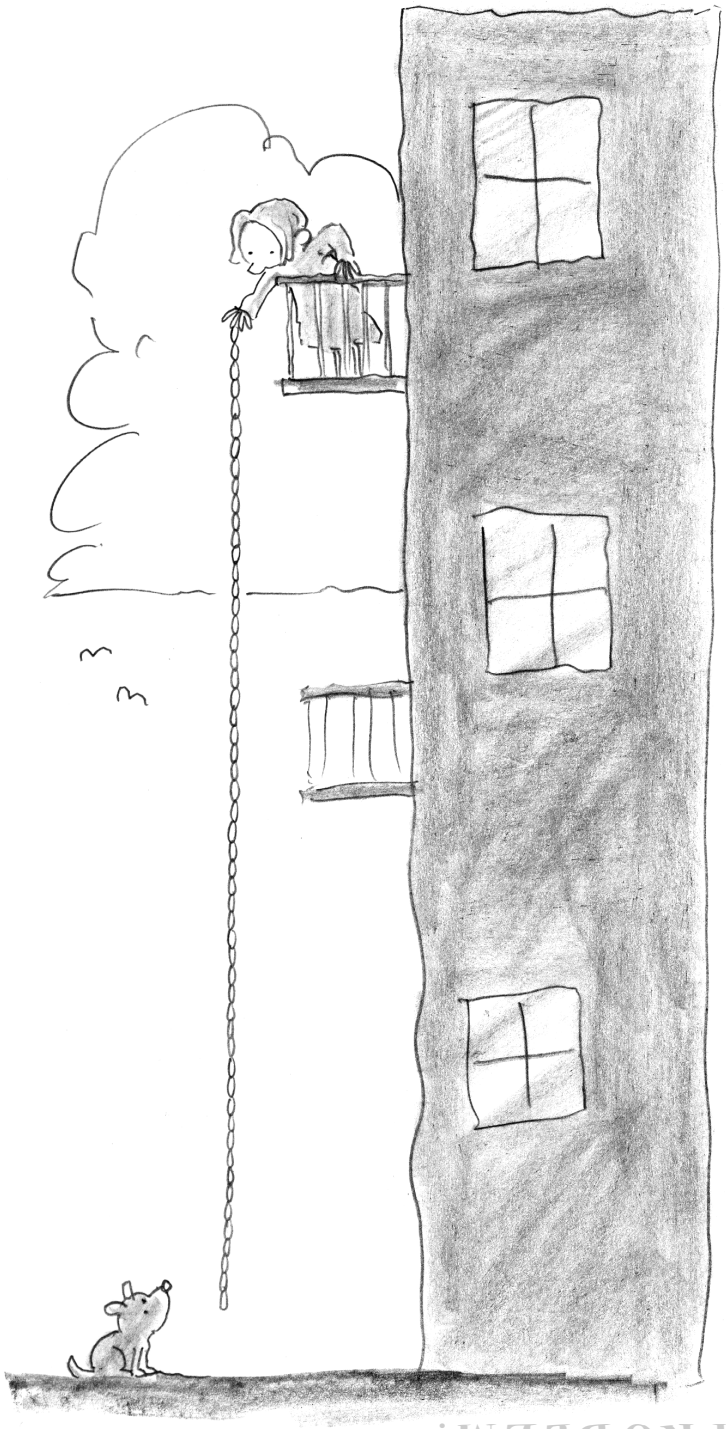
Looking for a Pattern



SOLVE THAT PROBLEM!
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Teaching Notes Looking for a Pattern

This strategy is an extension of *Drawing a Table* and *Creating an Organised List* (see page 19 and page 61). It is one of the most frequently used problem solving strategies, as mathematical patterns can be found everywhere – in nature, numbers and in shapes. Pupils learn, through probability and prediction, to distinguish between different patterns.

When a pattern is established, it is easy to predict what comes next. The most common way to check if there is a pattern is to:

- Find the difference between two consecutive numbers.
- Decide whether the numbers have been multiplied or divided by any given number.
- Find out if they are rising or falling numbers that increase or decrease following a regular sequence.

Once a pupil recognises a pattern, it can be extend or continued.

It is important for pupils to realise that a lot of the problem-solving skills they learn build on or are connected to one another.

The following skills and strategies need to be developed by pupils to help them solve problems that involve looking for a pattern.

Creating and continuing a pattern

Ask pupils to complete the following three number pattern. There is more than one possible answer.

Example: 1 2 4 — —

Some possible patterns are:					
(a)	1	2	4	8	16
(b)	1	2	4	7	11
(c)	1	2	4	1	2
(d)	1	2	4	5	7

They are all correct, as each has established its own pattern based on the first two numbers and each pattern can be explained.

