

**LESSON**

**9N4.3**

**Proportion or not?**

**Note:** The materials here provide sufficient resources for two lessons.

**OBJECTIVES**

- Consolidate understanding of the relationship between ratio and proportion.
- Identify the necessary information to solve a problem (by recognising problems involving direct proportion).

**STARTER**

**10 minutes**

**Vocabulary**

corresponding pairs  
direct proportion  
relationship

**Resources**

OHT of data sets  
selected from  
resource 9N4.3a  
Calculators

On the OHP display a pair of data sets which are in direct proportion.  
(See resource 9N4.3a; the sets that are in direct proportion are A, B, F, I, J.)

**Q Are the two sets in direct proportion?**

**Q How do you know?**

Explore a range of different strategies to draw out different relationships between the numbers. Repeat using different pairs of sets, some in direct proportion and some not. When the pairs are in direct proportion:

**Q Can you name another pair of numbers we could include in the sets (which share the same relationship)?**

**Q How could you describe the relationship between the sets?**  
(corresponding pairs)

**Q If x is included in the first set, which y goes with it in the second? For example:**

2	7
8	28
20	70
10	?

**MAIN ACTIVITY**

**35 minutes**

**Vocabulary**

As starter

**Resources**

Handout of real data  
sets selected from  
resource 9N4.3b  
Handout of problems  
selected from  
resource 9N4.3c

Describe and/or illustrate a proportion problem. For example:

**Q A bottle of diet cola indicates that 100 ml contains 0.4 kcal of energy.  
How much energy would 200 ml contain?**

Construct a table of values:

Cola (ml)	Energy content (kcal)
100	0.4
200	0.8

Include other 'easy' figures (e.g. 150 ml of cola and 1 litre of cola) and then less obvious figures (e.g. a typical glass of 180 ml).

**Q How can we work out the amount of energy?**

**Q Are the two sets of values in direct proportion?**

**Q Why? How do we know?**

Relate the answers to the table of numbers and also to the situation (i.e. the uniform nature of cola); draw out the use of 'for every'. Ensure this is well established with the class.

If time permits, use this question to confirm pupils' understanding of the situation:

**Q Can you calculate or estimate how much cola would provide 5 kcal?**

Point out that the volume of cola and the amount of energy are two values which can vary and are connected in some way. This is typical of many mathematical problems. To solve them, it is important to know how the variables are connected.

Distribute a selection of data sets from **resource 9N4.3b**. Ask pupils to work in pairs to identify quickly which sets of variables are in direct proportion. They should record their reasons briefly.

After a few minutes, select two or three of the examples and ask selected pairs to share their thinking with the class. Address any misconceptions revealed.

Now distribute a selection of problems from **resource 9N4.3c**. Ask pupils to classify them according to whether the variables are in direct proportion or not and to solve those they can.

## PLENARY

15 minutes

### Resources

OHT of situations selected from resource 9N4.3d

Address any issues which you have identified while pupils were working on the problems. Select two or three situations from **resource 9N4.3d**, and present them on an OHT.

**Q What are the variables?**

**Q Are they in direct proportion?**

**Q How can you justify your answer?**

### KEY IDEAS FOR PUPILS

- You might know that two sets of numbers are in direct proportion because you are familiar with the context and know how one variable relates to the other.
- You might observe that two sets of numbers are in proportion by looking at a table of values and noting the pattern of entries.
- Both of these points can be checked by ensuring that a constant multiplier connects every pair of values.

**Proportion or not?**

Which of these data sets are in direct proportion?

<b>A</b>	1	3	<b>B</b>	20	5
	2	6		28	7
	3	9		44	11
	7	21		4	1
			84	21	

<b>C</b>	3	4	<b>D</b>	10	15
	7	8		12	20
	14	15		16	30

<b>E</b>	3	10	<b>F</b>	77	11
	4	13		21	3
	5	16		672	96
	6	17			

<b>G</b>	411	611	<b>H</b>	3	9
	457	657		5	25
	429	629		8	64
		10		100	

<b>I</b>	42	4	<b>J</b>	14.2	65.32
	84	8		6.9	31.74
	105	10		321	1476.6
	252	24		55.55	255.53
	357	34			

Consider the sets of data in context. Which sets of variables are in direct proportion?

**Playgroup – proportion or not?**

Although there is a constant difference in each column, the figures are not in direct proportion. The relationship is  $c = 8(a - 1)$ , where  $c$  stands for the maximum number of children and  $a$  for the number of adult staff.

**Playgroup**

The following table shows how many adults are needed to look after different sized groups of children at a playgroup.

