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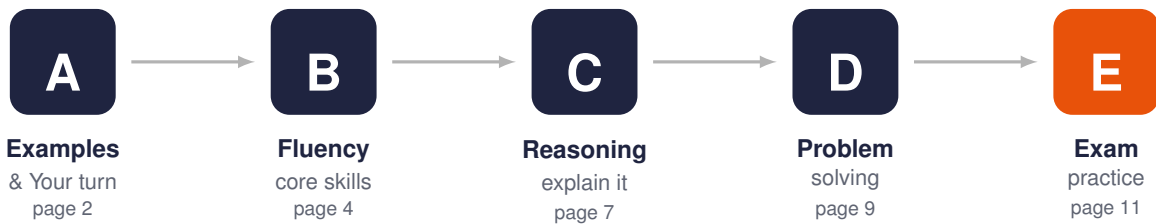
GCSE MATHEMATICS • ALGEBRA

Algebraic Fractions

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Free Algebraic Fractions worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: cancel common factors in algebraic fractions • add and subtract fractions with number denominators • multiply and divide simple algebraic fractions • *Higher:* simplify by factorising, add fractions with algebraic denominators, and solve equations with algebraic fractions.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: simplifying by factorising, algebraic denominators, and equations with algebraic fractions. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	15
Higher marks	16	14	17	15
My score				

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A

Worked examples & Your turn

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1

Simplify $\frac{15a^2b}{5ab}$

Cancel the numbers, then each letter: $15 \div 5 = 3$, $a^2 \div a = a$, $b \div b = 1$

$$3a$$

Your turn A1

Simplify $\frac{18x^3}{6x}$

Worked example A2

Write $\frac{x}{4} + \frac{x}{6}$ as a single fraction.

Common denominator 12: $\frac{3x}{12} + \frac{2x}{12}$

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

Your turn A2

Write $\frac{3x}{5} - \frac{x}{2}$ as a single fraction.

Worked example A3

Write $\frac{x+2}{3} + \frac{x-1}{2}$ as a single fraction.

Common denominator 6: multiply each whole numerator.

$$\frac{2(x+2) + 3(x-1)}{6} = \frac{2x+4+3x-3}{6}$$

$$\frac{5x+1}{6}$$

Your turn A3

Write $\frac{2x-1}{4} - \frac{x+3}{3}$ as a single fraction.



HIGHER*Higher only: factorising, algebraic denominators and equations***Worked example A4: simplify by factorising**Simplify fully $\frac{x^2 + 5x + 6}{x^2 - 4}$ *Factorise the top and the bottom, then cancel the common bracket.*

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

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

Your turn A4Simplify fully $\frac{2x^2 - 8}{x^2 + x - 6}$ **Worked example A5: algebraic denominators**Write $\frac{2}{x+1} + \frac{3}{x-2}$ as a single fraction.*Common denominator $(x+1)(x-2)$*

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

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

Your turn A5Write $\frac{4}{x-3} - \frac{1}{x+2}$ as a single fraction.**Worked example A6: multiplying and dividing**Simplify $\frac{x^2 - 1}{x+2} \times \frac{3x+6}{x-1}$ *Factorise: $\frac{(x+1)(x-1)}{x+2} \times \frac{3(x+2)}{x-1}$, then cancel.*

$$3(x+1)$$

Your turn A6Simplify $\frac{x^2 + 3x}{x-2} \div \frac{x^2 - 9}{x-2}$ **Worked example A7: solving an equation**Solve $\frac{2}{x} + \frac{3}{x+2} = 1$ *Multiply every term by $x(x+2)$*

$$2(x+2) + 3x = x(x+2) \quad x^2 - 3x - 4 = 0$$

$$x = 4 \text{ or } x = -1$$

Your turn A7Solve $\frac{4}{x-1} - \frac{3}{x} = 1$ 

B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION*Everyone starts here***B1** Simplify

(a) $\frac{8x}{4}$

(b) $\frac{8x}{4x}$

(c) $\frac{8x^2}{4x}$

(d) $\frac{8x}{4x^2}$

[4 marks]

B2 Simplify

(a) $\frac{4x+8}{4}$

(b) $\frac{6x-9}{3}$

(c) $\frac{5x+10}{x+2}$

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

[4 marks]

B3 Write as a single fraction.

