

Direct and Inverse Proportion

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (3 marks)

4 identical robot lawnmowers take 90 minutes to mow a football field.

(a) How many minutes would it take 6 of these robots to mow the field?

More robots will take **less** time (inverse proportion).

1 robot on its own would take: $90 \times 4 = 360$ minutes

6 robots take: $360 \div 6 = 60$ minutes

Answer: 60 minutes

Tip: Check your answer makes sense. With more robots it must take less than 90 minutes. $90 \div 4 \times 6 = 135$ is a common wrong answer.

Marks: 1 mark for $90 \times 4 (= 360)$. 1 mark for 60.

(b) State one assumption you made in your answer to part (a).

The method only works if every robot mows grass at the same rate.

Answer: All the robots mow at the same rate

2 (2 marks)

8 men can dig a trench in 15 hours.

How long would it take 6 men to dig the same trench?

Assume all the men work at the same rate.

Fewer men will take longer.

1 man would take: $8 \times 15 = 120$ hours

6 men take: $120 \div 6 = 20$ hours

Answer: 20 hours

Marks: 1 mark for 8×15 (120). 1 mark for 20.

3 (2 marks)

The cost of petrol is directly proportional to the number of litres bought.

35 litres of petrol cost £49.70

Work out the cost of 50 litres of petrol.

Find the cost of 1 litre first:

$$49.70 \div 35 = 1.42$$

$$\text{Cost of 50 litres: } 50 \times 1.42 = 71$$

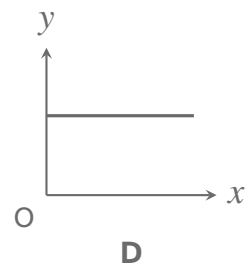
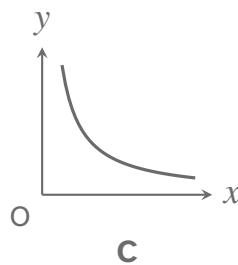
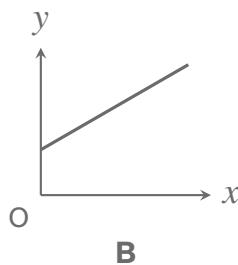
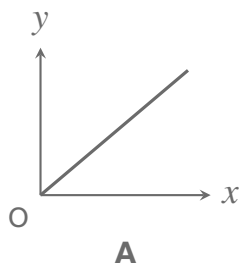
Answer: £71

Tip: Write the money answer as £71 or £71.00, not £7100 or 71p.

Marks: 1 mark for $49.70 \div 35$ (1.42). 1 mark for 71.

4 (2 marks)

Here are four graphs.



(a) Write down the letter of the graph that shows y is directly proportional to x .

A direct proportion graph is a straight line through the origin (0, 0).

B is a straight line, but it does not go through the origin.

Answer: A

- (b) Write down the letter of the graph that shows y is inversely proportional to x .

An inverse proportion graph is a curve.

As x increases, y decreases.

The curve gets close to the axes but never touches them.

Answer: C

5 (3 marks)

y is directly proportional to x .

When $x = 6$, $y = 15$

- (a) Find the value of y when $x = 10$

Direct proportion: $y = kx$

Use $x = 6$ and $y = 15$: $15 = 6k$

$$k = 15 \div 6 = 2.5$$

So $y = 2.5x$

When $x = 10$: $y = 2.5 \times 10 = 25$

Answer: 25

Marks: 1 mark for finding $k = 2.5$ (or a correct scaling method). 1 mark for 25.

- (b) Find the value of x when $y = 40$

Use $y = 2.5x$ with $y = 40$:

$$40 = 2.5x$$

$$x = 40 \div 2.5 = 16$$

Answer: 16

6 (3 marks)

A farmer has enough food to feed 12 cows for 20 days.

He sells 4 of the cows.

The remaining cows eat the same amount of food each day as before.

For how many days will the food last now?

The food would feed 1 cow for $12 \times 20 = 240$ days.

Cows left: $12 - 4 = 8$

Days for 8 cows: $240 \div 8 = 30$

Answer: 30 days

Tip: Fewer cows means the food lasts **longer**. Divide by the 8 cows that are left, not by the 4 that were sold.

Marks: 1 mark for 240. 1 mark for dividing by 8. 1 mark for 30.

7 (2 marks)

With 2 printers, a batch of exam papers takes 45 minutes to print.

The school needs the batch to be printed in 20 minutes or less.

What is the least number of printers the school needs to use?

Assume all the printers print at the same rate.

1 printer would take: $2 \times 45 = 90$ minutes

To finish in 20 minutes: $90 \div 20 = 4.5$ printers

You cannot use half a printer, and 4 printers would take $90 \div 4 = 22.5$ minutes, which is too long.

So the school needs 5 printers ($90 \div 5 = 18$ minutes).

Answer: 5

Tip: $90 \div 20 = 4.5$ is not the final answer. The number of printers must be a whole number, and rounding down to 4 is not enough.

Marks: 1 mark for 2×45 (90). 1 mark for 5.

8 (3 marks)

A hotel has 24 rooms.

10 decorators can paint all 24 rooms in 6 days.

All the decorators work at the same rate, and each room takes the same amount of work.

How many days would it take 5 decorators to paint 18 of the rooms?

1 decorator would paint all 24 rooms in $10 \times 6 = 60$ days.

So 1 decorator paints 1 room in $60 \div 24 = 2.5$ days.

1 decorator paints 18 rooms in $2.5 \times 18 = 45$ days.

5 decorators paint 18 rooms in $45 \div 5 = 9$ days.

Answer: 9 days

Tip: There are two changes here: fewer decorators (takes longer) and fewer rooms (takes less time). Deal with them one at a time.

Marks: 1 mark for 10×6 (60). 1 mark for $60 \div 24$ or $\frac{18}{24}$ or dividing by 5. 1 mark for 9.

9 (4 marks)

The pressure of the air inside a bicycle pump is P units.

The volume of the air inside the pump is $V\text{cm}^3$.

P is inversely proportional to V .

P is given by

$$P = \frac{1200}{V}$$

- (a) Work out the value of P when $V = 80$

$$P = \frac{1200}{80}$$

$$1200 \div 80 = 15$$

Answer: $P = 15$

- (b) Work out the value of V when $P = 40$

$$40 = \frac{1200}{V}$$

Multiply both sides by V : $40V = 1200$

$$V = 1200 \div 40 = 30$$

Answer: $V = 30$

Tip: Check your answer by putting it back into the formula: $1200 \div 30 = 40$ ✓

Marks: 1 mark for $40 = \frac{1200}{V}$ or $1200 \div 40$. 1 mark for 30.

- (c) The volume of the air is divided by 3
What happens to the pressure of the air?

P is inversely proportional to V .

When V is divided by 3, P is multiplied by 3.

Check: $V = 30$ gives $P = 40$, and $V = 10$ gives $P = 120 = 40 \times 3$ ✓

Answer: The pressure is multiplied by 3

Tip: Say exactly what happens ("it is multiplied by 3" or "it trebles"), not just "it goes up".