



5.1H Writing a Ratio as a Fraction or Linear Function: Higher Tier Practice

EDEXCEL 1MA1 · Calculator allowed · about 75 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** A recipe uses ingredients in the ratio 5:3:2 for flour:butter:sugar. Work out the fraction of the total mixture that is sugar.

(Total for Question 1 is 2 marks)

- 2** The lengths of three pieces of ribbon are in the ratio 7:4:9. The longest piece is 63 cm. Work out the length of the shortest piece.

(Total for Question 2 is 3 marks)

- 3** A mixture contains acid and water in the ratio $a:(2a + 3)$. If the total volume is 120 ml, express the volume of acid as a function of a , then find the acid volume when $a = 3$.

(a) Express the volume of acid, V ml, as a function of a . (2)

(b) Find V when $a = 3$. Give your answer in ml, simplified. (2)

(Total for Question 3 is 4 marks)

- 4 A photographer sets the ratio of red to blue light intensity to be $(2x + 1):(x - 1)$. The total intensity is fixed at 450 units. Given $x > 1$, find x and state the intensities of red and blue light.

(Total for Question 4 is 5 marks)

- 5 Write the linear function $y = mx + c$ that maps the ratio $x:(3x + 4)$ to the fraction of x in the total, expressed as a function of x for x not equal to $-4/3$. Simplify the function if possible.

(Total for Question 5 is 5 marks)

- 6 Show that if two quantities are in the ratio $(k + 2):(2k - 1)$ and their sum is S , then the first quantity equals $S \cdot (k+2)/(3k+1)$. Then, for $k = 2$ and $S = 240$, find the two quantities.

(a) Show that the first quantity equals $S \cdot (k+2)/(3k+1)$. (3)

(b) For $k = 2$ and $S = 240$ find the two quantities. (3)

(Total for Question 6 is 6 marks)

- 7 A town council divides its budget between parks and libraries in the ratio $5:(t + 3)$. The total budget is 1600 units. The council then changes the split so that the ratio of parks to libraries becomes $3:2$, while keeping the total budget at 1600 units and keeping the actual amount allocated to parks exactly the same as before. Find t .

(Total for Question 7 is 8 marks)

- 8 Show that for positive x the expression $f(x) = (4x + 6)/(2x + 3)$ is equal to 2 for all x except where it is not defined. Then explain what this means in terms of the ratio $4x+6 : 2x+3$.

(a) Show that $f(x) = (4x + 6)/(2x + 3) = 2$ for all x where the expression is defined. (6)

(b) Explain what this implies about the ratio $4x+6 : 2x+3$ for all x where it is defined. (4)

(Total for Question 8 is 10 marks)

9 A chemist uses volumes in the ratio $(x + 1):(2x - 5)$. For which value of x are the two volumes equal? By how much does the first volume exceed the second when $x = 8$?

(a) Find the value of x for which the two volumes are equal. **(3)**

(b) When $x = 8$ and the total volume is 660 ml, find how many ml the second volume exceeds the first by. **(4)**

(Total for Question 9 is 7 marks)

Mark scheme · 5.1H Writing a Ratio as a Fraction or Linear Function: Higher Tier Practice

Question 1

- **M1** write fraction sugar = $2/(5+3+2)$ or equivalent method
- **A1** $2/10 = 1/5$ cao
- **Answer: 1/5 (one fifth). Reason: sugar = 2 out of 10 total, so $2/10 = 1/5$, cao.**
Working check: $5+3+2=10$ so sugar fraction = $2/10 = 1/5$.

Question 2

- **M1** use scale factor: 63 corresponds to 9 (the largest part) so factor = $63/9 = 7$
- **M1** identify shortest part is 4 (smallest of 7, 4, 9) and multiply by factor: $4 * 7$
- **A1** 28 cm cao
- **Answer: 28 cm.**
Working check: scale factor = $63/9 = 7$, shortest part is 4, shortest = $4 * 7 = 28$.

Question 3

- (a) **M1** method: fraction acid = $a/(a + (2a+3)) = a/(3a+3)$
- (a) **A1** $V = 120 * a/(3a+3)$ or equivalent simplified form cao
- (a) **Answer: $V(a) = 120 * a/(3a + 3)$.**
Working check: total ratio = $a + (2a+3) = 3a+3$ so acid fraction = $a/(3a+3)$.
- (b) **M1** substitute $a = 3$ into $V = 120 * a/(3a+3)$ to get $120 * 3/(9+3)$
- (b) **A1** 30 ml cao
- (b) **Answer: 30 ml.**
Working check: $V = 120 * 3/12 = 120 * 1/4 = 30$ ml.

Question 4

- **M1** form equation using total intensity: $(2x+1)+(x-1)=450$
- **M1** simplify to $3x = 450$
- **M1** solve $x = 150$
- **A1** $x = 150$ cao
- **A1** red = $2(150)+1 = 301$ units, blue = $150-1 = 149$ units cao
- **Answer: $x = 150$; red intensity = 301 units; blue intensity = 149 units.**
Working check: $(2x+1)+(x-1)=3x=450$ so $x=150$. Red= $2(150)+1=301$, blue= $150-1=149$. Red+blue= $301+149=450$, consistent.