In (a), each subsequent number is doubled.
In (b), the difference between the numbers increases by one each time. First it is 1, then 2, then 3.
In (c), the numbers 1, 2, and 4 are repeated.
In (d), the difference between the numbers is 1, then 2. This is then repeated.

For problems similar to the above example, it is important for pupils to see that it is possible to have more than one correct answer, if the patterns created can be explained. A calculator can be a helpful tool to use when looking at patterns.

Some patterns include two operations.

Example: 6 9 8 11 10 — — —

This pattern includes two operations: + 3, - 1.

Use brackets when solving more complicated patterns. They can be used to group similar groups of numbers.

Example: 6 + 7 + 8 + 6 + 7 + 8 + 6 + 7 + 8

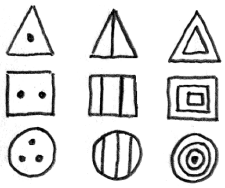
The pattern becomes clearer when brackets are used to group the numbers.

(6 + 7 + 8) + (6 + 7 + 8) + (6 + 7 + 8)

Spatial Patterns

To help pupils explore spatially, give them a set pattern series.

- On the first line, draw a row of three triangles with a pattern in each: a dot in the first triangle, a line in the second triangle, and an extra line within the third triangle.
- On the second line, draw a row of three squares, with two dots in the first square, two lines in the second square, and two extra lines around the third square.
- On the third line, draw a row of three circles, with three dots in the first circle, three lines in the second circle, and three extra lines within the third circle.
- A definite pattern has been established.



Pupils can continue their exploration of the pattern. They can add new shapes or explore new patterns using the three shapes already provided.

Finding a pattern in a table

Before looking for a pattern, pupils need to go through the process of creating a table. They need to decide:
Are there one, two, three or more variables?
Is a 'total' column necessary?

Example:

When Janie went strawberry picking, one out of every six strawberries had worm holes. How many good strawberries were there out of 84?

Draw up a table with three columns headed 'good', 'bad' and 'number of strawberries'.

We can see that a pattern has been established. The 'good' column is increasing in multiples of 5 and the 'bad' column is increasing by ones. So if there is a total of 84 strawberries picked, 70 will be good and 14 will be bad.

Good	Bad	Number of strawberries
5	1	6
10	2	12
15	3	18
20	4	24
25	5	30
30	6	36
35	7	42

Teaching Examples Looking for a Pattern

Example 1

Miriam plants three seeds for every eight seeds that her mother plants. How many seeds has Miriam planted when her mother has planted 64 seeds?

Understanding the problem

What do we know?

Miriam and her mother are planting seeds.
For every 3 seeds Miriam plants, her mother plants 8.
Miriam's mother planted 64 seeds.

What do we need to find out?

Questioning: How many seeds has Miriam planted?

Communicating a solution

Draw up a table with two columns. One column is headed 'Miriam's seeds' and the other is named 'mother's seeds'.

