Worksheet - Direct and inverse proportion

Year: Year 9 · 20

Show your working.

Question 1

Question 1 – Finding the constant *(Section A · Skills practice)*

y is directly proportional to x, so $y = kx$. When $x = 4$, $y = 12$. Work through these steps.

a. Find the constant of proportionality k.
b. Write the equation connecting y and x.
c. Find y when $x = 9$.
d. Find x when $y = 45$.

Question 2

Question 2 – Inverse proportion *(Section A · Skills practice)*

y is inversely proportional to x, so $y = \frac{k}{x}$. When $x = 8$, $y = 6$.

a. Find k by multiplying x and y.
b. Write the equation connecting y and x.
c. Find y when $x = 12$.
d. Find x when $y = 16$.

Question 3

Question 3 – The unitary method *(Section A · Skills practice)*

Use the unitary method (find the cost of one first). Show each step.

a. 5 pens cost £3.45. Find the cost of 12 pens.
b. 8 kg of apples cost £11.76. Find the cost of 5 kg.
c. A machine fills 9 bottles in 6 seconds. How many bottles does it fill in 2 minutes?
d. 7 notebooks cost £9.45. How many notebooks can be bought for £16.20?

Question 4

Question 4 – Direct or inverse? *(Section A · Skills practice)*

For each situation say whether the two quantities are in direct proportion, in inverse

proportion, or neither. Give a reason.

a. The number of tickets bought and the total cost at £7.50 each.
b. The speed of a car and the time for a fixed 120 km journey.
c. The number of workers and the days they need to dig a trench.
d. A child's age and her height.

Question 5

Question 5 – Complete the tables *(Section A · Skills practice)*

Each table shows two quantities that are proportional. Find the missing values.

Direct: x	**2**	**5**	**?**	**10**
y	6	?	21	?

Inverse: x	**2**	**4**	**?**	**10**
y	20	?	5	?

a. Find the constant for the direct table and complete it.
b. Find the constant for the inverse table and complete it.

Question 6

Question 6 – Reading equations *(Section A · Skills practice)*

Decide whether each equation shows direct proportion, inverse proportion or neither, and find the missing value.

a. $y = 5x$. Find y when $x = 0.6$.
b. $y = \dfrac{36}{x}$. Find x when $y = 9$.
c. $y = 5x + 2$. Is y directly proportional to x? Test $x = 1$ and $x = 2$.
d. $y = \dfrac{x}{4}$. Write down the constant of proportionality.

Question 7

Question 7 – Baking cookies *(Section B · Real-life practice)*

A recipe makes 12 cookies using 180 g of flour, 90 g of butter and 120 g of sugar. Mrs Patel wants to bake for the school summer fair.

Ingredient	**Flour**	**Butter**	**Sugar**
Amount for 12 cookies	180 g	90 g	120 g

a. Find the amount of each ingredient for 30 cookies.
b. Find the amount of each ingredient for 18 cookies.

c. She has only 500 g of sugar. What is the largest number of cookies she can make?
d. Flour costs £1.10 per kilogram. Find the cost of the flour for 30 cookies.

Question 8

Question 8 – Petrol for the road trip *(Section B · Real-life practice)*

The Okafor family's car uses 6.4 litres of petrol for every 100 km. They plan a trip from Bristol to Edinburgh, a distance of 575 km.

a. How much petrol does the car use per kilometre?
b. Find the petrol needed for the whole trip.
c. Petrol costs £1.45 per litre. Find the cost of the trip.
d. The tank holds 40 litres. How far can the car go on a full tank?

Question 9

Question 9 – Painting the fence *(Section B · Real-life practice)*

The school caretaker needs to paint the playing-field fence. 3 painters working at the same rate would take 8 days.

Painters	1	2	3	4	6	?
Days	?	?	8	?	?	2

a. How many painter-days of work are there altogether?
b. Complete the table.
c. The head wants the job finished in 5 days or fewer. What is the smallest number of painters needed?
d. Why might the real answer be different from the one in the table?

Question 10

Question 10 – Exchange rates *(Section B · Real-life practice)*

Before a school trip to Paris, Sam checks the exchange rate: £1 buys €1.15. Money is in direct proportion to pounds.

a. Convert £250 into euros.
b. Sam spends €172.50 on souvenirs. How many pounds is that worth?
c. The bank charges £3 to change any amount. Sam changes £250. How many euros does she receive?
d. A café in Paris sells hot chocolate for €3.45. What is this in pounds?

Question 11

Question 11 – Journey times *(Section B · Real-life practice)*

A coach company advertises a 240 km journey from Leeds to London. The time depends on the average speed.

Average speed (km/h)	60	80	48	?
Time (hours)	4	3	5	2.5

a. Show that the time is inversely proportional to the speed.
b. Find the average speed needed to complete the journey in 2.5 hours.
c. Write a formula for time t in terms of speed s.
d. The coach leaves at 07:15 and travels at 64 km/h. At what time does it arrive?