Number of adult staff	Maximum number of children
2	8
3	16
4	24
5	32

**Phone bill – proportion or not?**

The cost is directly proportional to the duration (30p/min) but the times may need to be converted to seconds to make the relationship clear.

**Phone bill**

Calls to other networks

Duration (min:sec)	Cost (pence)
2:35	77.5
7:12	216
3:04	92
12:55	387.5
10:10	305
1:44	52

**Beethoven’s symphonies – proportion or not?**

Clearly, these figures show no proportional relationship.

**Beethoven’s symphonies**

A boxed set of Beethoven’s nine symphonies provides the following information.

Symphony number	Duration of recording in minutes
1	36
2	30
3	48
4	31
5	29
6	33
7	32
8	24
9	64

**Belt prices – proportion or not?**

The two prices are very nearly in direct proportion.  
A conversion rate of £1 = €1.56 has been used, but the euro prices have been rounded to the nearest whole number.

### Belt prices

A clothing website allows customers to pay in pounds sterling (£) or euros (€)  
These are the prices for four different belts:

£6.99	or	€11
£13.99	or	€22
£15.99	or	€25
£25	or	€39

**Clicko kits – proportion or not?**

The number of base plates is not in proportion to the numbers of other components. However, the others are provided in the ratio 2:6:4:3.

### Clicko kits

Clicko building kits come in five sizes. Their components are listed below.

Kit	Base plates	Long rods	Short rods	L-joints	H-joints
Beginner	1	10	30	20	15
Designer	1	16	48	32	24
Advanced	1	24	72	48	36
Expert	2	42	126	84	63
Supreme	2	60	180	120	90

**Cooling coffee – proportion or not?**

The temperature is not directly proportional to the elapsed time.

### Cooling coffee

In a science experiment, the temperature of a cup of coffee is measured over half an hour. The results are tabulated.

Elapsed time in minutes	Temperature in °C
0	98
5	73
10	56
15	42
20	34
25	30
30	28

**Water drum – proportion or not?**

The depth and volume measures are in direct proportion.

### Water drum

A large concrete drum holds water for cattle on an Australian farm. The farmer measures the depth of the water and uses this table to estimate its volume.

Depth of water	Volume
0.9 m	150 gallons
1.2 m	200 gallons
1.5 m	250 gallons
2.4 m	400 gallons

These questions require a decision about whether the variables are in direct proportion.

- 1 2.5 litres of paint are sufficient to cover 80 square metres. How much paint do I need to cover 250 square metres?
- 2 A seaside harbour has a tide marker showing the depth of water inside the harbour. At midnight the depth is 4.2 m. At 2:00 am it is 4.9 m. What will the depth be at midday?
- 3 A garage sells diesel fuel at 73.9p per litre. How much can I buy for £20?
- 4 Henry the Eighth had six wives. How many wives did Henry the Fourth have?
- 5 My recipe for 9 scones uses 200 grams of flour. How much flour will I need for 24 scones? The 9 scones need 8 minutes in a hot oven. How long will I need to cook 24?
- 6 A gardener has a lawn which is 15 m by 12 m. She decides to feed it with fertiliser applied at 1.5 grams per square metre. How much fertiliser does she need?
- 7 A sprinter can run 100 m in 11.2 seconds. How long will it take the sprinter to run 250 m?
- 8 When Robyn was 1 year old she weighed 11 kg. When she was 2 years old she weighed 14 kg. How much did she weigh when she was 4 years old?

Consider the situation rather than sets of data.  
Are the variables in direct proportion?

**True or false?**

- 1 In the different countries of the world, the number of cars on the road is directly proportional to the population.
- 2 The weight of flour in a sack is directly proportional to the volume of flour.
- 3 The monthly electricity bill is directly proportional to the amount of electricity used.
- 4 The time an audio tape plays for is directly proportional to the length of tape.
- 5 The temperature of a saucepan of soup is directly proportional to the time it has been on the stove.
- 6 The cost of an article of clothing is proportional to how long it will last.
- 7 The time taken to read a maths problem and the time taken to solve it are in direct proportion.
- 8 The cost of a train journey is directly proportional to the distance travelled.

**When could we reasonably assume the following to be true and when false?**

- 9 The time taken to drive a journey is directly proportional to the distance covered.
- 10 The amount of money a waitress earns is directly proportional to the number of hours she works.
- 11 The cost of a phone call is proportional to the length of the call.
- 12 The amount of wallpaper I have to buy is directly proportional to the area of the walls I want to cover.
- 13 The time taken to read a book is directly proportional to the number of pages in the book.