

N10 • Developing an exam question: number

Mathematical goals

To help learners to:

- use past examination questions creatively;
- select and use appropriate techniques and strategies to solve problems involving numerical, graphical and algebraic manipulation.

Starting points

Most learners will have solved problems such as these arithmetically, but they may not have considered alternative methods of solution.

Learners are provided with copies of an examination question similar to those found in GCSE examinations. They answer the question, then analyse the content and identify the skills required to obtain a correct solution. They develop the task by asking further questions and by changing the task in various ways. They develop their own examination questions and attempt to answer the questions designed by other learners.

Materials required

For each learner you will need:

- Sheet 1 – *Van hire*;
- Sheet 2 – *Car hire template (version 1)*;
- Sheet 3 – *Car hire template (version 2)*.

Time needed

About 1 hour.

Suggested approach **Beginning the session**

Ask learners to work in pairs to tackle the GCSE examination questions in Sheet 1 – *Van hire*. When everyone has had time to have a go at this, hold a whole group discussion on the approaches used.

Whole group discussion (1)

(i) *Completing the question*

Collect suggestions for correct answers to each question and write on the board some of the approaches used.

For Question 1, some learners may have had difficulty in handling the decimals or in seeing that you can divide a smaller number by a larger one (such as $16 \div 50$).

How did you work out how much Hurt's vans cost per mile?

(I did 1 600p divided by 50 on my calculator and got 32p.)

(I did £32 divided by 100 miles and got £0.32 per mile.)

Can you see any other ways of getting the answer from the table?

For Question 2, the working is quite complex and learners need to keep a careful record of what they are doing. It may be helpful to ask two learners to write out their solutions in full on the board and compare and contrast them.

(ii) *Generating further questions*

There are many other questions an examiner might have asked, based on this data. Invite learners to suggest some of these. When doing this, they should not seek to change the data in any way, but simply ask new questions based on the data.

As learners suggest possible further questions, list them on the board. For example, the following are all possibilities and are of varying difficulty.

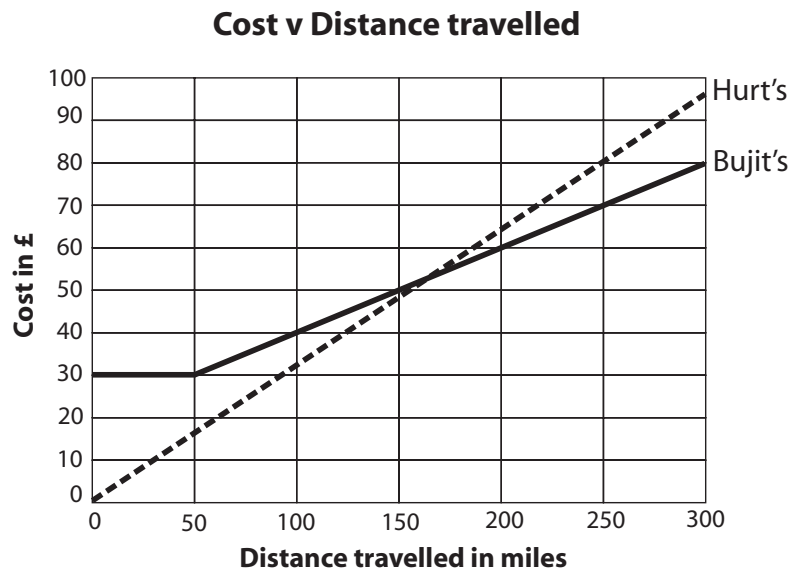
- Sanjay expected to travel 140 miles. Which company has the lower charge for this? How much would he save?
- Over what distance is Bujit's more expensive than Hurt's? Over what distance are Hurt's vans more expensive than Bujit's?
- Where is the cross-over point?
- Can you make a table showing Bujit's prices so that prices are easier to compare with Hurt's?

- Can you make a graph showing how the two companies' prices vary with the miles covered?
- Can you write a formula to show each company's prices?

Working in groups (1)

Ask learners to choose which of these further questions they think they can answer. Encourage them to work on them in pairs and try to agree on the correct answers. Learners may like to write their different solutions to the new questions on the board and compare them.

For example, the 'cross-over' point may be found by trial and error, or from a graph such as the one below:



Alternatively, they may use reasoning such as the following:

After 50 miles, Hurt's are £14 cheaper. From then on the Hurt's rate is 12p per mile more expensive. $£14 \div 12p = 117$ approx, so, if he travels 117 more miles, then both will cost about the same. $117 + 50 = 167$ miles.

or even by solving algebraic equations (though this is unlikely).

Whole group discussion (2)

(iii) Developing the situation

Hand out copies of Sheet 2 – *Car hire template (version 1)*. Ask learners to write their own GCSE question using this template.

Discuss with them how they might do this. They will need to decide on two costing systems to compare. They may be able to think of

systems that are more realistic than the ones in the original GCSE question.

It is possible to ask more interesting questions if there is a cross-over point, so learners may like to try to make sure this happens.

They should then try to devise a few more questions. A range of questions is desirable, from easy to more difficult. The aim is to devise questions that the learners feel are challenging, but that they can answer correctly.

Answers should be written on the back of the sheet.

A second template (Sheet 3 – *Car hire template (version 2)*) is provided for learners who would like to devise a graphical question.

Working in groups (2)

The new questions can be passed around between groups to be answered by other learners. Where learners have difficulty, the question-writers should explain what they intended and act as teachers, helping other learners to answer the questions.

Alternatively, some of the new questions may be photocopied for future sessions or for homework.

Reviewing and extending learning

Finally, hold a whole group discussion on what has been learned, drawing out any common difficulties. You may wish to include a discussion of the level of difficulty of the new questions.

What learners might do next

Ask learners to choose another question from a past exam paper and follow the process adopted in this session.

- (i) Do the question.
- (ii) Ask new questions about the same situation (and answer them).
- (iii) Change the situation and make up a new question.

Further ideas

This method for developing exam questions can be used in any topic. Examples in this pack include:

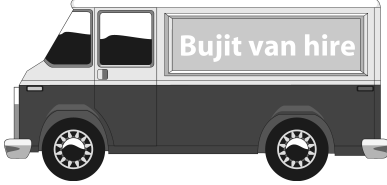
- A8** Developing an exam question: generalising patterns;
- S7** Developing an exam question: probability;
- SS8** Developing an exam question: transformations.

N10 Sheet 1 – Van hire

Sanjay wants to hire a van to move some furniture.

He obtains the following information from two hire companies.

Bujit's Van Hire



£30 for the first 50 miles.
Every mile after that costs an extra 20p.

Hurt's Vans

You only pay for the miles you travel.

Miles travelled	50	100	150	200
Hire charge	£16	£32	£48	£64

1. How much do Hurt's vans cost per mile?
2. Sanjay expects to travel 175 miles.
Which company has the lower charge for this distance?
You must show all your working.


Think of some other questions the examiner might ask, based on this information.

N10 Sheet 3 – Car hire template (version 2)

Cath wants to hire a car for a weekend.

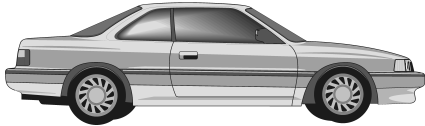
She obtains the following information from two hire companies.

..... **Car Hire**



£for the first
.....miles.
Every mile after that costs an
extra p.

..... **Car Hire**



Miles travelled				
Hire charge				

.....

