Mathletics

Problem Solving

Problem Solving
– Series D & E

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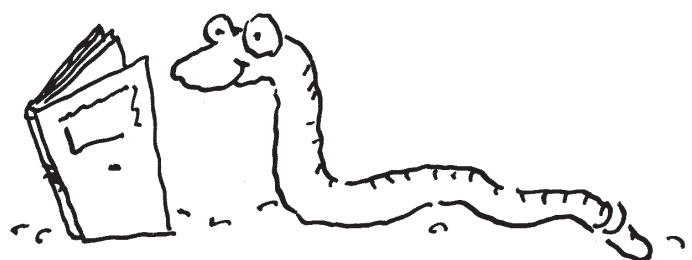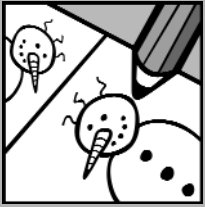
Draw a diagram

Rationale

Drawing a diagram helps children to demonstrate what they know about a problem. By drawing a picture of the data, they produce a concrete version. The problem itself becomes clearer, and a solution becomes apparent. Ideally, in time, students will be able to deduce an equation for future use. However, this is not the aim of these tasks.

Teaching *Draw a Diagram*

The following items should be considered in the teaching of problem solving using Draw a diagram.

A Types of diagrams which are commonly used.

B The 4 main skills students are expected to master.

A Types of diagrams used

1 Number lines where ⌢ will show values on the line.

2 Pizzas (for fractions). Diagrams must show equal parts to be viable.

3 Forms of pictures — views from above.

| tree | posts | house | people | car | animal |
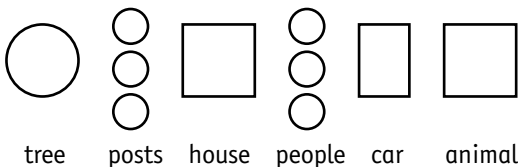
4 Tree Diagrams will illustrate the patterning of data where several objects are related to one other, eg shirts with shorts.

B Main skills

1 Choose the diagram type

Each page gives practice at one diagram type. Students should review the type of problem and the method of diagramming. For practice give oral problems to discuss types of diagrams to be used. Solve by demonstrating the diagram on the board.

2 Convert data to a visual format

Students should use plenty of space and leave the diagram in place for marking and sharing. Credit may be given for a good attempt at drawing the diagram to encourage students to place importance on 'process' as well as 'solution'.

3 Check the solution

The solution should be checked by going back to the original data to be sure that it has all been correctly understood.

4 Explain the solution

The ability to verbalise the solution and answer questions about it, demonstrates good mathematical understanding. eg Why did you choose the tree diagram? How did you show the frog's leaps?

Worksheet 1
NUMBER LINE DIAGRAMS 1

There is a selection of diagrams from which the students choose. This is aimed at teaching the students to obtain meaning from number lines.

In oral lead-up work, place a number line on the board and have students tell a story to match it. Verbalising the story behind any number line is important as they will then be able to judge which number line tells the correct story.

Worksheet 2
EVERYDAY TASKS 1

It is important for the students to highlight the main pieces of data and match them to the appropriate diagrams. Once again, giving oral practice as a class will assist students to see the correct meaning of diagrams and what they are saying. Verbalising what the diagram looks like and what it portrays is an important skill for understanding.

Worksheet 3
FRACTION FUN

Fractions and pizzas go well together because of the ease of cutting up circles to make fractional pieces. Fractions are just names for objects — 1 quarter is just like 1 pineapple or 1 tree. 'Quarter' is just a name for 1 of 4 equal parts. 11 quarters can be counted up and since 4 of them make 1, then 11 of them will make $2\frac{3}{4}$.

Worksheet 4
PLAYTIME

Students will want to solve these without doing the drawing, but insist on the drawings as it reinforces the correct data from the problem. Check the results by having students explain their diagrams.