Miriam's seeds	Mother's seeds
3	8
6	16
9	24
12	32
15	40
18	48
21	56
24	64

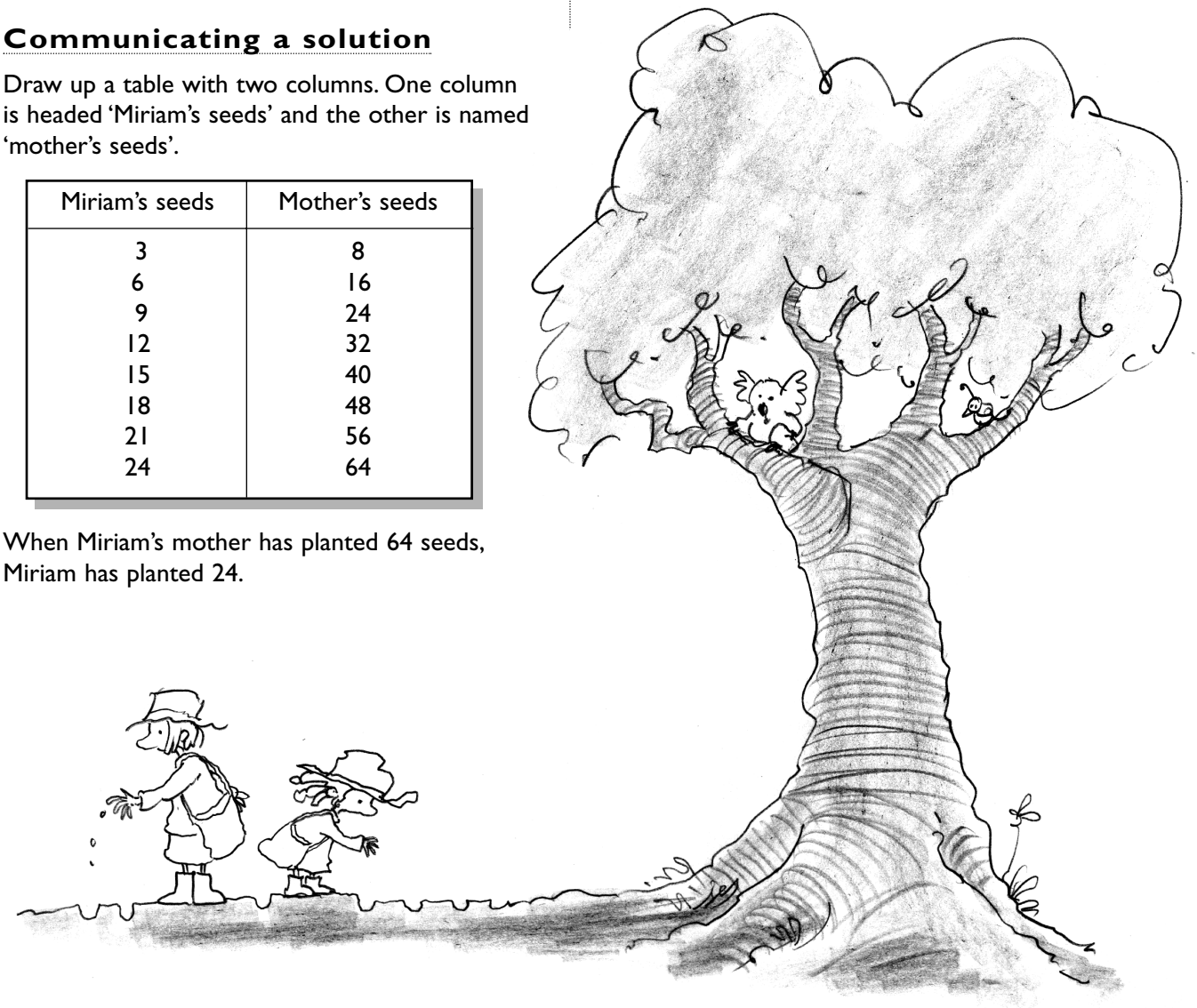
When Miriam's mother has planted 64 seeds, Miriam has planted 24.

Reflecting and Generalising

There is a pattern evident. Miriam's seeds are increasing in multiples of three and her mother's seeds increase in multiples of eight. If a pattern can be seen, it becomes easy to complete the table.

