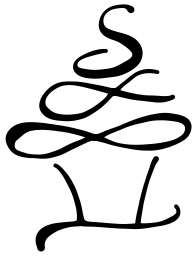
Practice Booklet

MYP 2 · Year 8 Mathematics

Unit 8.2 · Ratio and Proportion

Name: _____

8.2.1	Scale copies and similarity · Questions 1–19
8.2.2 · 8.2.3	Understanding ratio · Simplifying ratio · Questions 20–40
8.2.4 · 8.2.5	The form 1 : n · Ratio and fractions · Questions 41–58
8.2.6 · 8.2.6b	Direct proportion · Conversion graphs · Questions 59–76
8.2.7	Constant of proportionality · Questions 77–94
8.2.8 · 8.2.9	Scale diagrams · Map scales · Questions 95–112
Homework	Homework page and checking record
Answers	For checking and correcting in green pen



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How to use this booklet and your homework

READ THIS FIRST

Choosing your level

Every part of the unit has four levels. Start where you feel comfortable and move between them freely. Most questions ask you to explain as well as answer, because being able to say *why* is what makes a method stick.

Learning
Small numbers, with counters or a diagram beside you.

Practising
The standard question, with your reasoning written out.

Challenging
Working backwards, and finding what is wrong with someone else's thinking.

Mastery
Explaining why a rule must be true, and testing it on new cases.

Working on your homework

Pens and setting out

- Answers in blue or black non-erasable pen, or in pencil.
- Colour and highlighters are for annotating your work and showing the steps of a method.
- Never erase a mistake. Rework it underneath so you can see what changed.

Green pen is for checking. When you finish, use the answers at the back to check your work.

- **Got it wrong?** Circle the question number, then make your correction and write your error analysis in green pen.
- **Still can't work out how to solve it?** Put a star ★ next to the question number, so we know to go over it in class.

Each sheet

- Your name goes on every sheet, because they are handed in one at a time.
- Each question is worth up to 3 marks. If a question has parts (a, b, c...), each part is marked out of 3. At the end of each level, write your score out of the total for that level.
- Questions are numbered 1, 2, 3... all the way through the booklet, so we can say exactly which ones to do.
- If you are stuck after trying, ask for help. Showing me what you tried is a good start.

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8.2.1 Scale copies and similarity

LEARNING

Name:

Key vocabulary

Word	Meaning	Example
similar	the same shape, but not always the same size	2 by 3 and 6 by 9
scale factor	the number every length is multiplied by (new length ÷ old length)	10 ÷ 4 = 2.5
enlargement	a copy that is bigger than the original	scale factor above 1
reduction	a copy that is smaller than the original	scale factor below 1
corresponding	matching sides or angles in the two shapes	the two longest sides

Learning

1 A rectangle is 3 cm by 2 cm. A scale copy has scale factor 2. Write the sides of the copy. Draw both on squared paper if it helps

2 Complete the calculations.

a) 4 × 3 = ___

b) 5 × 2 = ___

c) 6 × ___ = 12

3 A 2 by 3 rectangle becomes a 4 by 6 rectangle. Find the scale factor by dividing each new length by the old length

4 Choose the right word: a copy that is bigger than the original is an _____ and a copy that is smaller is a _____

5 A 2 by 3 rectangle is stretched to 4 by 3. Is it a scale copy? Say what happened to each length

Learning score _____ / 21

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8.2.1 Scale copies and similarity

PRACTISING

Name:

Practising

6 Find the scale factor from the small shape to the large shape.

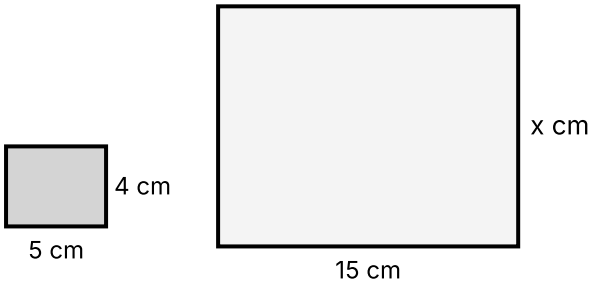
a) 4 cm to 10 cm

b) 6 cm to 18 cm

c) 12 cm to 3 cm

7 A rectangle is 5 cm by 4 cm. Find the sides of its copy with scale factor 3

8 The two rectangles are similar. The small one is 5 cm by 4 cm and the large one is 15 cm by x cm. Find x



9 A 15 cm side is enlarged with scale factor $\frac{1}{3}$. Write the new length

10 Are a 3 by 4 rectangle and a 6 by 9 rectangle similar? Show your working

11 A tomato soup for 4 people uses 800 g of tomatoes, 400 ml of stock, 40 ml of olive oil and 2 tsp of herbs.

a) Find the scale factor for 10 people.