Question 5

- **M1** form fraction $x/(x + 3x + 4) = x/(4x+4)$
- **M1** simplify to $x/(4(x+1))$ or $1/4 * x/(x+1)$
- **M1** express as linear function $y = (1/4) * x/(x+1)$ and note not defined at $x = -1$ and $x = -4/3$? (identify domain)
- **A1** state simplified expression $y = x/(4x+4)$ cao
- **A1** state domain restriction x not equal to -1 and note function form; accept equivalent simplified forms cao
- **Answer: $y = x/(4x + 4)$. Simplified form $y = x/(4(x + 1))$. Domain: x not equal to -1 .**
Working check: total = $x + (3x+4) = 4x+4$ so fraction of $x = x/(4x+4)$.

Question 6

- (a) **M1** write fraction first = $(k+2)/((k+2)+(2k-1))$
- (a) **M1** simplify denominator: $(k+2)+(2k-1)=3k+1$
- (a) **A1** conclude first = $S*(k+2)/(3k+1)$ cao
- (a) **Answer: First = $S*(k+2)/(3k+1)$.**

Working check: sum of ratio parts = $k+2 + 2k-1 = 3k+1$ so fraction = $(k+2)/(3k+1)$ and multiply by S.

- (b) **M1** substitute $k = 2$ into formula: first = $240*(4)/(7)$ or equivalent
- (b) **M1** calculate first = $960/7$ and second = $240 - \text{first}$ or use ratio parts 4:3 to get integer values? note
- (b) **A1** first = $960/7$ and second = $240*(3)/(7) = 720/7$ cao
- (b) **Answer: First = $960/7$; second = $720/7$.**

Working check: ratio for $k=2$ is 4:3 so parts sum 7. First = $240 * 4/7 = 960/7$, second = $240 * 3/7 = 720/7$.

Question 7

- **M1** express original parts: parks = $5p$, libraries = $(t+3)p$ so total = $(t+8)p = 1600$
- **M1** after change ratio becomes 3:2 so parks = $3q$, libraries = $2q$ and total = $5q = 1600$ so $q = 320$
- **M1** parks amount is unchanged: $5p = 3q$ so $p = 3q/5$
- **M1** substitute $q=320$ to get $p = 3*320/5 = 192$
- **M1** use total $(t+8)p = 1600$ so $(t+8)*192 = 1600$
- **M1** solve $(t+8) = 1600/192 = 25/3$? show steps
- **M1** find $t = 1600/192 - 8 = (25/3) - 8 = (25 - 24)/3 = 1/3$
- **A1** $t = 1/3$ cao
- **Answer: $t = 1/3$.**

Working check: total $1600 = 5p + (t+3)p = (t+8)p$. New ratio 3:2 gives $q = 320$ and parks $3q = 960$ so $p = 960/5 = 192$.

Then $t+8 = 1600/192 = 25/3$ so $t = 25/3 - 8 = 1/3$.

Question 8

- (a) **M1** attempt to divide numerator by denominator or factor: $4x+6 = 2(2x+3)$
- (a) **M1** write $(4x+6)/(2x+3) = 2(2x+3)/(2x+3)$
- (a) **M1** cancel $(2x+3)$ provided $2x+3$ not zero
- (a) **M1** conclude $f(x) = 2$ for all x with $2x+3$ not equal to 0
- (a) **M1** state excluded value $x = -3/2$
- (a) **A1** complete proof $f(x)=2$ and domain note cao
- (a) **Answer: $f(x) = 2$ for all x except $x = -3/2$, where f is undefined.**
- **Working check: $4x+6 = 2(2x+3)$ so $f(x) = 2(2x+3)/(2x+3) = 2$, provided $2x+3$ not zero.**
- (b) **M1** state that ratio simplifies to 2:1 for all allowed x
- (b) **M1** mention that both numerator and denominator scale by same factor so ratio constant
- (b) **M1** note excluded $x = -3/2$ where denominator is zero
- (b) **A1** clear statement: $4x+6 : 2x+3 = 2 : 1$ for all x except $x = -3/2$ cao
- (b) **Answer: The ratio $4x+6 : 2x+3$ is equivalent to $2 : 1$ for every x where defined. It is constant because numerator = 2 times denominator; $x = -3/2$ is excluded since denominator is zero.**
- **Working check: dividing both parts by $(2x+3)$ gives 2:1.**

Question 9

- (a) **M1** set $x+1 = 2x - 5$ and form equation
- (a) **M1** solve: $-x = -6$ so $x = 6$
- (a) **A1** $x = 6$ cao

- (a) **Answer:** $x = 6$.

Working check: $x+1 = 2x-5$ gives $x = 6$.

- (b) **M1** substitute $x = 8$ to get ratio parts 9 : 11
- (b) **M1** total parts = 20 so part value = $660/20 = 33$
- (b) **M1** compute difference second - first = $(11 - 9)*33 = 2*33$
- (b) **A1** 66 ml cao (second is $11*33 = 363$, first is $9*33 = 297$, so second exceeds first by 66 ml)
- (b) **Answer:** 66 ml. When $x = 8$ the ratio is 9:11, total parts 20 so unit = 33 ml. First = 297 ml, second = 363 ml, so the second exceeds the first by 66 ml.

Working check: $660/20 = 33$, $9*33 = 297$, $11*33 = 363$, difference = 66 ml.