(a) $\frac{x}{2} + \frac{x}{3}$

(b) $\frac{x}{2} - \frac{x}{3}$

(c) $\frac{3x}{4} + \frac{x}{6}$

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

[4 marks]

B4 Write as a single fraction in its simplest form.

(a) $\frac{x+1}{2} + \frac{x+3}{4}$

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

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

(d) $\frac{x+4}{6} - \frac{x-2}{3}$

[4 marks]



FOUNDATION*continued: multiplying, dividing and equivalent forms***B5** Simplify

(a) $\frac{x}{3} \times \frac{6}{x}$

(b) $\frac{2x}{5} \times \frac{10}{x^2}$

(c) $\frac{x}{4} \div \frac{x}{2}$

[3 marks]**B6** Is each expression equal to $\frac{x}{2} + 1$ for every value of x ? Answer yes or no.

(a) $\frac{x+2}{2}$

(b) $x + \frac{2}{2}$

(c) $\frac{3x+6}{6}$

(d) $\frac{x+1}{2}$

[4 marks]**HIGHER***Higher tier only***B7** Simplify fully

(a) $\frac{x^2 - 9}{x + 3}$

(b) $\frac{x^2 + 2x}{x^2 - 4}$

(c) $\frac{x^2 - x - 6}{x^2 - 9}$

(d) $\frac{2x^2 + 5x - 3}{4x^2 - 1}$

[4 marks]**B8** Write as a single fraction in its simplest form.

(a) $\frac{1}{x} + \frac{1}{x+1}$

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

(c) $\frac{3}{x+2} + \frac{x}{x+2}$

(d) $\frac{x}{x-1} - \frac{1}{x+1}$

[4 marks]

HIGHER*continued: multiplying, dividing and solving***B9** Simplify fully

(a) $\frac{x+2}{x-1} \times \frac{x-1}{3x+6}$

(b) $\frac{x^2-4}{x} \div \frac{x+2}{x^2}$

(c) $\frac{x^2+x}{x^2-1} \times \frac{x-1}{x}$

(d) $\frac{2x+2}{x^2-9} \div \frac{x+1}{x+3}$

[4 marks]**B10** Solve

(a) $\frac{6}{x} = 3$

(b) $\frac{6}{x} = x+1$

(c) $\frac{1}{x} + \frac{1}{x+1} = \frac{7}{12}$

(d) $\frac{x+3}{x-1} = x$

[4 marks]

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C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Kim simplifies $\frac{x+6}{6}$ and writes $x+1$

Explain Kim's mistake, and write the expression in a correct simpler form.

[2 marks]

- C2** Tom writes $\frac{x}{2} + \frac{x}{3} = \frac{2x}{5}$

Explain Tom's mistake, and write the correct single fraction.

[2 marks]

- C3** Show that $\frac{x+1}{2} + \frac{x+5}{6}$ simplifies to $\frac{2x+4}{3}$

[3 marks]

- C4** (a) Work out $\frac{x}{2} + \frac{x}{3}$ when $x = 6$ (b) Work out $\frac{5x}{6}$ when $x = 6$

(c) Explain why the answers are the same.

[3 marks]



HIGHER*Higher tier only*

- C5** Jo simplifies $\frac{x^2+3x}{x^2+9}$ by cancelling the x^2 terms and writes $\frac{3x}{9} = \frac{x}{3}$

Explain Jo's mistake. Can the fraction be simplified?