Worksheet 5
NUMBER LINE DIAGRAMS 2

These diagrams tell the story with visuals, not words. The first two problems have the beginnings of the solution as assistance, but 3 and 4 leave the task to the students. Highlight important data and check that the diagram relates to the narrative at the end.

Worksheet 6
EVERYDAY TASKS 2

These diagrams can be related to finding factors of given numbers. Also, some students can use these diagrams to illustrate their tables of multiples.

Worksheet 7
THE TROPHY SHELF

Organised rearranging should be encouraged. Once the order for the first row is decided, for the second row there should be only one change — eg (a, b, c; a, c, b; – a at the beginning) (b, c, a; b, a, c; – b at the beginning) (c, a, b; c, b, a – c at the beginning).

Worksheet 8
TREE DIAGRAMS

This may be a new concept for Years 3 and 4. Talk your students through the example given. Explain that the benefit of these drawings is that there is organisation of the data, and the record stays in place for checking later. This visual presentation of written data helps students see how the problem is being solved.
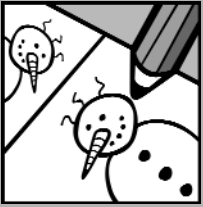
Name *Date*

Number line diagrams 1

Which number line correctly shows the way to work each problem?

1 A flea makes 4 jumps of 15 cm, 17 cm, 18 cm and 20 cm.

How far has it jumped?

Solution

a

0   20   40   60   80   100   120   140

b

0   20   40   60   80   100   120   140

c

0   20   40   60   80   100   120   140
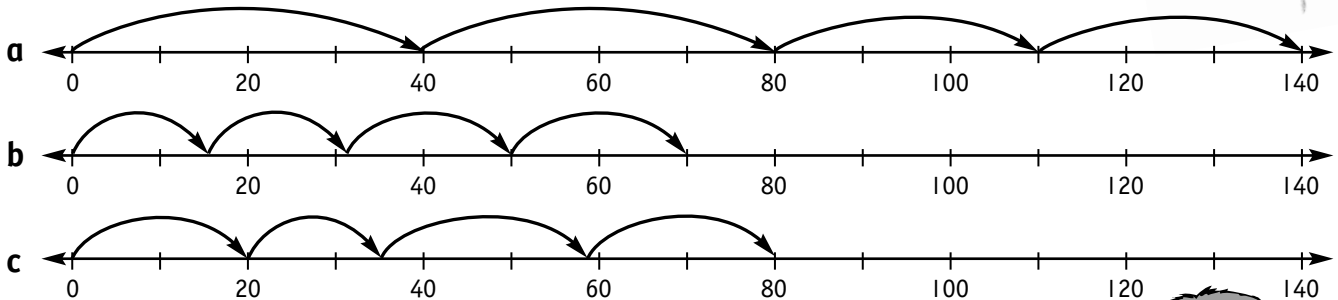
2 John had 50 cards, lost 17 and was given 8 more.

How many does he now have?