b) Find the amount of each ingredient for 10 people

Practising score _____ **/ 27**

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8.2.1 Scale copies and similarity

CHALLENGING

Name:

Challenging

12 Find and describe the mistake. Ben makes a copy of a 3 cm by 5 cm rectangle with scale factor 4 by adding 4 to each side. He gets 7 cm by 9 cm

13 A photo 10 cm wide and 15 cm tall is printed 25 cm wide, keeping its shape. How tall is the print?

14 A triangle has sides 3 cm, 4 cm and 5 cm. A similar triangle has a shortest side of 9 cm. Find the other two sides

15 A 12 cm line is reduced to 9 cm. Write the scale factor as a fraction in simplest form and as a decimal

Challenging score _____ / 12

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8.2.1 Scale copies and similarity

MASTERY

Name:

Mastery

16 Explain why doubling only the width of a 2 by 3 rectangle does not make a scale copy

17 A 2 cm by 3 cm rectangle has a copy made with scale factor 2.
a) Find both areas.
b) How many times bigger is the area of the copy? Why is it not 2?

18 A square of side 4 cm is enlarged with scale factor 5. Find the new area and say how it is linked to the scale factor

19 Use the soup recipe for 4 people. Scale it for the 19 people in your class. Which amounts are awkward to measure, and what would you do?

Mastery score _____ **/ 15**

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8.2.2 Understanding ratio · 8.2.3 Simplifying ratio

LEARNING

Name:

Key vocabulary

Word	Meaning	Example
ratio	compares two quantities, part with part	2 red : 3 blue
proportion	compares a part with the whole	$\frac{2}{5}$ of the counters are red
total parts	all the parts of the ratio added together	2 + 3 = 5
equivalent ratio	same value, made by multiplying or dividing both parts by the same number	2 : 3 = 4 : 6
simplest form	the only common factor of the parts is 1	12 : 18 = 2 : 3

Learning

20 There are 5 red counters and 3 blue counters. Write the ratio red : blue

21 Write the ratio blue : red for the same counters. Is it the same as your answer to question 1? Why?

22 A bag has 2 red counters and 3 blue counters. Write the total number of parts

23 Fill the gaps: 2 : 3 = 4 : ___ = ___ : 9

24 Share 10 sweets between two people in the ratio 1 : 4. Use the bar model.

a) How many equal parts are there in total?

b) How many sweets are in one part?

c) How many does each person get?



25 Glass 1 has 200 ml of juice and 300 ml of water. Glass 2 has 100 ml of juice and 200 ml of water.

a) Write juice : water for each glass.

b) Which glass tastes more of juice? Explain how you know

Learning score _____ **/ 27**

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8.2.2 Understanding ratio · 8.2.3 Simplifying ratio

Name:

Practising

26 A class has 12 cats and 8 dogs in a story. Write the ratio cats : dogs

27 A bag has 2 red and 3 blue counters.
a) Write the ratio red : blue.
b) Write the fraction of the counters that are red

28 Share 40 CHF between Ana and Ben in the ratio 3 : 2. Draw a bar model

29 Share 36 in the ratio 5 : 1

30 Simplify the ratios.
a) 18 : 24
b) 40 : 100
c) 14 : 35

31 Simplify 75 cm : 3 m. Change to the same units first

32 Pour glass 1 and glass 2 together into one jug.
a) How much juice and how much water are in the jug?
b) Write juice : water for the jug.
c) Is the jug stronger or weaker than glass 1? Than glass 2?

Practising score _____ **/ 36**

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Name:

Challenging

33 Find and describe the mistake. Sam shares 30 sweets in the ratio 2 : 3 by dividing 30 by 2 to get 15 and 15

34 Is 6 : 8 equivalent to 9 : 12? Show how you know

35 Fill the gap: 2 : 7 = 8 : ___

36 Red : blue = 2 : 3 and there are 12 red counters. How many blue counters are there?

Challenging score _____ / 12

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Name:

Mastery

37 Explain, with a drawing, the difference between the ratio 2 : 3 and the fraction $\frac{2}{5}$ for a bag of red and blue counters

38 Share 60 in the ratio 2 : 3 : 5. Show each step

39 The ratios 4 : 6 and 10 : 15 look different. Explain why they describe the same mix and write both in simplest form

40 Mix 2 glasses of glass 1 with 1 glass of glass 2. Find the ratio of juice to water. Will a mixture of the two glasses always be stronger than glass 2 and weaker than glass 1? Explain

Mastery score _____ **/ 12**

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8.2.4 The form 1 : n · 8.2.5 Ratio and fractions