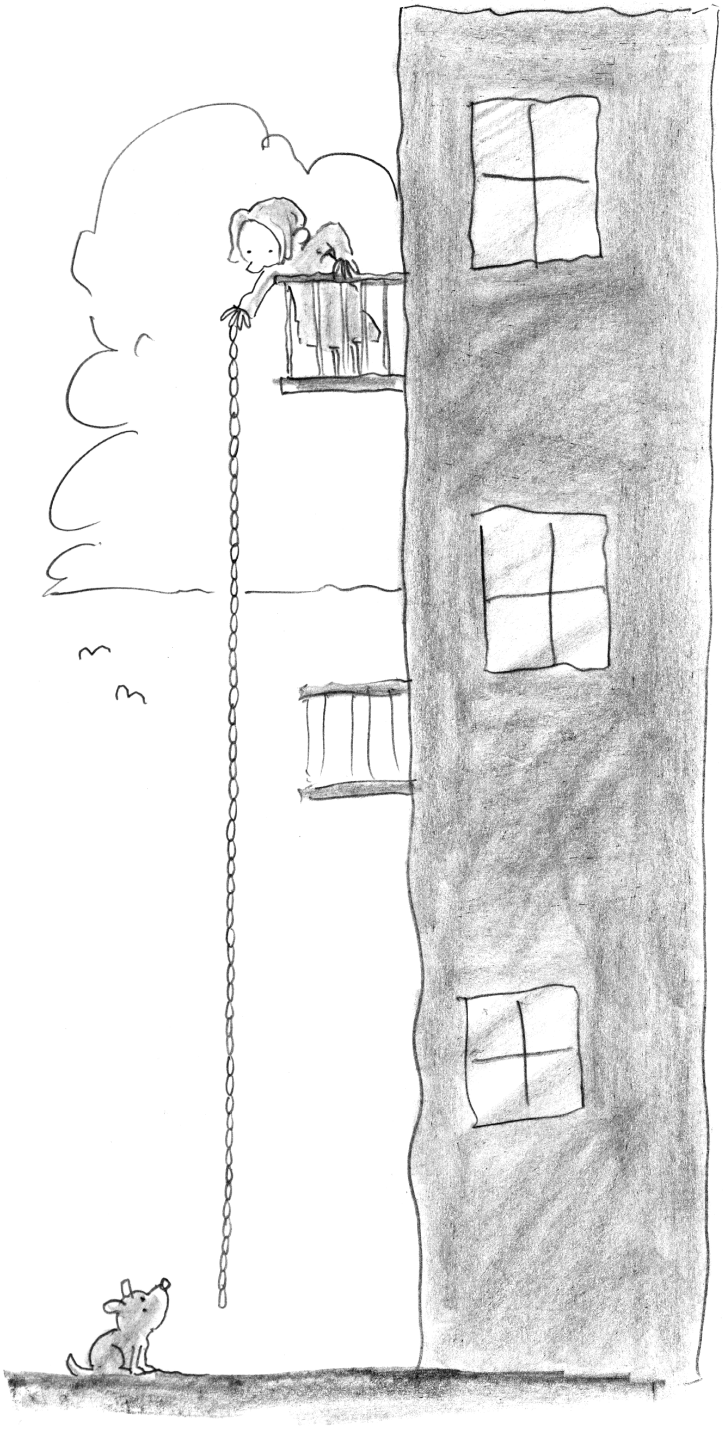
Extension

Different numbers can be used so that different multiples or patterns can be seen.



Example 2

Marcelle was linking a paperclip chain. On the first day she joined two paperclips together; on the second day she added three more to the chain; and on the third day she added four paperclips. If she continues adding paperclips at the same rate, how many will she add on the ninth day? How many paperclips will there be altogether in the chain?



Understanding the problem

What do we know?

Marcelle joined two paperclips on the first day.
On each day after that she added one more than on the day before.
She stopped on the ninth day.

What do we need to find out?

Questioning: How many paperclips did she add on the ninth day?
How many paperclips were there altogether in the chain?

Communicating a solution

Draw up a table with three rows and 10 columns. Label the first row 'Day', the second row 'Added paperclips' and the third row 'Total'.

Day	1	2	3	4	5	6	7	8	9
Added paperclips	2	3	4	5	6	7	8	9	10
Total	2	5	9	14	20	27	35	44	54

On the ninth day, Marcelle will add 10 paperclips and there will be 54 paperclips in the chain.

Reflecting and Generalising

By using a table with clear headings, it is easier to see the pattern that has been created.

Extension

Change the number of paperclips by adding two more than the day before, or by doubling the number added the day before.

Example 3

The Ross family are working on a fitness program. On the first day, they cycle around the oval three times; on the second day, seven times; and on the third day, eleven times, and so on. How many days must they exercise before they reach their goal of cycling around the oval 31 times?

Understanding the problem

What do we know?

The number of circuits of the oval increases each day.

What do we need to find out?

Questioning: How many days must they exercise before they reach their goal?
Is there a pattern?

Communicating a solution

As the numbers are increasing each day, pupils should draw up a table to enable them to see if there is a pattern. The two variables are the days and the number of circuits.

Days	Circuits
1	3
2	7
3	11
4	15
5	19
6	23
7	27
8	31

It will take 8 days for the Ross family to reach their goal of 31 circuits of the oval.

Reflecting and Generalising

Once the table has been drawn up, it is easy to see a pattern. The numbers are increasing by four circuits a day.

Extension

Instead of increasing by the same number of circuits per day, the number of circuits could increase using a formula, for example, the first day increases by one, the second day by two, the third day by three etc.

Copymaster Looking for a Pattern

★ Understanding the problem

List what you know .....

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★ What do you need to find out?

Questioning: What are you uncertain about? Is there any unfamiliar or unclear language? What are you being asked to do?

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★ Planning and communicating a solution

Are you working in a sequence? Can you develop a pattern?

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★ Reflecting and generalising

Did the strategy work? Could a better method have been used? Will you be able to apply this method to similar problems?

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★ Extension

How can this problem be extended? What factors can be added as part of a 'what if' question?

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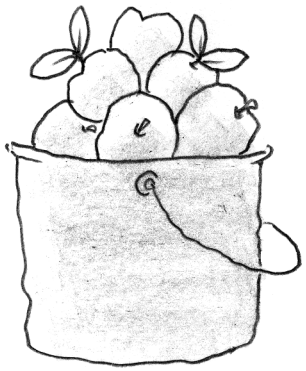
PROBLEM SOLVING TASK CARDS - Looking for a Pattern

Problem 85

Numbers 1 2 3

Level A

During the holidays, Karen picked apples at the Granny Smith Orchard. She was paid 10p for the first bucket of apples, 20p for the second, 40p for the third and 80p for the fourth. How much was she paid for the eighth bucket?