Solution

a

0   10   20   30   40   50   60   70

b

0   10   20   30   40   50   60   70

c

0   10   20   30   40   50   60   70
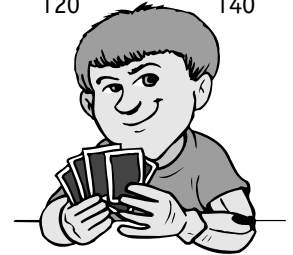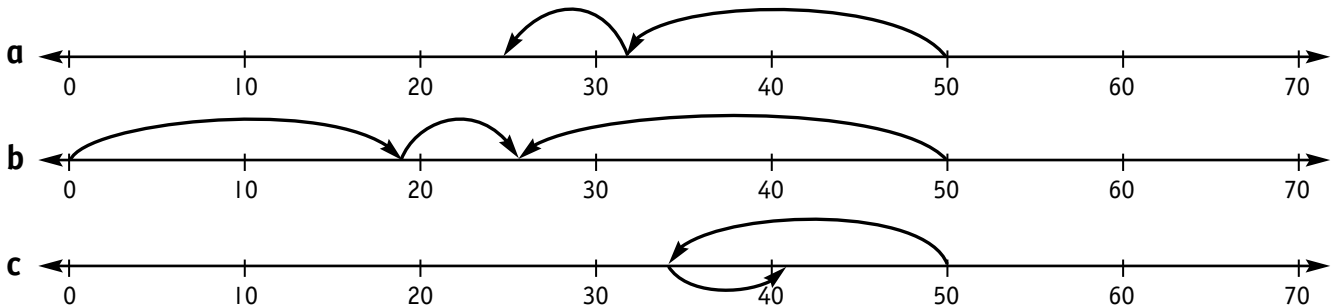
3 We were 800 km from home. Dad drove 250 km towards home one day, and 324 km the next. How far were we still from home?

Solution

a

0   500   1000

b

0   500   1000

c

0   500   1000
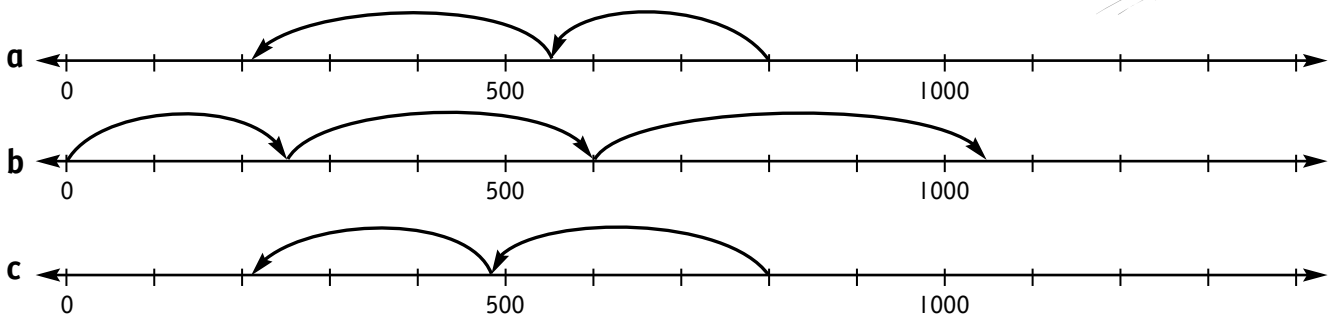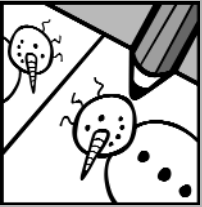
Name   *Date*

Everyday tasks 1

Which diagram correctly shows the answer to each puzzle?

1 If I can pack 6 cubes into a rectangular box, how many cubes can I pack into a box twice as long and twice as wide as the original? _____

a

b

c
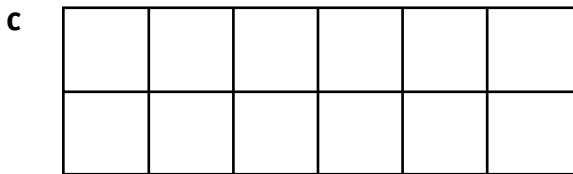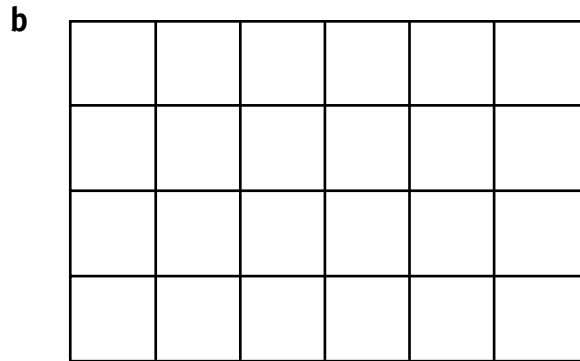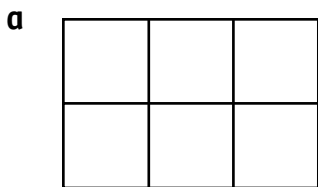
2 I place a blue chalk mark at the beginning of my first step, then a blue chalk mark at the end of each step.

