

# PAT Teaching Resources Centre

## PAT Maths

Concept builder: **Identifying which operation to use in a word problem**

**Strand:** Number and Algebra

### KEY CONCEPTS AND SKILLS

- Understanding that mathematical symbols make up a concise language used to specify operations
- Understanding that the same mathematical operation can be represented in English by many different words and phrases

### COMMON MISCONCEPTIONS AND ERRORS

- Thinking that a maths operator symbol has one meaning, so there is only one way to refer to it in English
- Thinking that 'total' or 'altogether' are words that always imply addition
- Thinking that word problems are hard because if you don't 'get' what to do you can only guess the answer

### CONCEPT BUILDING ACTIVITY

#### Key word flash cards

Note: this activity can be adjusted for lower grade levels, for example, by only exploring addition and subtraction.

- Each student is given four cards that are large enough to take their handwritten text but small enough to be portable (about A6 size).
- On one side of a card they write in large print one of the symbols  
 $+$ ,  $-$ ,  $\times$  or  $\div$ .
- Begin a discussion about the various English words that represent '+', listing the first couple on the board and asking students to extend the list. Students copy the words onto the reverse side of their '+' card: *ADD, SUM, PLUS, EXTRA, MORE, INCREASE, RECEIVE ...*
- Move to '-' and help students to make the link that this is the inverse operation to '+' so the English words will include the antonyms of the '+' list. Copy the words onto their '-' card: *SUBTRACT, DIFFERENCE, LESS, FEWER, DECREASE, TAKE AWAY...*

- (The following steps could be held over for a later date, depending on your judgement about students' readiness.) Similarly, look at ' $\times$ ': *MULTIPLY, TIMES, PRODUCT, DOUBLE, TRIPLE, PER ...*
- And ' $\div$ ' where again the words include the antonyms of the ' $\times$ ' words: *DIVIDE, HOW MANY, QUOTIENT, HALVE ...*
- Finally, display some word problems or hand out a sheet. The task is not to solve them, but to highlight the key words that indicate which operation to use.
- Stress that [word problems](#) are not all meant to be done 'in your head', but can be analysed methodically.
- Caution students that it is always important to read and understand a problem in its context and not just rely blindly on key words (see more in Further reading). Provide counter-examples, such as the use of the word 'times' in Q5 of the word problems provided.
- Have students file the cards in a folder pocket for later reference.
- Display a summary poster in the classroom.

### FURTHER READING

Hegarty, M. (1995). Comprehension of arithmetic word problems: A comparison of successful and unsuccessful problem solvers, *Journal of Educational Psychology*, 87, 18–32. Retrieved from

<http://citeseerx.ist.psu.edu/viewdoc/download?rep=rep1&type=pdf&doi=10.1.1.167.8370>

# Example Question (1): Interpret two line graphs

**Content strand:** Statistics and Probability

**PAT Maths description:** Interpret two line graphs and their common scale to estimate the difference between them at a particular time.

## QUESTION

### Class Competition



Miss La Plastrier's class



Mrs D'Olivier's class

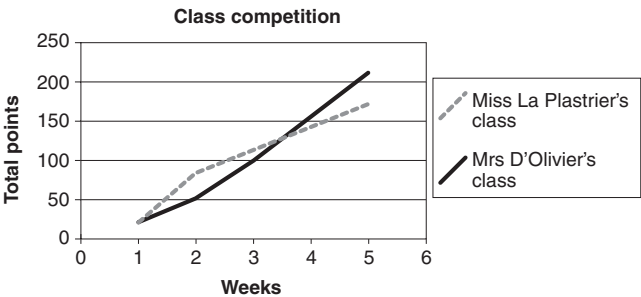
At a school, two classes decide to have a competition over 10 weeks. Both classes have 20 students. They are awarded points by their teachers as follows:

- 1 point for every student getting to class on time all week;
- 2 points for every student doing homework on time all week.

In week 3, Mrs D'Olivier's class had:

- 20 students who arrived at class on time all week;
- 15 students who submitted homework on time all week.

After five weeks, the two teachers draw a graph to show progressive totals for each class.



