(simplifying top line)}$$

We didn't multiply out the bottom line because the bottom line was already in its simplest possible form. However we could have multiplied it out if we chose to.

Exercise 5

1. Simplify the following:

a)	$\frac{x+2}{3}+\frac{x+3}{6}$	**(b)**	$\frac{a+6}{4}+\frac{a-2}{3}$	**(c)**	$\frac{d-3}{2}-\frac{d+2}{6}$
d)	$\frac{2a-1}{4}-\frac{a+2}{5}$	**(e)**	$\frac{a+3b}{2}+\frac{a-2b}{4}$	**(f)**	$\frac{2u+v}{3}-\frac{u-v}{4}$
g)	$\frac{2}{x+3}+\frac{3}{x+2}$	**(h)**	$\frac{4}{x+5}+\frac{5}{x+1}$	**(i)**	$\frac{7}{x-3}+\frac{4}{x+2}$
j)	$\frac{2}{x+4}-\frac{3}{x-3}$	**(k)**	$\frac{1}{x-3}-\frac{5}{x-2}$	**(l)**	$\frac{2}{x-5}-\frac{3}{x-4}$

Mixed Exercise

1. Write as a single fraction in its simplest form $\frac{5}{x+2}+\frac{4}{x}$: $x \neq -2,\ x \neq 0$.

2. Simplify this fraction $\frac{2x^2-5x+3}{4x^2-9}$

3. Simplify fully the fraction $\frac{6e^2-3e}{4e^2-1}$

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

5. Write as a single fraction in its simplest form: $\frac{3a}{5x}\div\frac{a}{x^2}$

6. Express as a single fraction in its simplest form: $\frac{3}{x}-\frac{2}{x-5}$.

Answers

Exercise 1

1. **a)** $\frac{1}{2}$ **(b)** $\frac{2}{3}$ **(c)** $\frac{15}{8}$ **(d)** $\frac{3}{4}$ **(e)** $2a$ **(f)** $\frac{3b}{2}$

g) $\frac{3}{2x}$ **(h)** $\frac{5}{3y}$ **(i)** $\frac{1}{4c}$ **(j)** $\frac{4}{a^2}$ **(k)** $\frac{1}{4p}$ **(l)** $\frac{6a}{c}$

m) $\frac{2}{a}$ **(n)** $\frac{5x}{6y}$ **(o)** $\frac{v}{3t}$ **(p)** $\frac{5b^2}{a}$ **(q)** $\frac{6p}{5q}$ **(r)** $\frac{27x^2}{2}$

s) $\frac{3n}{4}$ **(t)** $\frac{4df}{5e}$ **(u)** $\frac{3b^2}{4a}$ **(v)** $\frac{k}{7m}$ **(w)** $\frac{1}{2eg}$ **(x)** $\frac{7y^2}{12x^2}$

Exercise 2

1. a) $\frac{a+2b}{2}$ (b) $2(2x+3y)$ (c) $\frac{3+a}{b}$ (d) $\frac{x+y}{2}$

e) $\frac{y+x}{6+y}$ (f) $\frac{a+2b}{3b}$ (g) $\frac{5b+3b^2}{2}$ (h) $\frac{7p+5q}{s}$

i) $\frac{3}{2b-c}$ (j) $\frac{2x}{3(x+y)}$ (k) $\frac{t}{3r-t}$ (l) $\frac{1}{2a+3b}$

m) $\frac{7p}{4}$ (n) $\frac{4}{3a}$ (o) $\frac{2n}{3}$ (p) $\frac{3x}{2}$

2. a) $b-2$ (b) $x+9$ (c) $a-5$ (d) $y-6$ (e) $\frac{c+7}{2}$ (f) $\frac{a-8}{2}$

g) $\frac{p+1}{5}$ (h) $\frac{q-3}{3}$ (i) $\frac{a-b}{3}$ (j) $\frac{x+y}{5}$ (k) $m-3$ (l) $\frac{d+4}{4}$

m) $x+2$ (n) $\frac{1}{p-1}$ (o) $\frac{a}{x+5}$ (p) $\frac{a-1}{a+1}$ (q) $\frac{b-3}{b+3}$ (r) $\frac{c-3}{c-5}$

s) $\frac{3x-1}{x-2}$ (t) $\frac{y+2}{y-3}$ (u) $\frac{p-5}{p+1}$ (v) $\frac{c-4}{c-7}$ (w) $\frac{2x+1}{x+3}$ (x) $\frac{2a-5}{a-4}$

y) $\frac{5b+1}{5b-1}$

Exercise 3

1. a) $\frac{x^2}{18}$ (b) $\frac{y^2}{8}$ (c) $\frac{ab}{14}$ (d) $\frac{pq}{24}$ (e) $\frac{c^3}{30}$ (f) $\frac{12}{a^2}$

