M1 Maths

N3-3 Proportion

- direct proportion
- inverse proportion

Summary Learn Solve Revise Answers

Summary

If two quantities are in direct proportion (often just called proportion), then whenever one is multiplied or divided, the other is multiplied or divided by the same thing.

If two quantities are in inverse proportion, then whenever one is multiplied, the other is divided by the same thing and vice versa.

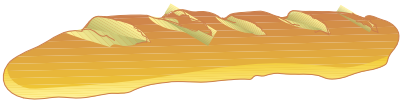
Common sense has to be used to decide whether two quantities are in direct proportion, inverse proportion or neither.

Learn

Direct proportion

In Module N2-3 (Rates), we solved problems like: *If 5 people need 8 kg of food for a journey, how much would12 people need?* We described this as a 2-step rate problem. We solve it by working out how much for 1, then how much for the required number.

We know that	5 people need 8 kg.
Then	1 person needs 1.6 kg.
Then	12 people need 19.2 kg.



This type of problem is sometimes called a proportion problem or more specifically a direct proportion problem. We say that the amount of food is proportional (or directly proportional) to the number of people. Whenever one is multiplied or divided, the other is multiplied or divided by the same thing.

Below are a few more of these problems to refresh your memory.

Practice

Q1 (a) If a car can do 120 km on 8 L of petrol, how far will it go on 20 L?

(b) Mothball gets paid $48 for 6 hours work. How much would he be paid for 20 hours work?

(c) If 4 people can pack 6 tonnes of mangoes in a day, how many people would it take to pack 15 tonnes in a day?

(d) A photo 5 cm long and 4 cm wide is enlarged so it is 17 cm long. How wide will it be?

(e) If 5 L of cordial should be mixed with 22 L of water, how much cordial should be mixed with 15 L of water?

(f) 6 kg of potatoes cost $11.40. How much would 10 kg cost?

(g) Cybes walks 15 km in 2 hours. At the same speed, how long would it take him to walk 24 km?

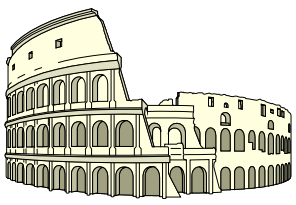
Inverse proportion

Inverse proportion is, in a sense, the opposite of direct proportion. With direct proportion, if you multiply or divide one quantity by something, you do the same to the other quantity. With inverse proportion, if you multiply one quantity by something, you divide the other quantity by the same thing; if you divide one quantity by something, then you multiply the other quantity by the same thing.

An example is the number of cleaners needed to clean a school and the time it takes. If you use twice as many people, it will take half as long: if you multiply the number of people by 2, then you will divide the time needed by 2. If you multiply the number of people by 10, then you will divide the time needed by 10.

Inverse proportion problems can be solved in a way very similar to the way we solve direct proportion problems.

Example: It takes 10 people 3 hours to clean a stadium. How long will it take 15 people?



First work out how long it would take one person. If 10 people take 3 hours, 1 person by themselves would take 10 times as long, i.e. 30 hours. 15 people would do it in $^1/_{15}$ of the time one person takes. So divide 30 by 15 to get 2 hours.

Practice

Q2 (a) If 2 people can clean a bus depot in 12 hours, how long would 3 people take?

(b) If it takes 12 people 5 hours to pack a truck load of mushrooms, how long would it take 15 people?

(c) Travelling at 60 km/h a trip takes 6 h. How long would it take at 40 km/h?

(d) As a gas is compressed, its pressure is inversely proportional to its volume. If it starts at 2 atmosphere pressure and 10 L, what will be its volume when the pressure is 5 atmospheres?

(e) What will be the pressure of the gas when its volume is 0.5 L?

(f) A team of 4 people will take 15 hours to pick the lemons in an orchard. How long would 6 people take?

(g) If it takes 5 people 24 hours to pick a field of strawberries, how long will it take 16 people?

(h) There are 0.5 people per square metre in an exercise yard. If the same people are transferred to a yard 4 times as big, how many people will there be per square metre then?

You have to use a bit of common sense to decide whether two quantities are directly proportional, inversely proportional or neither. Just think: If one of the quantities doubles, will the other one double, or will it halve, or will it do something else?

For example, the number of people on a trek and the number of loaves of bread needed for the trek would be directly proportional; the number of people needed to do a job and the time it would take will be inversely proportional.

However, the number of people in a car and the time it will take to travel to Bundaberg would not be directly proportional or inversely proportional: if a car takes 6 hours to drive to Bundaberg with one person in it, it shouldn't take 18 hours with 3 people in it. Nor should it do it in 2 hours.

To make sure you can decide whether a situation involves direct proportion, inverse proportion or neither, the next question set has some of each. For each question, write D, I or N (depending on whether the situation is direct proportion, inverse proportion or neither), then, if it can be worked out, give the working and answer.

Practice

Q3 (a) A bus can do 200 km on 40 L of diesel. How far will it go on 50 L?

(b) A truck can do 800 km on 120 L of diesel. How much diesel will it need to go 520 km?

(c) 3 people can put a set of letters in envelopes in 6 hours. How long will it take 5 people?

(d) If a passenger plane can fly 800 km/h with 2 crew on board, how fast will it fly with 10 crew on board?