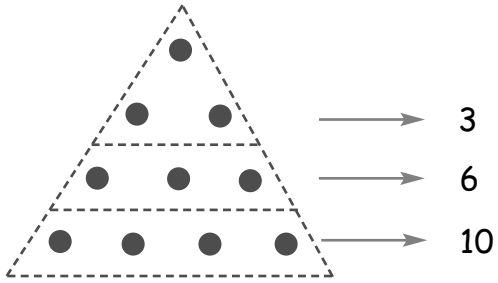


Problem 86

Shape & Space

Level A

This is a picture of some triangular numbers. Can you see the pattern? What will the next triangular number be? What will the sixth one be?



Problem 87

Numbers 1 2 3

Level A

Each of these groups of numbers follow a pattern.
Find the pattern, and write down the next three numbers.

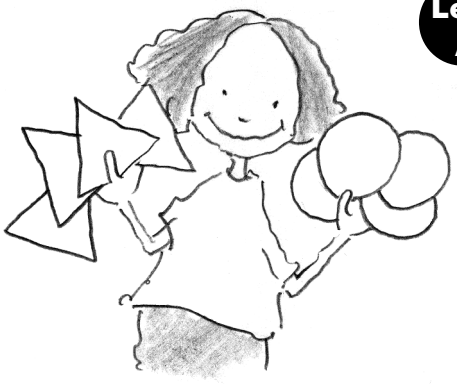
(a) 2 6 10 14 — — —
(b) 11 22 33 44 — — —
(c) 1 3 7 13 21 — — —
(d) 64 32 16 8 — — —
(e) 6 9 8 11 10 13 — — —

PROBLEM SOLVING TASK CARDS - Looking for a Pattern

Problem 88

Numbers 1 2 3

Level A



Sally is doing a maths assignment. She wants the title page to feature a border using different shapes. She has four orange triangles and four yellow circles. Show two different ways can she could set up the border, and for each explain the repeating pattern.

Problem 89

Shape & Space

Level A

Complete the following multiplication patterns. The first one has been done for you.

30	50	18
60	**10**	**6**
15	**5**	**3**

(a)

	4	**7**
	11	**3**

(b)

	2	**8**
	6	**7**

(c)

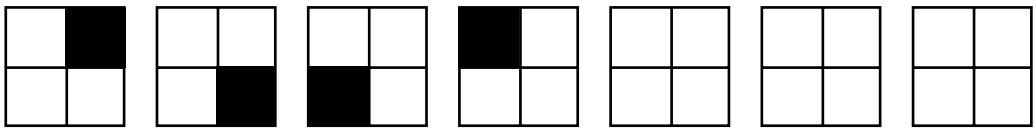
	9	**4**
	5	**12**

Problem 90

Shape & Space

Level A

Look for a pattern in this row of squares.
Shade in the last three squares to finish the pattern.



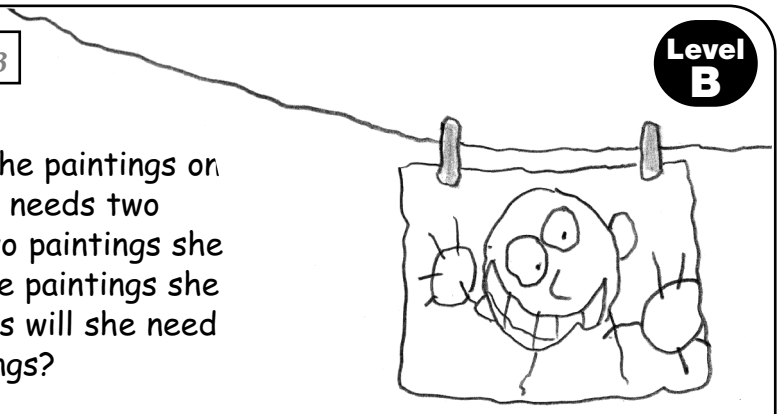
PROBLEM SOLVING TASK CARDS - Looking for a Pattern

Problem 91

Numbers 1 2 3

Level B

When Mrs Patel hangs one of the paintings on the string in the classroom she needs two clips to hold it securely. For two paintings she needs three clips, and for three paintings she needs four clips. How many clips will she need for 15 paintings? For 30 paintings?

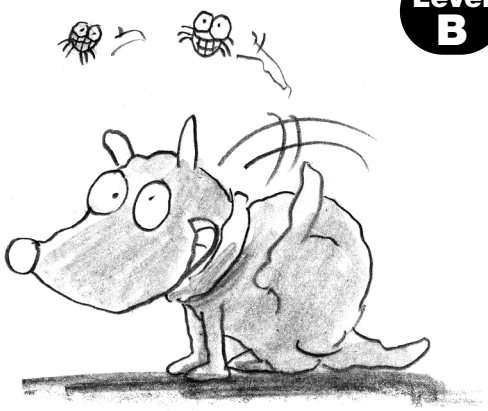


Problem 92

Numbers 1 2 3

Level B

The dog started out with two fleas. By the next week the dog had six fleas, and by the third week there were fourteen. The following week the dog was really scratching, because there were 26 fleas. If the fleas continue multiplying at the same rate, how many fleas will there be in the ninth week?