g) $\frac{30}{xy}$ (h) $\frac{12}{p^2}$ (i) $\frac{8}{15m^2}$ (j) $\frac{11}{3bc}$ (k) $\frac{5}{4}$ (l) $\frac{20}{21}$

m) $\frac{8}{15y}$ (n) $\frac{2}{7a^3}$ (o) $\frac{10}{3p^4}$ (p) $\frac{s}{5t}$ (q) $\frac{15}{8q}$ (r) $\frac{7b^2c^2}{9a}$

s) $\frac{8m^3}{5n^3}$ (t) $\frac{2z^2}{3y^2}$ (u) $\frac{5a^2b^2}{2p^3}$ (v) $\frac{3a}{14d}$ (w) $8x^2y$ (x) $\frac{3}{2s^2t^2}$

y) $\frac{8q^2a}{5p^2}$

2. a) $\frac{1}{2}$ (b) $\frac{x}{y}$ (c) $\frac{2b}{5}$ (d) $\frac{p}{2}$ (e) $\frac{4}{c}$ (f) $\frac{1}{2}$

g) $\frac{m}{2k}$ (h) $\frac{y}{3}$ (i) $\frac{2}{b}$ (j) $\frac{x}{8}$ (k) $\frac{18}{25}$ (l) $\frac{8pq}{15}$

m) $\frac{16a^2}{27}$ (n) $\frac{15}{28n^3}$ (o) $\frac{16a^2y}{9}$

Exercise 4

1. a) $\frac{2a}{5}$ (b) $\frac{b}{2}$ (c) $\frac{7x}{8}$ (d) $\frac{5p}{6}$ (e) $\frac{7y}{9}$ (f) $\frac{5}{m}$

g) $\frac{6}{x}$ (h) $\frac{9}{2a}$ (i) $\frac{13}{3y}$ (j) $\frac{43}{5p}$ (k) $\frac{3b+2a}{ab}$ (l) $\frac{5y+3x}{xy}$

m) $\frac{2n+7m}{mn}$ (n) $\frac{4q+3p}{pq}$ (o) $\frac{9d+7c}{cd}$ (p) $\frac{9y+4x}{6xy}$

q) $\frac{8b+15a}{6ab}$ (r) $\frac{2b+9a}{3ab}$ (s) $\frac{5n+6m}{4mn}$ (t) $\frac{7q+p}{3pq}$

u) $\frac{2+a}{a^2}$ (v) $\frac{5+3x}{x^2}$ (w) $\frac{b+4}{b^2}$ (x) $\frac{12m+5}{3m^2}$

2. a) $\frac{2a}{5}$ (b) $\frac{3b}{10}$ (c) $\frac{5x}{8}$ (d) $\frac{p}{6}$ (e) $\frac{2y}{9}$ (f) $\frac{3}{m}$

g) $\frac{4}{x}$ (h) $\frac{9}{2a}$ (i) $\frac{2}{3y}$ (j) $\frac{37}{5p}$ (k) $\frac{3b-2a}{ab}$ (l) $\frac{5y-3x}{xy}$

m) $\frac{7n-2m}{mn}$ (n) $\frac{4q-3p}{pq}$ (o) $\frac{9d-7c}{cd}$ (p) $\frac{9y-4x}{6xy}$

q) $\frac{10b-9a}{6ab}$ (r) $\frac{5b-2a}{3ab}$ (s) $\frac{5n-6m}{4mn}$ (t) $\frac{7q-p}{3pq}$

u) $\frac{a-2}{a^2}$ (v) $\frac{7-3x}{x^2}$ (w) $\frac{4b-9}{3b^2}$ (x) $\frac{21-8p}{6p^2}$

Exercise 5

1. **a)** $\frac{3x+7}{6}$ **(b)** $\frac{7a+10}{12}$ **(c)** $\frac{2d-11}{6}$ **(d)** $\frac{6a-13}{20}$

e) $\frac{3a+4b}{4}$ **(f)** $\frac{5u+7v}{12}$ **(g)** $\frac{5x+13}{(x+3)(x+2)}$ **(h)** $\frac{9x+29}{(x+5)(x+1)}$

i) $\frac{11x+2}{(x-3)(x+2)}$ **(j)** $\frac{-x-18}{(x+4)(x-3)}$ **(k)** $\frac{13-4x}{(x-3)(x-2)}$ **(l)** $\frac{7-x}{(x-5)(x-4)}$

Mixed Exercise

1. $\frac{9x+8}{x(x+2)}$

2. $\frac{x-1}{(2x+3)}$

3. $\frac{3e}{e+1}$

4. $\frac{-2x-13}{(x-1)(x+2)}$

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

6. $\frac{x-15}{x(x-5)}$