2.2 Algebraic Fractions: Adding, Subtracting and Solving Equations: 2-hour Pack

AQA 8365 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Solve (x + 1)/5 - (x + 5)/3 = -2/3.

(Total for Question 1 is 3 marks)

2 Write (x + 4)/7 - (x - 6)/2 as a single fraction in its simplest form.

(Total for Question 2 is 3 marks)

3 Write 6/(x - 3) + 5/(x - 5) as a single fraction, simplifying the numerator.

(Total for Question 3 is 3 marks)

4 Solve (x - 5)/9 - (x + 5)/5 = -10/9.

(Total for Question 4 is 3 marks)

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5 Solve $1/(x + 8) + 1/(x + 11) = 1/2$.

(Total for Question 5 is 5 marks)

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6 Write $5/(x + 1) - 7/(x - 6)$ as a single fraction, simplifying the numerator.

(Total for Question 6 is 3 marks)

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7 Solve $(x + 6)/(x + 1) = (x + 2)/(x - 2)$.

(Total for Question 7 is 4 marks)

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8 Write $3/(x - 4) - 4/(x - 6)$ as a single fraction, simplifying the numerator.

(Total for Question 8 is 3 marks)

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9 Solve $(x + 2)/9 - (x - 5)/5 = 71/45$.

(Total for Question 9 is 3 marks)

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10 Solve $1/(x + 6) + 1/(x + 12) = 1/4$.

(Total for Question 10 is 5 marks)

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11 Solve $(x - 1)/(x - 2) = (x - 1)/(x + 3)$.

(Total for Question 11 is 4 marks)

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12 A cyclist rides 120 km at x km/h and then 120 km at $(x + 2)$ km/h. The total time for the two stages is 225/14 hours. Form an equation in x and show that it can be written as a quadratic. Hence find the value of x, given that $x > 0$.

(Total for Question 12 is 4 marks)

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13 Solve $(x - 5)/(x + 4) = (x - 1)/(x - 2)$.

(Total for Question 13 is 4 marks)

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14 Solve $1/(x + 8) + 1/(x + 16) = 1/3$.

(Total for Question 14 is 5 marks)

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15 A cyclist rides 120 km at x km/h and then 120 km at (x + 6) km/h. The total time for the two stages is 35/3 hours. Form an equation in x and show that it can be written as a quadratic. Hence find the value of x, given that $x > 0$.

(Total for Question 15 is 4 marks)

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16 Solve $1/(x + 8) + 1/(x + 20) = 1/8$.

(Total for Question 16 is 5 marks)

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17 Solve $3/(x + 1) + 2/(x - 1) = 1$.

(Total for Question 17 is 5 marks)

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18 Write $3/(x^2 - 9) + 2/(x + 3)$ as a single fraction in its simplest form.

(Total for Question 18 is 4 marks)

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19 Write $5/(x + 3) - 2/(x^2 + 3x)$ as a single fraction in its simplest form.

(Total for Question 19 is 2 marks)

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20 Solve $(3x + 1)/(x + 4) = (3x - 2)/(x + 1)$

(Total for Question 20 is 2 marks)

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21 Solve $6/(x - 2) - 4/(x + 2) = 1$

(Total for Question 21 is 3 marks)

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22 Solve $7/(x - 1) = x + 5$, giving all solutions.

(Total for Question 22 is 3 marks)

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23 Write $4/(x^2 - 16) + 3/(x + 4)$ as a single fraction in its simplest form.

(Total for Question 23 is 2 marks)

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24 Solve $5/(x + 2) + 3/(x - 1) = 4$, giving your answers correct to 3 significant figures.

(Total for Question 24 is 5 marks)

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25 Solve $6/(x - 1) - 4/(x + 1) = 2$.

(Total for Question 25 is 5 marks)

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26 Solve $5/(x - 1) - 3/(x + 1) = 1$, giving your answers in exact surd form.

(Total for Question 26 is 3 marks)

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27 Solve $(x + 3)/(x - 2) - (x - 1)/(x + 2) = 3$, giving all solutions as exact fractions.

(Total for Question 27 is 6 marks)

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28 Solve $(x + 4)/(x - 1) - (x - 2)/(x + 1) = 2$, giving all solutions in exact surd form.