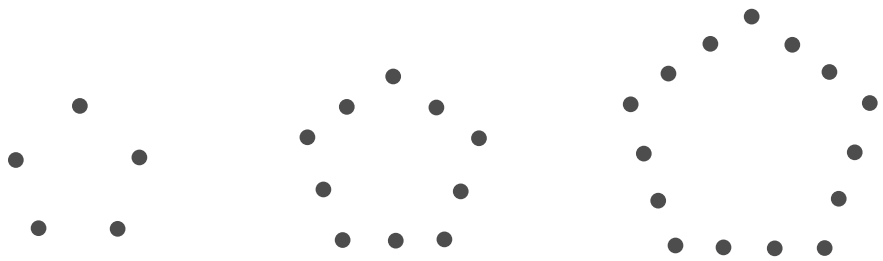


Problem 93

Shape & Space

Level B

What are the next three pentagonal numbers?



PROBLEM SOLVING TASK CARDS - Looking for a Pattern

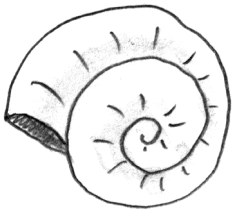
Problem 94

Numbers 1 2 3

Level B

A marine biologist is researching the structure of a nautilus. The shell's pattern follows a sequence discovered by the mathematician Fibonacci. Insert the next three numbers.

0 1 1 2 3 5 8 13 _ _ _

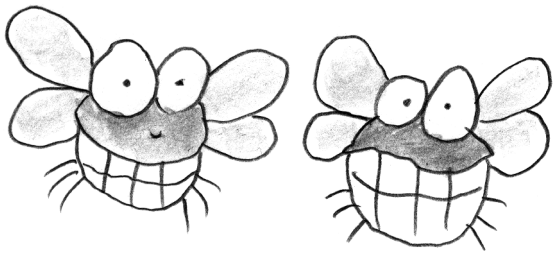


Problem 95

Numbers 1 2 3

Level B

Flies are known to breed at an amazing rate. One day there are two flies; on the next day, five; on the third day, nine; and on the fourth day, 14. How many flies will there be on the eighth day?

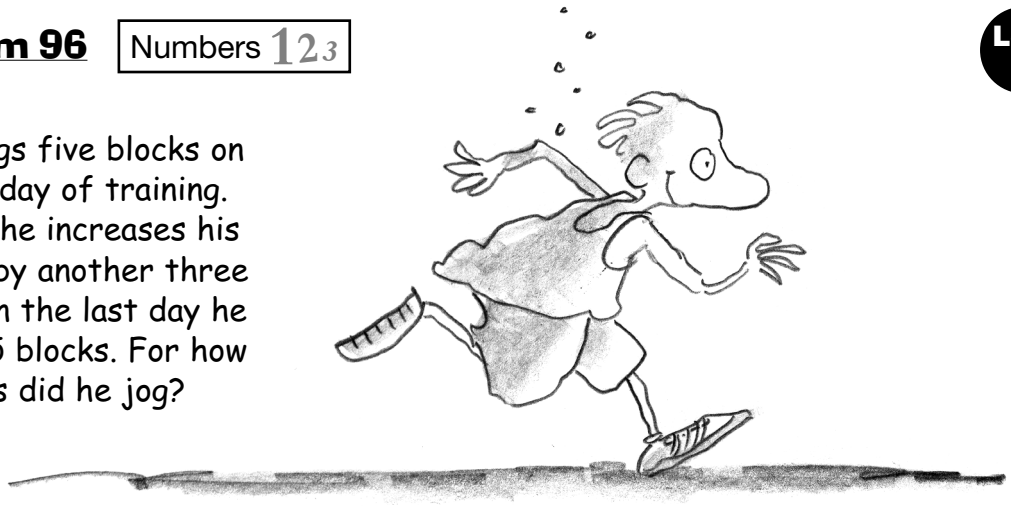


Problem 96

Numbers 1 2 3

Level B

Gerald jogs five blocks on the first day of training. Each day he increases his distance by another three blocks. On the last day he jogged 35 blocks. For how many days did he jog?



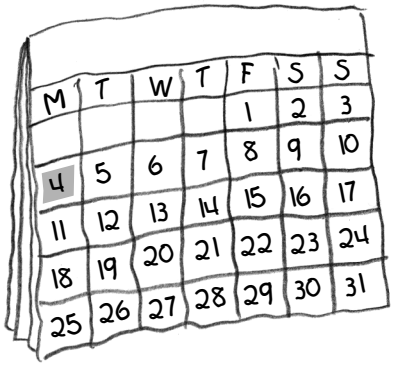
PROBLEM SOLVING TASK CARDS - Looking for a Pattern

Problem 97

Numbers 1 2 3

Level C

Look closely at this month to answer the following question. Mr and Mrs James both do shiftwork. Mrs James is off every sixth day and Mr James is off every ninth day. They are both off tomorrow, Monday the 4th. Will they have any other days where they are off work together this month?