Question 12

Question 12 – The pizza party *(Section B · Real-life practice)*

A pizza shop says that 3 large pizzas feed 10 children. The class is planning a party.

a. How many pizzas are needed for 30 children?
b. How many pizzas are needed for 24 children? Round up to a whole pizza.
c. Pizzas cost £8.50. What is the cost for 24 children?
d. There is £50 to spend. How many children can be fed? (Only whole pizzas can be bought.)

Question 13

Question 13 – Feeding the class hamsters *(Section B · Real-life practice)*

A bag of hamster food lasts 30 days for 4 hamsters, when each hamster eats the same amount each day. The class gets two more hamsters.

a. Show that the bag is 120 hamster-days of food.
b. How long does the bag last for 6 hamsters?
c. How long does it last for 5 hamsters?
d. The bag costs £6.60. Find the cost of feeding one hamster for one day.

Question 14

Question 14 – Filling the water tank *(Section B · Real-life practice)*

A farm has a water tank holding 1 800 litres. One pump fills it at 15 litres per minute.

a. How long does one pump take to fill the tank? Give your answer in hours.
b. Two identical pumps are used. How long does the tank take to fill?
c. How many pumps are needed to fill the tank in 30 minutes?
d. Is the time taken directly or inversely proportional to the number of pumps? Explain.

Question 15

Question 15 – Which shop is proportional? *(Section C · Problem solving)*

Two garden centres sell compost. Shop A charges a set price per kilogram. Shop B adds a delivery charge to every order.

Mass (kg)	2	4	6	8
Shop A (£)	3.00	6.00	9.00	12.00
Shop B (£)	3.50	6.00	8.50	11.00

a. Show that the cost at Shop A is directly proportional to the mass and write an equation.
b. Show that the cost at Shop B is not directly proportional.
c. Find the formula for Shop B and the cost of 10 kg.
d. Which shop is cheaper for 10 kg, and which is cheaper for 2 kg?
e. Find the mass for which the two shops cost the same.

Question 16

Question 16 – Building the garden wall *(Section C · Problem solving)*

A builder estimates that 6 bricklayers, all working at the same rate, can build a boundary wall in 10 days. Work out the answers to the following.

a. How many bricklayer-days of work does the wall need?
b. How long would 4 bricklayers take?
c. How many bricklayers are needed to finish in 4 days?
d. After 3 days of work by the 6 bricklayers, 2 of them leave. How many more days do the other 4 take to finish?
e. What is the total time for the wall in part (d)?

Question 17

Question 17 – The school run *(Section C · Problem solving)*

Layla's school is 15 km from home. Her journey time t minutes depends on her average speed s km/h.

Speed s (km/h)	20	30	40	60
Time t (min)	45	30	22.5	15

a. Show that t is inversely proportional to s and find k in $t = \dfrac{k}{s}$.
b. Find the speed needed to arrive in 20 minutes.
c. The bus leaves at 07:50 and travels at 25 km/h. Find the time it arrives.
d. Layla cycles at 12 km/h. Will she arrive in less than an hour?
e. Explain why the real journey time may not follow the formula exactly.

Question 18

Question 18 – The flyer printers *(Section C · Problem solving)*

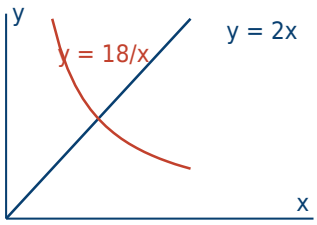
A print shop uses identical printers. One printer prints 240 flyers in 8 minutes. A club orders 1 500 flyers.

a. How many flyers does one printer print per minute?
b. How long would one printer take for the order?
c. How long would 3 printers take, working together?
d. How many printers are needed to print the order in 10 minutes?
e. The shop charges £0.04 per flyer plus a £5 set-up charge. Find the cost of the order.

Question 19

Question 19 – Graphs of proportion *(Section C · Problem solving)*

The graph shows $y = 2x$ (blue) and $y = \dfrac{18}{x}$ (red). Some values are in the table.



x	1	2	3	6	9
$y = 2x$	2	4	?	12	18
$y = 18 \div x$	18	9	?	3	2

a. Complete the table.
b. Which graph shows direct proportion and which shows inverse proportion? How can you tell from the shape?
c. Use the table to find the value of x where the two graphs cross, and the value of y there.
d. Show by algebra that the graphs cross at this point.

Question 20

Question 20 – Challenge: proportional to a square *(Section D · Challenge)*

Some quantities are proportional to the square of another. The area A of a circle is proportional to r^2. Suppose y is directly proportional to x^2, and $y = 18$ when $x = 3$.

a. Find the constant k in $y = kx^2$.
b. Find y when $x = 5$.
c. Find the positive value of x when $y = 72$.

d. What happens to y when x doubles?
e. Now suppose w is inversely proportional to x^2, and $w = 4$ when $x = 3$. Find w when $x = 6$.