(Total for Question 28 is 4 marks)

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Mark scheme · 2.2 Algebraic Fractions: Adding, Subtracting and Solving Equations: 2-hour Pack

Question 1

multiplies through by 15 or combines fractions	**M1**
3(x +1) - 5(x +5) = -10	**M1**
x = -6 cao	**A1**

Answer: x = -6

Question 2

common denominator 14	**M1**
numerators scaled and combined	**M1**
(-5x + 50)/14 oe cao	**A1**

Answer: (-5x + 50)/14

Question 3

common denominator (x + p)(x + q) used	**M1**
numerator expanded with at most one error	**M1**
(11x - 45)/((x - 3)(x - 5)) oe cao	**A1**

Answer: (11x - 45)/((x - 3)(x - 5))

Question 4

multiplies through by 45 or combines fractions	**M1**
5(x -5) - 9(x +5) = -50	**M1**
x = -5 cao	**A1**

Answer: x = -5

Question 5

combines the left-hand side into a single fraction	**M1**
cross-multiplies	**M1**
x^2 + 15x + 50 = 0 oe	**A1**
factorises or uses the formula	**M1**
x = -10 or x = -5 cao	**A1**

Answer: x = -10 or x = -5

Question 6

common denominator (x + p)(x + q) used	**M1**
numerator expanded with at most one error	**M1**
(-2x - 37)/((x + 1)(x - 6)) oe cao	**A1**

Answer: (-2x - 37)/((x + 1)(x - 6))

Question 7

cross-multiplies	**M1**
expands both sides; x^2 terms cancel	**M1**
collects x terms	**M1**
x = 14 cao	**A1**

Answer: x = 14

Question 8

common denominator (x + p)(x + q) used	**M1**
numerator expanded with at most one error	**M1**
(-x - 2)/((x - 4)(x - 6)) oe cao	**A1**

Answer: (-x - 2)/((x - 4)(x - 6))

Question 9

multiplies through by 45 or combines fractions	**M1**
5(x +2) - 9(x -5) = 71	**M1**
x = -4 cao	**A1**

Answer: x = -4

Question 10

combines the left-hand side into a single fraction	**M1**
cross-multiplies	**M1**
x^2 + 10x = 0 oe	**A1**
factorises or uses the formula	**M1**
x = -10 or x = 0 cao	**A1**

Answer: x = -10 or x = 0

Question 11

cross-multiplies	**M1**
expands both sides; x^2 terms cancel	**M1**
collects x terms	**M1**
x = 1 cao	**A1**

Answer: x = 1

Question 12

120/x + 120/(x + 2) = 225/14	**M1**
multiplies through to remove denominators	**M1**
correct quadratic obtained	**A1**
x = 14 cao	**A1**

Answer: x = 14

Question 13

cross-multiplies	**M1**
expands both sides; x^2 terms cancel	**M1**
collects x terms	**M1**
x = 7/5 cao	**A1**

Answer: x = 7/5

Question 14

combines the left-hand side into a single fraction	**M1**
cross-multiplies	**M1**
x^2 + 18x + 56 = 0 oe	**A1**
factorises or uses the formula	**M1**
x = -14 or x = -4 cao	**A1**

Answer: x = -14 or x = -4

Question 15

120/x + 120/(x + 6) = 35/3	**M1**
multiplies through to remove denominators	**M1**
correct quadratic obtained	**A1**
x = 18 cao	**A1**

Answer: x = 18

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Question 16

combines the left-hand side into a single fraction	**M1**
cross-multiplies	**M1**
$x^2 + 12x - 64 = 0$ oe	**A1**
factorises or uses the formula	**M1**
x = -16 or x = 4 cao	**A1**

Answer: x = -16 or x = 4

Question 17

multiply through by (x+1)(x-1) to clear fractions	**M1**
correct expanded equation $5x - 1 = x^2 - 1$	**A1**
rearrange to $x^2 - 5x = 0$	**M1**
factorise x(x - 5) = 0	**M1**
x = 0 and x = 5	**A1**