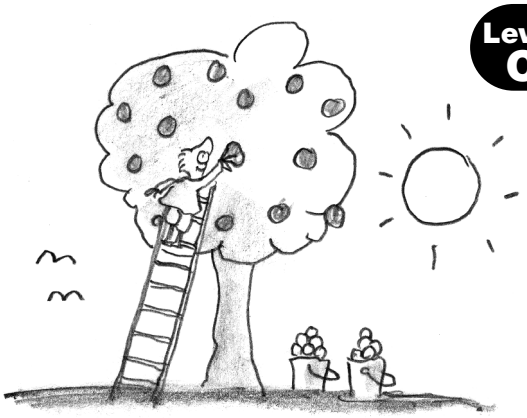
M	T	W	T	F	S	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Problem 98

Numbers 1 2 3

Level C

At the beginning of the season, an orange picker collects one ripe orange on the first day, two on the second, four on the third, and eight on the fourth. How many is he likely to pick on the 10th day, following the same pattern? How many will he have collected by the 15th day?

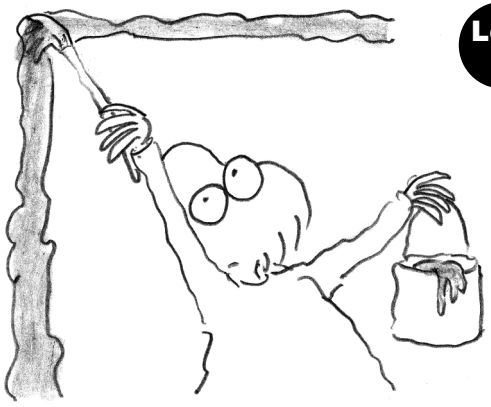


Problem 99

Numbers 1 2 3

Level C

Peter is painting frames of a mural. On the first day he paints three frames. On the second day he has painted five; on the third, eight; and on the fourth day his total is 12. On which day will he have painted 80 frames?



PROBLEM SOLVING TASK CARDS - Looking for a Pattern

Problem 100

Numbers 1 2 3

Level C

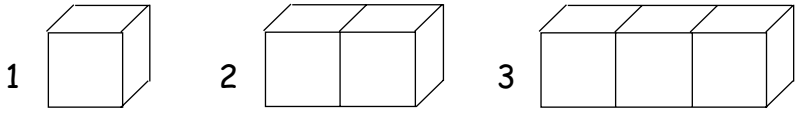
Alana was travelling cross-country. The first day, she travelled 80 kilometres; the second day, 100 kilometres; the third day, 70 kilometres; the fourth day, 90 kilometres; and on the fifth day she travelled 60 kilometres. How many kilometres did she travel on the 13th day?

Problem 101

Numbers 1 2 3

Level C

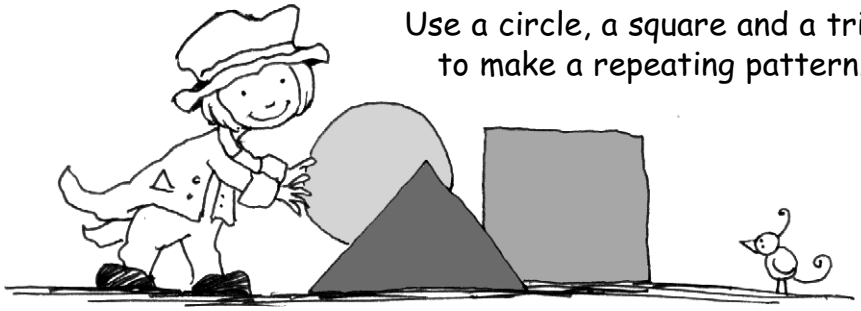
A class has made some wooden cubes. They have decided to paint the faces of the cubes. They are going to group their cubes starting with one cube in one group, two cubes stuck together in the next group, three stuck together in the next and so on. The cubes are always stuck together to form a line. How many faces will they have to paint when four cubes are stuck together? How many when eight are stuck together?



Problem 102

Shape & Space

Level C



Use a circle, a square and a triangle to make a repeating pattern.

Extension: Try using more than three shapes.

Answers to Task Cards Looking for a Pattern

Problem 85

Bucket	1	2	3	4	5	6	7	8
Amount paid	10p	20p	40p	80p	£1.60	£3.20	£6.40	£12.80

Karen was paid £12.80 for the eighth bucket.