LEARNING

Name:

Key vocabulary

Word	Meaning	Example
1 : n	a ratio with first part 1, found by dividing both parts by the first part	2 : 5 = 1 : 2.5
n : 1	a ratio with second part 1, found by dividing both parts by the second part	5 : 2 = 2.5 : 1
numerator	the number above the line in a fraction	2 in $\frac{2}{5}$
denominator	the number below the line: the total number of equal parts	5 in $\frac{2}{5}$

Learning

41 Complete: 2 : 6 = 1 : ___ (divide both parts by 2)

42 Write each ratio as 1 : n.

a) 2 : 8

b) 5 : 20

c) 3 : 9

43 Work out.

a) 5 ÷ 2

b) 3 ÷ 4

c) 7 ÷ 2

44 The ratio red : blue is 1 : 3. What fraction of the counters are red? Use the bar model



45 $\frac{2}{5}$ of a bag is red and the rest is blue. Write the ratio red : blue

Learning score _____ / 27

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8.2.4 The form 1 : n · 8.2.5 Ratio and fractions

PRACTISING

Name:

Practising

46 Write each ratio as 1 : n.

a) 4 : 10

b) 5 : 2

c) 8 : 20

47 Write each ratio as n : 1.

a) 12 : 3

b) 9 : 2

c) 10 : 4

48 Write 2 : 5 and 1 : 3 as 1 : n. Which mix has more of the second thing for every 1 of the first?

49 $\frac{3}{7}$ of a class are boys. Write the ratio boys : girls

50 Share 30 in the ratio 2 : 3. Draw a bar model

51 Write 4 : 5 as a fraction for each part

Practising score _____ **/ 30**

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8.2.4 The form 1 : n · 8.2.5 Ratio and fractions

CHALLENGING · MASTERY

Name:

Challenging

52 Find and describe the mistake. Mia writes 3 : 5 as the fraction $\frac{3}{5}$ for the first part

53 Write 0.5 : 2 as a ratio 1 : n

54 A paint mix is yellow : blue = 2 : 5. Write it as 1 : n, then find how many ml of blue go with 30 ml of yellow

55 $\frac{2}{9}$ of a class of 36 students are left-handed. Write the ratio left-handed : right-handed and find how many are left-handed

Challenging score _____ / 12

Mastery

56 Explain why dividing both parts by the first number always gives a ratio of the form 1 : n. Use 6 : 15 as an example

57 Juice A is orange : water = 2 : 5 and juice B is orange : water = 3 : 7. Write both as 1 : n and decide which tastes stronger

58 Red : blue = 3 : 5 and there are 40 counters in total. Write the fraction that are red, then find how many red and blue counters there are. Draw a bar model

Mastery score _____ / 9

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8.2.6 Direct proportion · 8.2.6b Conversion graphs

LEARNING

Name:

Key vocabulary

Word	Meaning	Example
direct proportion	y is always the same number of times x	y = 5x
unit value	the amount for 1 item	1 pen costs 3 CHF
origin	the point (0, 0) where the axes cross	a proportion graph starts here
conversion graph	a graph that changes one unit into another	miles to km

Learning

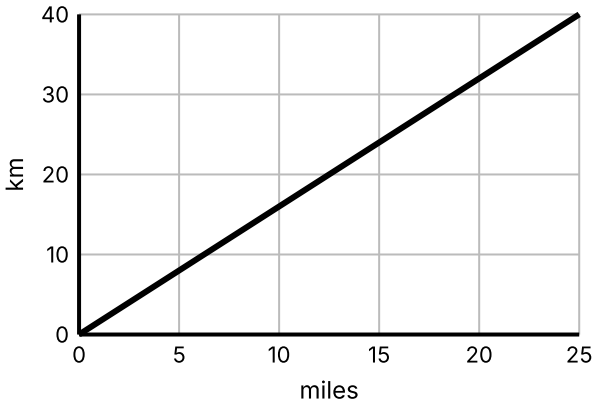
59 1 pen costs 3 CHF. Complete the table. Pens: 1, 2, 3, 4 Cost in CHF: 3, ___, ___, ___

60 2 pens cost 6 CHF. What do 5 pens cost? Find the cost of 1 pen first

61 Use the conversion graph.

a) 10 miles = ___ km

b) 40 km = ___ miles



62 Use 1 mile ≈ 1.6 km. How many km are 20 miles? How many km are 0 miles?

63 x is 1, 2, 3 and y is 4, 7, 10. Work out y ÷ x each time. Is it proportional?

Learning score _____ / 18

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Name:

Practising

64 6 pencils cost 9 CHF. What do 4 pencils cost?

