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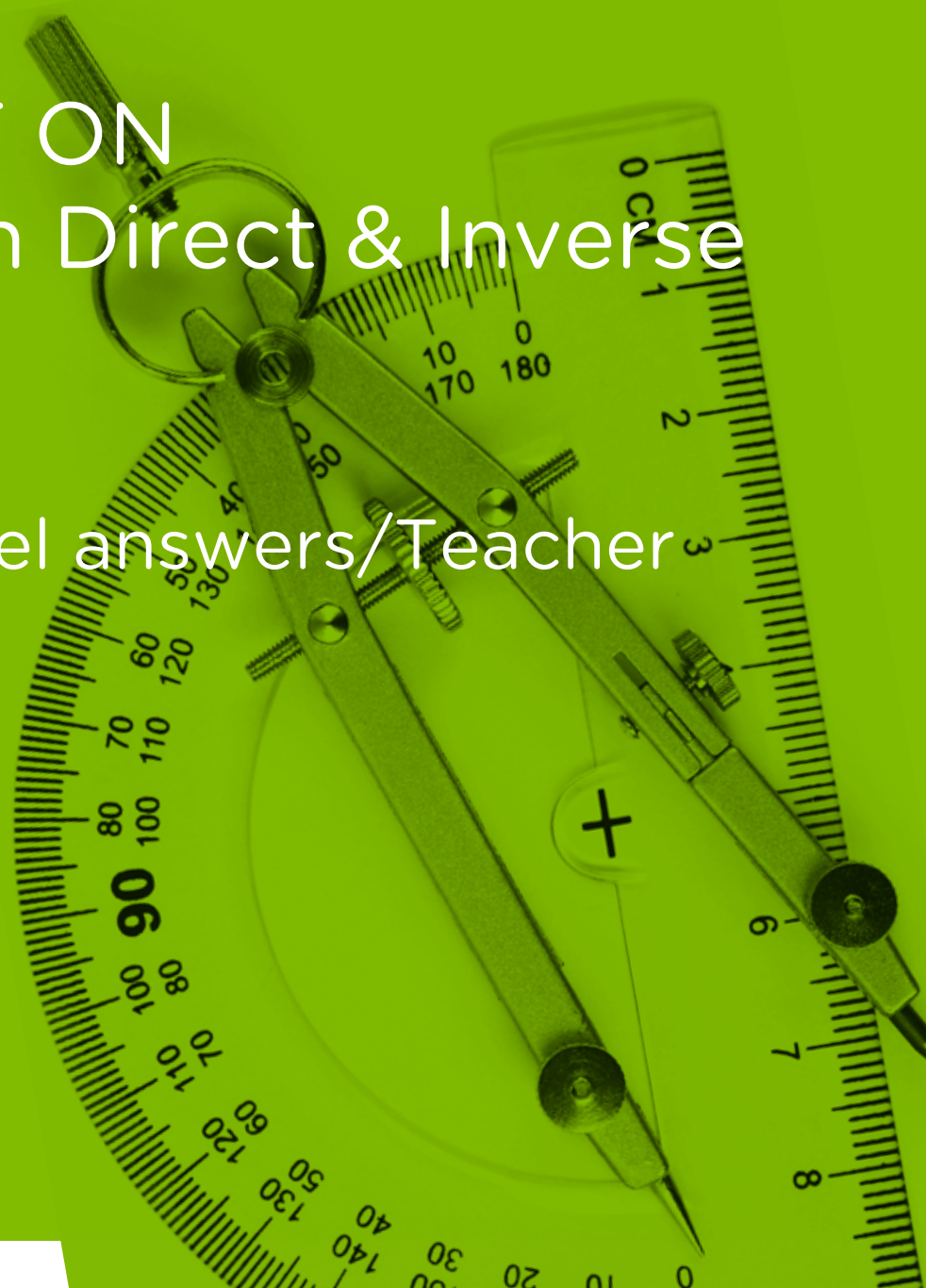
MATHEMATICS

SPOTLIGHT ON
Spotlight on Direct & Inverse Proportion

Problems Model answers/Teacher



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Spotlight on Direct & Inverse Proportion Problems

Model answers/Teacher notes

The questions in this booklet are given in approximate order of difficulty. The symbols at the start of each question indicate whether a calculator may be used or not.

The type of questions in this booklet could all be asked at Foundation and questions 4 and 5 at Higher tier, with questions 1 to 3 useful for reinforcing the skills and understanding.