(e) If 4 people can make the sandwiches for an outdoor event in 15 hours, how many people would be needed to do it in 6 hours?

(f) 15 people need 9 loaves of bread per day. How many loaves will 10 people need?

(g) Hugo wants to grow 5000 cabbages. If he uses a rectangular plot of land 12 m wide, it will need to be 20 m long. How long would it have to be if it was 5 m wide?

(h) To make high-strength concrete, 2 buckets of cement are mixed with 9 buckets of gravel. How many buckets of cement should be added to 33 buckets of gravel?

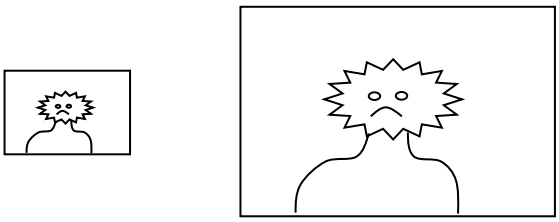
(i) Barnsey can eat 3 bananas in 2 minutes. How many can she eat in 4 hours?

(j) If a bottle of soft drink is poured into a measuring cylinder with cross section 12 cm^2, it fills it to a depth of 50 cm. To what depth will it fill a measuring cylinder with a 20 cm^2 cross section?

(k) It takes a train 70 hours to travel from Sydney to Perth with 400 passengers. How long would it take with 40 passengers?

(l) A painter paints a 1.2 m high wall. Each tin of paint will paint a 6 m length of the wall. How many metres would a tin paint if the wall was 1.6 m high?

(m) A 10 cm by 15 cm picture is enlarged so that its longer side is 40 cm. How long will the shorter side be?



(n) A consignment of food will last 20 people 6 days. How long would it last 8 people?

(o) Roger gets paid $3200 for painting a house in 5 days. How much would he be paid if he painted it in 3 days?

(p) 600 mL of Coke contains 65 g of sugar. How much does 2 L contain?

(q) There is 2.4 hectares of land for each person on Earth. If 80% of humanity emigrated to Mars, how many hectares would there be per person then?

(r) If a man can see 30 km from the top of a tower, how far could six men see from the top of the tower?

Solve

Q51 If 4 people can pick 360 kg of raspberries in 6 hours, how long would it take 3 people to pick 400 kg?

Q52 If a batch of ginger beer is poured into a cylindrical container with diameter 60 cm, it will fill it to a depth of 1.1 m. How deep would it fill a cylinder with diameter 40 cm?

Q53 Draw a sketch graph of the relation between two quantities which are in direct proportion.

Q54 Draw a sketch graph of the relation between two quantities which are in inverse proportion.

Revise

Revision Set 1

Q61 For each question, write D, I or N (depending on whether the situation is direct proportion, inverse proportion or neither), then, if it can be worked out, give the working and answer.

(a) 8 kg of potatoes cost \$11.20. How much would 3 kg cost?

(b) If it takes 5 people 6 hours to lick the road clean, how long would it take 12 people?

(c) A van can do 300 km on 40 L of diesel. How much diesel will it need to go 500 km?

(d) A man who eats 2 Big Macs a day can walk 35 km before collapsing. How far can a man who eats 12 Big Macs a day walk before collapsing?

(e) A large fish tank is a rectangular prism with base area 1500 cm^2. A small fish tank is rectangular prism with base area 600 cm^2. The small one contains water 40 cm deep. If the water is poured into the larger one, how deep will it be?

(f) A photo 6 cm long and 4 cm wide is enlarged so it is 15 cm long. How wide

will it be?

(g) It takes 2 h to get to Mandy's place at 6 km/h. How long would it take at 20 km/h?

(h) If 4.5 L of cordial should be mixed with 22.5 L of water, how much cordial should be mixed with 2 L of water?

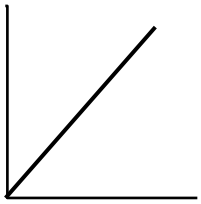
(i) If it takes one person 20 minutes to carve a match stick, how long would it take 120 people?

(j) 19 people can clean a sports hall in 43 minutes. How long would it take 7 people?

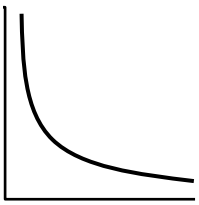
Answers

Q1	(a) 300 km	(b) $160	(c) $10	(d) 10
	(e) 3.4 L	(f) $19	(g) 3.2 hours	
Q2	(a) 8 hours	(b) 4 hours	(c) 9 hours	(d) 4 L
	(e) 40 atm	(f) 10 hours	(g) 7.5 hours	(h) 0.125
Q3	(a) D 250 km	(b) D 78 L	(c) I 3.6 hours	(d) N 800 km/h
	(e) I 10	(f) D 6	(g) I 48 m	(h) D 7.3
	(i) N	(j) I 30 cm	(k) N 70 hours	(l) I 4.5 m
	(m) D 26.7 cm	(n) I 15 days	(o) N $3200	(p) 217 g
	(q) I 12 ha	(r) N 30 km		
Q51	8.9 hours			
Q52	2.475 m			

S3



S4



Q61	(a) D $4.20	(b) I 5 hours	(c) D 66.7 L	(d) N
	(e) I 16 cm	(f) D 10 cm	(g) I 0.6 h	(h) D 0.4 L
	(i) N	(j) I 117 min		