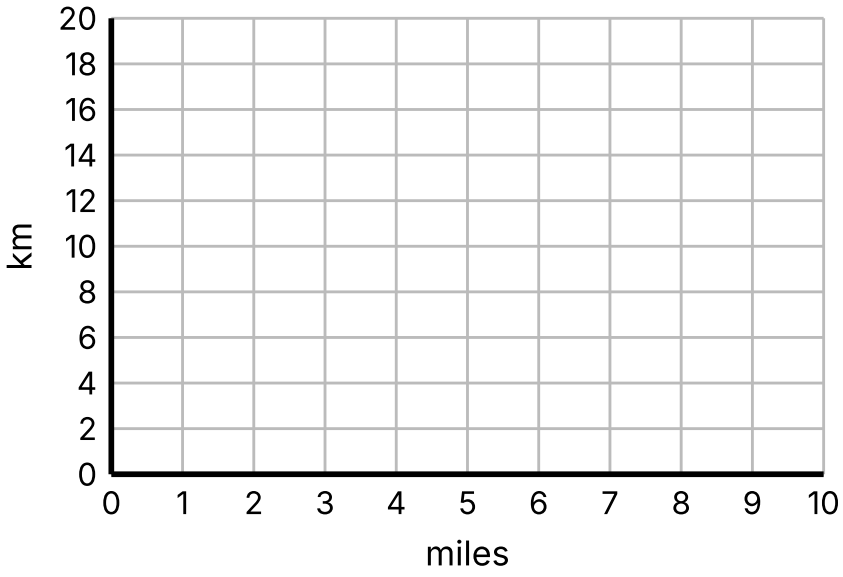
65 3 books cost 24 CHF. What do 5 books cost?

66 A car uses 6 litres of petrol for every 100 km. How much petrol does it use for 250 km?

67 Use 1 mile ≈ 1.6 km.
a) 30 miles = ___ km
b) 80 km = ___ miles

68 y is 2, 4, 6 when x is 1, 2, 3. What is y when x = 10?

69 Plot the points (0, 0) and (10, 16) on the grid and join them with a straight line. What does the line show about 5 miles?



Practising score _____ **/ 21**

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8.2.6 Direct proportion · 8.2.6b Conversion graphs

CHALLENGING · MASTERY

Name:

Challenging

70 Find and describe the mistake. Kai says x: 1, 2, 3 and y: 3, 5, 7 is proportional because y goes up by 2 each time

71 The Celsius to Fahrenheit graph passes through (0, 32). Is it a direct proportion graph? Explain

72 Use 1 mile ≈ 1.6 km. How many miles is 48 km?

73 5 kg of apples cost 12.50 CHF.
a) What do 8 kg cost?
b) What do 3 kg cost?

Challenging score _____ **/ 15**

Mastery

74 Explain how you can tell from a graph that two quantities are in direct proportion

75 Is y = x + 2 a direct proportion? Explain by using x = 0 and a table

76 The side of a square is 1, 2, 3. Compare the perimeters and the areas. Is either of them proportional to the side?

Mastery score _____ **/ 9**

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8.2.7 Constant of proportionality

LEARNING

Name:

Key vocabulary

Word	Meaning	Example
constant of proportionality	the number k that links y and x: k = y ÷ x	y = 3x, so k = 3
rule	the equation y = kx	y = 4x
unit rate	the amount for 1 unit, equal to k	60 km per hour
gradient	how much the line goes up for every 1 across, equal to k	k = 2.5

Learning

77 x = 5 and y = 20. Find k by working out y ÷ x

78 x is 1, 2, 3 and y is 3, 6, 9. Work out y ÷ x each time, then write the rule y = kx

79 The rule is y = 4x. Find y when x = 7

80 4 pens cost 6 CHF. Find the cost of 1 pen. This number is k

81 The rule is y = 2x.
a) Find y when x = 5.
b) Find x when y = 12

Learning score _____ / 18

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8.2.7 Constant of proportionality

PRACTISING

Name:

Practising

82 x = 6 and y = 15. Find k and write the rule

83 The rule is y = 0.5x. Find y when x = 12

84 The rule is y = 2.5x. Find x when y = 20

85 Is this proportional? x is 2, 4 and y is 6, 11

86 A bus travels 90 km in 1.5 hours at a steady speed. Find k in km per hour and write the rule for the distance d after t hours

87 x is 2, 4, 6 and y is 5, 10, 15. Find k, then find y when x = 20

Practising score _____ **/ 18**

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8.2.7 Constant of proportionality

CHALLENGING · MASTERY

Name:

Challenging

88 Find and describe the mistake. Lena finds k from x = 4 and y = 10 by working out 4 ÷ 10 = 0.4 and writes y = 0.4x

89 Shop A sells 3 kg of grapes for 7.50 CHF and shop B sells 5 kg for 11 CHF. Find k for each shop and say which is cheaper per kilogram

90 Is y = 2x + 1 a direct proportion? Test it with x = 0

91 y is directly proportional to x. When x = 8, y = 20. Find y when x = 14

Challenging score _____ **/ 12**

Mastery

92 Explain why the graph of y = kx always goes through the origin (0, 0)

93 For y = 0.25x, k is less than 1. Explain what this means for y compared with x and give an example

94 Explain how the constant k is linked to the unit value and to the gradient of the line

Mastery score _____ **/ 9**

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8.2.8 Scale diagrams · 8.2.9 Map scales

LEARNING

Name:

Key vocabulary

Word	Meaning	Example
scale	compares a distance on the drawing or map with the real distance	1 : 50
drawing length	the length on the drawing, plan or map	6 cm on the plan
real length	the actual length, found by multiplying by the scale	6 × 50 = 300 cm
cm, m, km	100 cm = 1 m and 1000 m = 1 km, so 100 000 cm = 1 km	300 cm = 3 m

Learning

95 A scale is 1 : 10. A drawing is 5 cm long. Find the real length in cm

96 How many cm are in 1 m? Change 300 cm to m

97 The scale is 1 : 20 and a drawing is 5 cm long. Find the real length in cm

98 A map has the scale 1 : 50 000. How many cm in real life is 1 cm on the map? Write the answer in m

99 Change.
a) 40 000 cm to m
b) 6000 m to km

Learning score _____ **/ 18**

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Name:

Practising

100 The scale is 1 : 100 and a drawing is 3 cm long. Find the real length in m

101 The scale is 1 : 50 and a drawing is 8 cm long. Find the real length in m

102 The scale is 1 : 20 and a real length is 3 m. Find the drawing length in cm

103 A model car has the scale 1 : 24 and the real car is 4.8 m long. Find the length of the model in cm

104 A map has the scale 1 : 25 000. A path is 12 cm long on the map. Find the real distance in km

105 A map has the scale 1 : 50 000. A real distance is 9 km. Find the map length in cm

Practising score _____ **/ 18**

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Name:

Challenging

106 Find and describe the mistake. Tom has a map with the scale 1 : 25 000 and a path 8 cm long on the map. He says the path is 200 000 m long

107 A model plane has the scale 1 : 72 and the real wingspan is 36 m. Find the wingspan of the model in cm

108 A map has the scale 1 : 100 000. A road is 3 cm long on the map. Find the real distance in km

109 A hike is 12 km long. How many cm long is it on a map with the scale 1 : 25 000?

Challenging score _____ **/ 12**

Mastery

110 Explain, with an example, why you multiply to go from the drawing to real life but divide to go from real life to the drawing

111 A room is 6 m by 4.5 m. Draw it on a plan with the scale 1 : 200. Find the lengths of the sides on the plan in cm and explain why you changed to cm first

112 A 5 km path is drawn on a map with scale 1 : 25 000 and on a map with scale 1 : 50 000. Find both map lengths and say which map shows more detail

Mastery score _____ **/ 9**

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Homework and checking record

HAND THIS PAGE IN WITH YOUR SHEETS

Name:

Your teacher will tell you which sheet and questions to do. Choose your level, set out your work in pen or pencil, then check it with the answers at the back using a **green pen**: circle wrong question numbers, and star ★ any you still cannot solve.

Sheet	Questions	Which ones I did	Checked in green ✔	Teacher
8.2.1 Scale copies and similarity	Q1–19			
8.2.2 Understanding ratio · 8.2.3 Simplifying ratio	Q20–40			
8.2.4 The form 1 : n · 8.2.5 Ratio and fractions	Q41–58			
8.2.6 Direct proportion · 8.2.6b Conversion graphs	Q59–76			
8.2.7 Constant of proportionality	Q77–94			
8.2.8 Scale diagrams · 8.2.9 Map scales	Q95–112			

Error analysis

Circle the number of any question you got wrong. Star ★ it if you still cannot solve it after correcting. Then write the questions you need to rework, and what you will do differently:

One thing I understand better now

Score: Parent / guardian signature:

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Answers

CHECK IN GREEN PEN

8.2.1 Scale copies and similarity

Learning	**1**	6 cm by 4 cm, because 3 × 2 = 6 and 2 × 2 = 4. Every length is multiplied by 2.
	2	a) 12 b) 10 c) 2
	3	4 ÷ 2 = 2 and 6 ÷ 3 = 2, so the scale factor is 2.
	4	Enlargement; reduction. (An enlargement has scale factor above 1 and a reduction has scale factor below 1.)
	5	No. The width was multiplied by 2 but the height was multiplied by 1. The lengths use different numbers, so the shape is stretched.
Practising	**6**	a) 10 ÷ 4 = 2.5 b) 18 ÷ 6 = 3 c) 3 ÷ 12 = $\frac{1}{4}$ (or 0.25), a reduction
	7	15 cm by 12 cm (5 × 3 = 15 and 4 × 3 = 12)
	8	The scale factor is 15 ÷ 5 = 3, so x = 4 × 3 = 12 cm. Check: 15 over 5 = 3 and 12 over 4 = 3.
	9	15 × $\frac{1}{3}$ = 15 ÷ 3 = 5 cm
	10	No. 6 ÷ 3 = 2 but 9 ÷ 4 = 2.25. The lengths are not multiplied by the same number.
	11	a) 10 ÷ 4 = 2.5 b) tomatoes 800 × 2.5 = 2000 g, stock 400 × 2.5 = 1000 ml, olive oil 40 × 2.5 = 100 ml, herbs 2 × 2.5 = 5 tsp
Challenging	**12**	Scale factor means multiply, not add. 3 × 4 = 12 and 5 × 4 = 20, so the copy is 12 cm by 20 cm.
	13	Scale factor 25 ÷ 10 = 2.5, so the height is 15 × 2.5 = 37.5 cm.
	14	Scale factor 9 ÷ 3 = 3. The other sides are 4 × 3 = 12 cm and 5 × 3 = 15 cm.
	15	9 ÷ 12 = $\frac{9}{12}$ = $\frac{3}{4}$ = 0.75. The fraction and the decimal are the same number written two ways.
Mastery	**16**	It becomes 4 by 3. The width was multiplied by 2 but the height by 1, so the lengths do not use the same scale factor. The angles stay right angles but the shape is stretched.
	17	a) The original is 6 cm², the copy is 4 × 6 = 24 cm². b) 24 ÷ 6 = 4 times bigger. Both the length and the width double, so the area is multiplied by 2 × 2 = 4.
	18	The new side is 20 cm, so the area is 400 cm². The old area is 16 cm² and 400 ÷ 16 = 25 = 5². The area is multiplied by the scale factor squared.
	19	The scale factor is 19 ÷ 4 = 4.75. Tomatoes 3800 g, stock 1900 ml, olive oil 190 ml and herbs 9.5 tsp. Half a teaspoon is hard to measure, so round to 9 or 10 tsp or use a little less or more herbs.

Learning	**20**	5 : 3
	21	3 : 5. It is not the same, because the order matters: the first number goes with the first thing named.
	22	2 + 3 = 5 parts in total
	23	2 : 3 = 4 : 6 = 6 : 9. Both parts are multiplied by 2, then by 3.
	24	a) 5 parts b) 10 ÷ 5 = 2 sweets c) 1 × 2 = 2 sweets and 4 × 2 = 8 sweets
	25	a) Glass 1 is 2 : 3 and glass 2 is 1 : 2. b) Glass 1. For every 3 parts of water it has 2 parts of juice, while glass 2 has 1.5 parts of juice for every 3 parts of water. Accept a fraction method: $\frac{2}{5}$ is more than $\frac{1}{3}$.
Practising	**26**	12 : 8
	27	a) 2 : 3 b) $\frac{2}{5}$. A ratio compares part with part and a fraction compares a part with the whole.
	28	5 parts in total. One part is 40 ÷ 5 = 8 CHF. Ana gets 3 × 8 = 24 CHF and Ben gets 2 × 8 = 16 CHF. Check: 24 + 16 = 40.
	29	6 parts in total. One part is 36 ÷ 6 = 6. The shares are 30 and 6.
	30	a) 3 : 4 (divide by 6) b) 2 : 5 (divide by 20) c) 2 : 5 (divide by 7)
	31	3 m = 300 cm, so 75 : 300. Divide both by 75: 1 : 4.
	32	a) 300 ml of juice and 500 ml of water b) 3 : 5 c) Weaker than glass 1 and stronger than glass 2: the juice is $\frac{3}{8}$ = 0.375 of the jug, which is between $\frac{1}{3}$ and $\frac{2}{5}$.
Challenging	**33**	He divided by 2, one of the ratio numbers. He must divide by the total number of parts: 2 + 3 = 5. One part is 30 ÷ 5 = 6, so the shares are 12 and 18.
	34	Yes. 6 : 8 = 3 : 4 (divide by 2) and 9 : 12 = 3 : 4 (divide by 3). They have the same simplest form.
	35	2 × 4 = 8, so 7 × 4 = 28. The answer is 28.
	36	12 red is 2 parts, so one part is 6. Blue is 3 × 6 = 18 counters.
Mastery	**37**	The ratio 2 : 3 compares red with blue (part with part). The fraction $\frac{2}{5}$ compares red with all the counters (part with whole), where 2 + 3 = 5 is the total number of parts.
	38	2 + 3 + 5 = 10 parts. One part is 60 ÷ 10 = 6. The shares are 12, 18 and 30. Check: 12 + 18 + 30 = 60.
	39	4 : 6 = 2 : 3 and 10 : 15 = 2 : 3. The value of the ratio does not change, only how it is written.
	40	Juice 500 ml and water 800 ml, so 5 : 8, which is $\frac{5}{13}$ ≈ 0.385 juice. This is between $\frac{1}{3}$ ≈ 0.33 and $\frac{2}{5}$ = 0.4. A mixture cannot be stronger than its strongest ingredient or weaker than its weakest, so it is always in between.