Answer: x = 0 or x = 5

Question 18

factorise $x^2 - 9 = (x - 3)(x + 3)$	**M1**
rewrite second fraction with denominator (x-3)(x+3), e.g. 2(x-3)/[(x-3)(x+3)]	**M1**
combine numerators: 3 + 2(x - 3)	**M1**
$(2x - 3)/(x^2 - 9)$ oe cao	**A1**

Answer: $(2x - 3)/(x^2 - 9)$

Question 19

factorise $x^2+3x = x(x+3)$; rewrite first fraction with denominator x(x+3)	**M1**
$(5x - 2)/(x^2 + 3x)$ oe cao	**A1**

Answer: $(5x - 2)/(x^2 + 3x)$

Question 20

cross multiply and expand both brackets: (3x+1)(x+1) = (3x-2)(x+4)	**M1**
x = 3/2 oe cao, e.g. x = 1.5	**A1**

Answer: x = 3/2

Question 21

multiply through by (x-2)(x+2) to clear fractions: $6(x+2) - 4(x-2) = x^2 - 4$	**M1**
expand and simplify to $x^2 - 2x - 24 = 0$, then factorise (x - 6)(x + 4) = 0	**M1**
x = 6 and x = -4 (both values) cao	**A1**

Answer: x = 6 or x = -4

Question 22

multiply both sides by (x - 1): $7 = (x + 5)(x - 1)$	**M1**
expand and rearrange to $x^2 + 4x - 12 = 0$	**M1**
factorise (x + 6)(x - 2) = 0, giving x = -6 and x = 2	**A1**

Answer: x = -6 or x = 2

Question 23

factorise $x^2-16 = (x-4)(x+4)$; rewrite second fraction with denominator (x-4)(x+4)	**M1**
$(3x - 8)/(x^2 - 16)$ oe cao	**A1**

Answer: $(3x - 8)/(x^2 - 16)$

Question 24

multiply through by (x+2)(x-1) to clear fractions	**M1**
expand both sides correctly: $8x + 1 = 4x^2 + 4x - 8$	**M1**
rearrange to $4x^2 - 4x - 9 = 0$	**M1**
apply quadratic formula with a=4, b=-4, c=-9	**M1**
x = 2.08 and x = -1.08 (both awrt 3 s.f.)	**A1**

Answer: x = 2.08 or x = -1.08 (3 s.f.)

Question 25

multiply through by (x-1)(x+1) to clear fractions	**M1**
expand and simplify to a three-term quadratic equal to zero, e.g. $x^2 - x - 6 = 0$	**M1**
factorise (x - 3)(x + 2) = 0	**M1**
x = 3	**A1**
x = -2	**A1**

Answer: x = 3 or x = -2

Question 26

multiply through by (x-1)(x+1) to clear fractions: 5(x+1) - 3(x-1) = (x-1)(x+1)	**M1**
expand and rearrange to $x^2 - 2x - 9 = 0$	**M1**
$x = 1 + \sqrt{10}$ and $x = 1 - \sqrt{10}$ oe	**A1**

Answer: $x = 1 + \sqrt{10}$ or $x = 1 - \sqrt{10}$

Question 27

combine LHS over common denominator (x - 2)(x + 2)	**M1**
expand (x+3)(x+2) and (x-1)(x-2) correctly	**M1**
numerator simplifies to 8x + 4	**A1**
form quadratic equation $3x^2 - 8x - 16 = 0$ (or equivalent) from $(8x+4)/(x^2-4) = 3$	**M1**
factorise (3x + 4)(x - 4) = 0	**M1**
x = 4 and x = -4/3	**A1**

Answer: x = 4 or x = -4/3

Question 28

combine LHS over common denominator (x - 1)(x + 1), expanding (x+4)(x+1) and (x-2)(x-1) correctly	**M1**
numerator simplifies to 8x + 2	**A1**
form and solve the equation $(8x+2)/(x^2-1) = 2$, i.e. $2x^2 - 8x - 4 = 0$, i.e. $x^2 - 4x - 2 = 0$	**M1**
$x = 2 + \sqrt{6}$ and $x = 2 - \sqrt{6}$	**A1**

Answer: $x = 2 + \sqrt{6}$ or $x = 2 - \sqrt{6}$

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