Problem 86

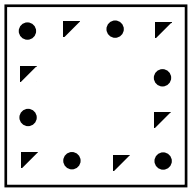
The next number is 15.
The sixth number is 21.
The number of dots in a row increases by one each time.
(Make sure pupils add the next row of dots so as to continue the triangular shape.)

Problem 87

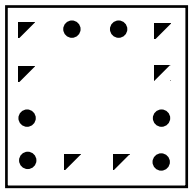
a. 18, 22, 26 (4 is added each time)
b. 55, 66, 77 (11 is added each time)
c. 31, 43, 57 (add 2, 4, 6, 8, 10, 12, 14)
d. 4, 2, 1 (the number is halved each time)
e. 12, 15, 14 (add 2, then subtract 1, then repeat this pattern)

Problem 88

The answers will vary.
Here are two possible answers.



Repeating pattern is CTCT etc



Repeating pattern is TTCC

Problem 89

(a)

12	44	21
28	4	7
33	11	3

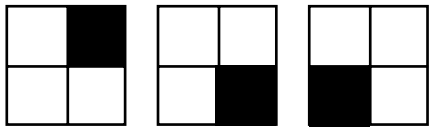
(b)

14	12	56
16	2	8
42	6	7

(c)

108	45	48
36	9	4
60	5	12

Problem 90



Problem 91

Paintings	1	2	3	4	5	15	30
Clips	1	3	4	5	6	16	31

For 15 paintings she will need 16 clips, and for 30 paintings she will need 31 clips.

Problem 92

Week	Fleas	
1	2	
2	6	(+ 4)
3	14	(+ 8)
4	26	(+ 12)
5	42	(+ 16)
6	62	(+ 20)
7	86	(+ 24)
8	114	(+ 28)
9	146	(+ 32)

In the ninth week there will be 146 fleas. (The pattern involves adding multiples of 4.)

Problem 93

20, 25 and 30.

(Make sure the pupils' diagrams follow the same pentagonal shape as the examples given.)

Problem 94

21, 34, 55. Each number in the sequence is the sum of the two numbers that have come before it.

Problem 95

Day	1	2	3	4	5	6	7	8
Number of flies	2	5	9	14	20	27	35	44

(+ 3, + 4, + 5, + 6, + 7, + 8, + 9)

There will be 44 flies on the eighth day.

Answers to Task Cards Looking for a Pattern

Problem 96

Day	Number of blocks
1	5
2	8
3	11
4	14
5	17
6	20
7	23
8	26
9	29
10	32
11	35

Gerald jogged for 11 days.

Problem 97

Yes, on the 22nd.

Problem 98

Day	Oranges
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1 024
12	2 048
13	4 096
14	8 192
15	16 384

He will pick 512 on the 10th day. He will have collected a total of 16 384 oranges by the 15th day.

Problem 99

Day	1	2	3	4	5	6	7	8	9	10	11	12
Number of frames	3	5	8	12	17	23	30	38	47	57	68	80

On the 12th day he will have painted 80 frames.
(+ 2, + 3, + 4, + 5, + 6, + 7, + 8, + 9, + 10, + 11, + 12)

Problem 100

Day	1	2	3	4	5	6	7	8	9	10	11	12	13
Distance travelled (km)	80	100	70	90	60	80	50	70	40	60	30	50	20

Alana travelled 20 kilometres on the 13th day.
(The pattern involves the two operations + 20, –30.)

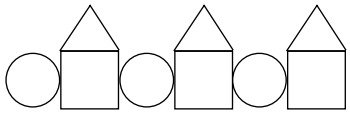
Problem 101

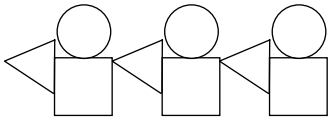
Number of cubes stuck together	1	2	3	4	5	6	7	8
Number of faces that can be painted	6	10	14	18	22	26	30	34

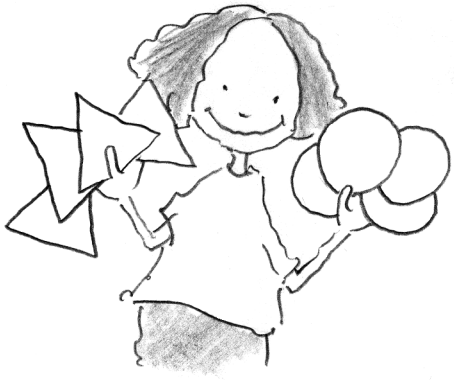
The number of faces that can be painted goes up by four each time. Four cubes stuck in a line will have 18 faces to be painted. Eight cubes stuck in a line will have 34 faces to be painted.

Problem 102

Teacher to check. Here are two possible answers:







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