8.2.4 The form 1 : n · 8.2.5 Ratio and fractions

Learning	**41**	2 ÷ 2 = 1 and 6 ÷ 2 = 3, so 2 : 6 = 1 : 3
	42	a) 1 : 4 b) 1 : 4 c) 1 : 3
	43	a) 2.5 b) 0.75 c) 3.5
	44	There are 1 + 3 = 4 equal parts, and 1 of them is red. The fraction is $\frac{1}{4}$.
	45	2 parts red and 5 − 2 = 3 parts blue, so red : blue = 2 : 3
Practising	**46**	a) 1 : 2.5 (divide by 4) b) 1 : 0.4 (divide by 5) c) 1 : 2.5 (divide by 8)
	47	a) 4 : 1 b) 4.5 : 1 c) 2.5 : 1
	48	2 : 5 = 1 : 2.5 and 1 : 3 stays 1 : 3. The mix 1 : 3 has more (3 against 2.5).
	49	3 parts boys and 7 − 3 = 4 parts girls, so boys : girls = 3 : 4
	50	5 parts in total. One part is 30 ÷ 5 = 6. The shares are 2 × 6 = 12 and 3 × 6 = 18.
	51	There are 4 + 5 = 9 parts in total. The first part is $\frac{4}{9}$ and the second part is $\frac{5}{9}$.
Challenging	**52**	The denominator must be the total number of parts: 3 + 5 = 8. The first part is $\frac{3}{8}$ (and the second part is $\frac{5}{8}$).
	53	Divide both parts by 0.5: 0.5 ÷ 0.5 = 1 and 2 ÷ 0.5 = 4, so 1 : 4
	54	2 : 5 = 1 : 2.5. 30 ml of yellow is 30 × 2.5 = 75 ml of blue.
	55	$\frac{2}{9}$ means 2 parts of 9, so the ratio is 2 : 7. One part is 36 ÷ 9 = 4, so 2 × 4 = 8 students are left-handed.
Mastery	**56**	The first part divided by itself is 1, and the same division on the second part keeps the ratio equivalent. 6 ÷ 6 = 1 and 15 ÷ 6 = 2.5, so 6 : 15 = 1 : 2.5.
	57	A = 1 : 2.5 and B = 1 : 2.33... (7 ÷ 3). B has less water for each part of orange, so B tastes stronger.
	58	There are 8 parts, so $\frac{3}{8}$ are red. One part is 40 ÷ 8 = 5. Red is 3 × 5 = 15 and blue is 5 × 5 = 25.

8.2.6 Direct proportion · 8.2.6b Conversion graphs

Learning	**59**	6, 9, 12. Each extra pen adds 3 CHF.
	60	1 pen costs 6 ÷ 2 = 3 CHF, so 5 pens cost 5 × 3 = 15 CHF.
	61	a) 16 km b) 25 miles. Read across from the miles or up from the km, then along to the line.
	62	20 × 1.6 = 32 km. 0 miles is 0 km, which is why the line starts at the origin.
	63	4 ÷ 1 = 4, 7 ÷ 2 = 3.5, 10 ÷ 3 = 3.33... The answers are different, so it is not proportional.
Practising	**64**	1 pencil costs 9 ÷ 6 = 1.50 CHF, so 4 pencils cost 4 × 1.50 = 6 CHF.
	65	1 book costs 24 ÷ 3 = 8 CHF, so 5 books cost 5 × 8 = 40 CHF.
	66	250 km is 2.5 lots of 100 km, so 6 × 2.5 = 15 litres.
	67	a) 30 × 1.6 = 48 km b) 80 ÷ 1.6 = 50 miles
	68	y is always 2 times x, so y = 20.
	69	A straight line through the origin. At 5 miles the line is at 8 km, because 5 × 1.6 = 8.
Challenging	**70**	Going up by the same amount is not enough. For direct proportion y ÷ x must be the same each time: 3, 2.5, 2.33... So it is not proportional. When x = 0 the pattern gives y = 1, so the graph would not go through the origin.
	71	No. A direct proportion graph goes through the origin (0, 0), and this one does not: 0 °C is 32 °F, not 0.
	72	48 ÷ 1.6 = 30 miles
	73	1 kg costs 12.50 ÷ 5 = 2.50 CHF. a) 8 × 2.50 = 20 CHF b) 3 × 2.50 = 7.50 CHF
Mastery	**74**	The graph is a straight line that goes through the origin (0, 0).
	75	No. When x = 0, y = 2, not 0, so the graph does not go through the origin. y ÷ x also changes: 3, 2, 1.67... for x = 1, 2, 3.
	76	Perimeters 4, 8, 12: each is 4 times the side, so proportional. Areas 1, 4, 9: area ÷ side is 1, 2, 3, which changes, so area is not proportional to the side.