## Question 2 of 3

S35053

**2** After five weeks, the number of points separating the two teams is closest to

- ☐ 50
- ☐ 100
- ☐ 150
- ☐ 200
- ☐ 250

## COMMON ERRORS AND MISCONCEPTIONS

|                 |                                                                                                                                                                                                                                       |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Key             | A: 50                                                                                                                                                                                                                                 |
| Item commentary | This item requires students to use a key to compare two line graphs that share a common scale, determine the difference between the two lines at a particular point in time and select a response that best reflects this difference. |

|   |                                                                                                 |
|---|-------------------------------------------------------------------------------------------------|
| A | Key                                                                                             |
| B | 100 (may think the scale is increasing by 100)                                                  |
| C | 150 (may focus on the points for one class only)                                                |
| D | 200 (may focus on the points for one class only)                                                |
| E | 250 (may add the difference in points to the number of points gained by Miss D'Olivier's class) |

## KEY CONCEPTS AND SKILLS

- Interpreting line graphs that share a common scale
- Interpreting a key
- Estimating the value of points between scale markings

# Example Question (2): Calculate the parts needed

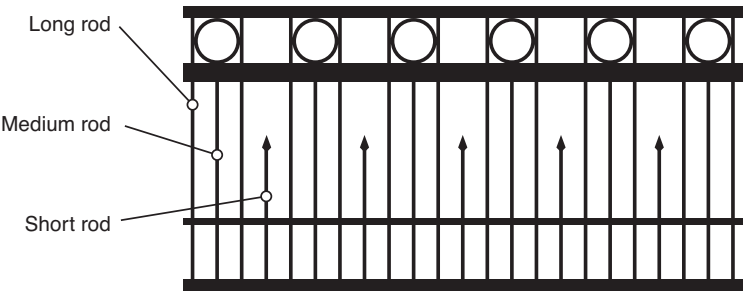
**Content strand:** Number and Algebra

**PAT Maths description:** Use the given information (parts per section) and a given method for joining the sections to calculate the number of parts needed for multiple sections.

## QUESTION

### Fence

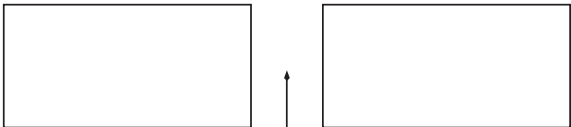
This section of fence is three metres long.  
It contains six circles, five short rods, six medium rods and 12 long rods, as shown in the picture.



The company making the fence has 112 circles, 95 short rods, 106 medium rods and 203 long rods in stock.

When two 3-metre sections are joined together to make a longer fence, one extra short rod is required in the space between each pair of 3-metre sections.

The extra space for the short rod is 20 cm.



## Question 2 of 3

S27052

**2** How many short rods **altogether** would four 3-metre sections of fencing joined together in this way require?

- ☐ 14 short rods
- ☐ 15 short rods
- ☐ 20 short rods
- ☐ 23 short rods
- ☐ 24 short rods

## COMMON ERRORS AND MISCONCEPTIONS

|                 |                                                                                                                                                                                                                                                                           |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Key             | D: 23 short rods                                                                                                                                                                                                                                                          |
| Item commentary | This item requires students to solve a multi-step problem by interpreting a model (diagram of a fence with component parts) where applying a provided rule is required; decide on an appropriate strategy (multiplication with addition); and provide a numerical answer. |
| A               | 14 short rods (may find the number of short rods multiplied by 2 and add to the number of fence sections)                                                                                                                                                                 |
| B               | 15 short rods (may find the number of short rods multiplied by 3, the length of each section)                                                                                                                                                                             |
| C               | 20 short rods (may multiply the number of sections, 4, by the number of short rods, ignoring the extra rod to join the sections)                                                                                                                                          |
| D               | Key                                                                                                                                                                                                                                                                       |
| E               | 24 short rods (may multiply the number of sections, 4, by the number of short rods per section, then add four extra short rods to join the sections, not realising there are only three joins)                                                                            |

## KEY CONCEPTS AND SKILLS

- Solving a two-step problem involving addition and multiplication