NB The Guidance for Teaching (FR11) for this syllabus may also be a useful reference:
http://www.eduqas.co.uk/qualifications/mathematics/gcse/GCSE%20Maths%20Guidance%20for%20Teaching.pdf?language_id=1

Aim: To reinforce and practice the skill of solving word problems involving direct and inverse proportion.

The maths needed:

Learners need to be able to

- recognise when quantities are directly proportional to each other
- recognise when quantities are inversely proportional to each other
- understand and state assumptions made in a solution
- understand the impact of an assumption not being correct

Guidance:
The booklet can be worked through individually, in pairs or in small groups. The results can be peer marked, presented by groups or teacher marked. It may also work well as a homework task.

The first 3 questions involve 2 related quantities only. Learners will need to identify whether the quantities are in direct or inverse proportion. Many learners need practice to think of a suitable assumption and also the impact that assumption might make on a solution. In Question 3, learners will need to think a little harder to determine the correct answer to part (a)(i). The answer to the question indicates the quantities are inversely proportional to each other, but this is not needed for the explanation in part (a)(ii), which simply needs to be a statement in context. Question 4 and Question 5 each involve 3 related quantities and learners will need to apply both direct and inverse proportion skills to find the solution.

Possible directed questions/comments that could be asked/mentioned if needed:

What do you know already?
How many columns do you need in your table?
Are those quantities in direct or inverse proportion?
Does it take 1 worker more time or less time to do the job than 4 workers?
What do you think is a sensible next step?
Have you answered the question?
What have you not been told in the question and had to assume?
If that had not been the case, would your answer have changed?

TIP: Always set up a table and work in steps, dealing with two quantities at a time, to keep your answer neat and make your work easier to follow!

Solutions are mainly in red and commentary on the right, in purple.

1. (a) On a farm, 6 workers pick a crop of potatoes.
This takes 12 days.
How long would it take 8 workers to pick the same sized crop of potatoes?

Number of workers	Number of days
6 ÷6	12 ×6
1 ×8	72 ÷8
8	9

Answer: 9 days

Will it take more or less time for 1 worker to pick the potatoes?
- 1 person will take longer, so the process is '÷6' and '×6'.

What do you need to do next?
- The question requires the time for 8 people. 8 people will take less time to pick the same sized crop. The process is '×8'and '÷8'.

(b) State one assumption that you have made in answering this question.

For example:
All the workers work at the same rate.
or
The conditions in the field are the same.

What have you not been told in the question? E.g.
- Nothing is known about the type of potatoes (they might not be the same)
- Nothing is known about the rate at which the workers are able to pick the potatoes
- Nothing is known about the picking conditions – the weather may be better or worse.

2. (a) A machine uses 40 litres of juice to fill 100 bottles.
How many litres would be needed to fill 65 bottles?

Number of bottles	Number of litres
100 ÷100	40 ÷100
1 ×65	0.4 ×65
65	26

Answer: 26 litres

Will it take more or less juice to fill one bottle?
- 1 bottle needs less juice, so the process is '÷100' and '÷100'.

What do you need to do next?
- The question requires the quantity for 65 bottles. 65 bottles needs more juice than 1 bottle, so the process is '×65' and '×65'.

(b) State one assumption that you have made in your answer to part (a).
How would your answer to part (a) change if this assumption were not correct?

For example:
Assumption: The bottles are all the same size.
Change: If some of the bottles are larger, fewer bottles can be filled.

or
Assumption: The bottles are all filled with exactly the same amount of juice.
Change: The last bottle may not be quite as full as the rest if this is not the case.

What have you not been told in the question? E.g.
- Nothing is known about the type of bottles (they might not be the same)
- Nothing is known about how the bottles are filled (could there be spillage; no measurement is exact)

- Impacts should be based on the assumption chosen.

3. When a bag of sweets is shared equally between 7 children, each child gets 6 sweets.

(a) (i) Tick any correct statement about the number of children and the number of sweets.

The number of sweets each child gets × the number of children is always the same amount.	✓
The number of children ÷ the number of sweets each child gets is always the same amount.	
The number of children and the number of sweets each child gets are not connected.	

(ii) Explain why you chose your answer to part (a)(i).

The total number of sweets being shared should be equal to the number of children × the number of sweets each child gets when they are shared equally.

Check out each statement one at a time to see which, if any, are correct.
What does the calculation in first statement work out?

- The first statement is correct as it always gives the total number of sweets in the bag.
- The second statement finds the number of children per number of sweets in a 'portion', which makes no sense.
- The third statement is clearly not true as when there are more children each will get fewer sweets.