8.2.7 Constant of proportionality

Learning	**77**	k = 20 ÷ 5 = 4
	78	3, 3, 3, so k = 3 and the rule is y = 3x
	79	y = 4 × 7 = 28
	80	6 ÷ 4 = 1.50 CHF, so k = 1.5
	81	a) y = 2 × 5 = 10 b) 2 × 6 = 12, so x = 6
Practising	**82**	k = 15 ÷ 6 = 2.5, so y = 2.5x
	83	y = 0.5 × 12 = 6
	84	x = 20 ÷ 2.5 = 8
	85	6 ÷ 2 = 3 but 11 ÷ 4 = 2.75. The values are different, so it is not proportional.
	86	k = 90 ÷ 1.5 = 60 km per hour, so d = 60t
	87	k = 5 ÷ 2 = 2.5 (the same each time). y = 2.5 × 20 = 50
Challenging	**88**	k = y ÷ x, not x ÷ y. k = 10 ÷ 4 = 2.5, so the rule is y = 2.5x. Check: 2.5 × 4 = 10.
	89	A: k = 7.50 ÷ 3 = 2.5. B: k = 11 ÷ 5 = 2.2. Shop B has the lower k, so it is cheaper per kilogram (8 kg costs 20 CHF at A and 17.60 CHF at B).
	90	No. When x = 0, y = 1, not 0. A direct proportion has the rule y = kx, which always gives y = 0 when x = 0.
	91	k = 20 ÷ 8 = 2.5, so y = 2.5 × 14 = 35
Mastery	**92**	When x = 0, y = k × 0 = 0 for every value of k, so the point (0, 0) is always on the line.
	93	y is always smaller than x: it is a quarter of x. For example when x = 8, y = 2.
	94	k is the value of y when x = 1 (the unit value, such as the price of 1 item). On the graph the line goes up k for every 1 across, so k is the gradient.

8.2.8 Scale diagrams · 8.2.9 Map scales

Learning	**95**	5 × 10 = 50 cm
	96	100 cm. 300 cm = 3 m
	97	5 × 20 = 100 cm
	98	50 000 cm in real life. 50 000 ÷ 100 = 500 m.
	99	a) 400 m b) 6 km
Practising	**100**	3 × 100 = 300 cm = 3 m
	101	8 × 50 = 400 cm = 4 m
	102	3 m = 300 cm and 300 ÷ 20 = 15 cm
	103	4.8 m = 480 cm and 480 ÷ 24 = 20 cm
	104	12 × 25 000 = 300 000 cm = 3000 m = 3 km
	105	9 km = 900 000 cm and 900 000 ÷ 50 000 = 18 cm
Challenging	**106**	8 × 25 000 = 200 000 is in cm, not in m. 200 000 cm = 2000 m = 2 km.
	107	36 m = 3600 cm and 3600 ÷ 72 = 50 cm
	108	3 × 100 000 = 300 000 cm = 3 km
	109	12 km = 1 200 000 cm and 1 200 000 ÷ 25 000 = 48 cm
Mastery	**110**	Real life is bigger, and the scale 1 : 50 says 1 cm on the drawing is 50 cm in real life. So 6 cm on the drawing is 6 × 50 = 300 cm, and going back, 300 ÷ 50 = 6 cm.
	111	6 m = 600 cm and 600 ÷ 200 = 3 cm. 4.5 m = 450 cm and 450 ÷ 200 = 2.25 cm. The scale compares lengths in the same unit, so change to cm first.
	112	5 km = 500 000 cm. On 1 : 25 000 it is 20 cm and on 1 : 50 000 it is 10 cm. The 1 : 25 000 map is larger, so it shows more detail.