[3 marks]

- C6** Explain why $\frac{x^2-4}{x-2} = x+2$ for every value of x except $x=2$

[3 marks]

- C7** Show that $\frac{1}{x-1} - \frac{1}{x+1} \equiv \frac{2}{x^2-1}$

[3 marks]

- C8** x is a positive number.

(a) Show that $x + \frac{1}{x} - 2 = \frac{(x-1)^2}{x}$

(b) Hence prove that the sum of a positive number and its reciprocal is always at least 2, and say when it equals 2

[5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** A rectangle has length $\frac{x}{3}$ cm and width $\frac{x}{4}$ cm. Its perimeter is 7 cm.
Find x . [3 marks]
- D2** (a) Show that the mean of $\frac{x}{2}$, $\frac{x}{3}$ and $\frac{x}{6}$ is $\frac{x}{3}$
(b) The mean is 5. Find x . [4 marks]
- D3** x is a positive number. Which is bigger: $\frac{x}{3} + \frac{x}{4}$ or $\frac{x}{2} + \frac{x}{5}$? Show how you decide. [3 marks]
- D4** Simplify $\frac{6x+12}{3x+6}$ and explain why the answer is the same for every value of x except $x = -2$ [3 marks]



HIGHER*Higher tier only*

- D5** Ria cycles 24 km at x km/h, then another 24 km at $(x+4)$ km/h. The whole journey takes 5 hours.
Find her speed on the first part of the journey. [4 marks]
- D6** Pipe A fills a tank in x hours. Pipe B fills it in $(x+3)$ hours. Together they fill it in 2 hours.
Show that $\frac{1}{x} + \frac{1}{x+3} = \frac{1}{2}$, and find x . [4 marks]
- D7** Simplify fully $\frac{x^3 - 4x}{x^2 + 4x + 4}$ [4 marks]
- D8** (a) Show that the equation $\frac{1}{x-2} + \frac{1}{x+2} = \frac{4}{x^2 - 4}$ leads to $x = 2$
(b) Explain why the equation has no solution. [5 marks]



E**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover***E1** Simplify

(a) $\frac{12x^2y}{4xy}$

.....
(1)

(b) $\frac{6x+9}{3}$

.....
(1)

(Total for Question E1 is 2 marks)

E2 Write $\frac{x}{3} + \frac{x}{5}$ as a single fraction.

.....
(Total for Question E2 is 2 marks)

E3 Write $\frac{x+1}{4} + \frac{x-2}{6}$ as a single fraction in its simplest form.

.....
(Total for Question E3 is 3 marks)



E4 (a) Simplify $\frac{2x}{3} \times \frac{9}{4x^2}$

.....
(2)

(b) Simplify $\frac{x}{4} \div \frac{x}{6}$

.....
(1)

(Total for Question E4 is 3 marks)

E5 Ben simplifies $\frac{2x+6}{2}$ and writes $x+6$

Explain Ben's mistake, and give the correct answer.

.....
(Total for Question E5 is 2 marks)

E6 Write $\frac{2x+1}{3} - \frac{x-4}{2}$ as a single fraction in its simplest form.

.....
(Total for Question E6 is 3 marks)

HIGHER

Higher tier only

E7 Simplify fully $\frac{x^2-9}{x^2+x-6}$

.....
(Total for Question E7 is 3 marks)



E8 Write $\frac{3}{x+2} - \frac{2}{x-1}$ as a single fraction in its simplest form.

.....

(Total for Question E8 is 3 marks)

E9 Solve $\frac{3}{x-1} + \frac{2}{x+1} = 2$

.....

(Total for Question E9 is 4 marks)

E10 (a) Show that $\frac{x^2-4}{x^2+5x+6} \div \frac{x-2}{2x+6} = 2$ for all the values of x for which it is defined.

(4)

(b) Write down the values of x for which the expression is not defined.

.....

(1)

(Total for Question E10 is 5 marks)

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