(b) If the same bag of sweets had been shared between 2 children, how many sweets would each child receive?

Number of children	Number of sweets
7 ÷7	6 ×7
1 ×2	42 ÷2
2	21

Answer: 21 sweets

If the bag sweets were given to 1 child would they have more or less sweets than the 7 children had each?

- 1 child will have more sweets so the process is '÷7' and '×7'.

What do you need to do next?

- The question requires the number of sweets that 2 children would have got.
  2 people will have fewer sweets each than 1 child.
  The process is '×2'and '÷2'.

4. (a) It would take 2 people 4 days to build a brick wall which is 10 metres long.
How long would it take 6 people to build a different brick wall which is 15 metres long?
You may assume all the people work at the same rate.

Number of people	Number of days	Number of metres
2 ÷2	4 ×2	10
1	8 ×1.5	10 ×1.5
1 ×6	12 ÷6	15
6	2	15

Answer: 2 days

Remember, work with two quantities at a time. Other solutions are possible and the commentary would need to be adapted for those cases.

For this answer:
Will 1 person take more or less time to build a 10-metre wall?

- 1person will take more time (twice as much) so the process is '÷2' and '×2'.

What do you need to do next?

- The quantity of metres needs to be changed, so work out how many days 1 person would take to build the 15 metre wall.

Would 1 person take more or less time to build a 15-metre wall than a 10-metre wall?

- 1 person would take longer to build the 15-metre wall, so the process is '×1.5' and '×1.5'

Would it take 6 people more or less time than 1 person to build the 15-metre wall?

- 6 people will take less time and so the process is '×6' and '÷6'.

(b) State **two** other assumptions you have made when answering part (a).

For example:
Assumption 1: The 15-metre wall is the same height as the 10-metre wall.
or
Assumption 2: The bricks used to build the 15-metre wall are the same size as the ones used to build the 10-metre wall.

Can you use 'Workers may not all work at the same rate.' as an assumption?

- No – it was stated in part (a) that the constant rate of working could be assumed and here you are being asked for *other* assumptions.
-

What have you not been told in the question? E.g.

- Nothing is known about the height of the wall
- Nothing is known about how the size of the bricks
- Nothing is known about the weather.

5. (a) A team of 12 cleaners take 2 hours to clean some floors of a multi-storey building.

How long would it have taken a team of 15 cleaners to clean 3 times as many floors of the same building?
You may assume each cleaner works at the same rate.

Number of cleaners	Number of hours	Number of floors
12 ÷12	2 ×12	X
1	24 ×3	X ×3
1 ×15	72 ÷15	3X
15	4.8	3X

Answer: 4.8 hours

Remember, work with two quantities at a time. Other solutions are possible and the commentary would need to be adapted for those cases.

For this answer:

- You know the number of cleaners and the number of hours they take (12 and 2) but you do not know the actual number of floors they clean in this time.

What can you use instead?

- Learners need to be comfortable with not knowing the actual number of floors. In fact it makes no difference to the answer and, in this case, they could invent a length if they wanted, to help understand the process. However, this would indicate the answer to only be valid for this one instance and so it is necessary to use a letter (here X has been used to make it look less algebraic – although any symbol would do!).

Will 1 cleaner take more or less time to clean X floors?

- 1cleaner will take more time so the process is '÷12' and '×12'.

What do you need to do next?

- The number of floors needs to be changed, so work out how many hours 1 cleaner would take clean 3 times as many floors.

Would 1 cleaner take more or less time to clean 3 times as many floors?

- Clearly, 1 person would take longer to do this. The process is '×3' and '×3'.

Would it take 15 cleaners more or less time than 1 cleaner to clean 3X floors?

- 15 cleaners will take less time and so the process is '×15' and '÷15'.

(b) (i) State one ***other*** assumption that you have made in your answer to part (a).

For example:
The floors that are cleaned are equally dirty.

Can you use 'Workers may not all work at the same rate.' as an assumption?

- No – it was stated in part (a) that the constant rate of working could be assumed and here you are being asked for one *other* assumption.

What have you not been told in the question? E.g.

- Nothing is known about the use of each of the floors

(ii) How would your answer to part (a) change if your assumption is not correct?

For example:
If some of the floors need more cleaning, the time taken will be longer.

- The impact stated must be based on the assumption made.

Have you answered the question?

- The impact must be the result of the assumption made not being correct.