How many blue chalk marks will I make for 8 steps? _____

a ✕   ✕   ✕   ✕   ✕   ✕   ✕   ✕   ✕

b ✕   ✕   ✕   ✕   ✕   ✕   ✕   ✕
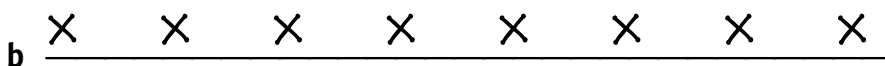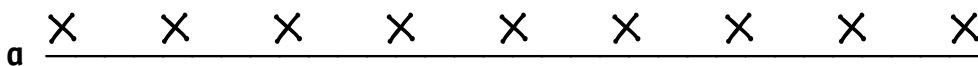
3 I have to put 5 posts along each side of my square cubby house, including the corners.

How many posts will I need? _____

a = 24   **b** = 20   **c** = 16
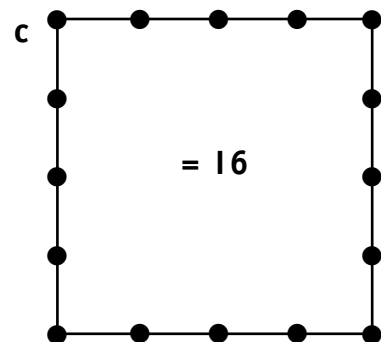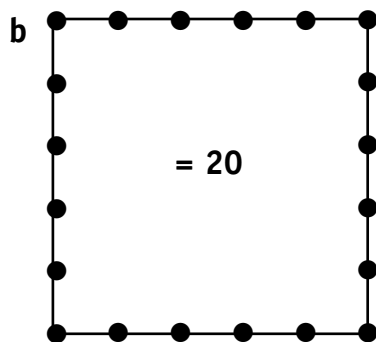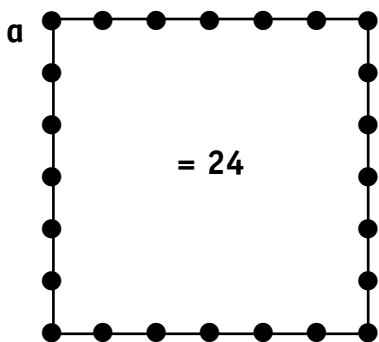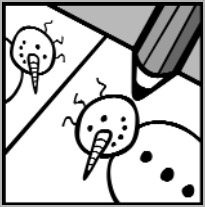
Fraction fun

Name   *Date*

It is best to draw diagrams when fractions are involved. Choose which diagram is used to illustrate and solve each problem.

1 If I have to give $\frac{1}{4}$ of an orange to each of 11 girls in my team, how many oranges will I need? _____

a = $2\frac{3}{4}$

b = 11

c = 6
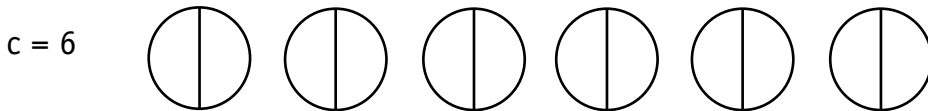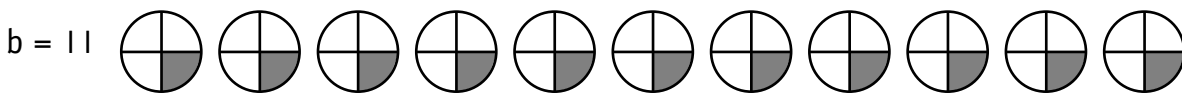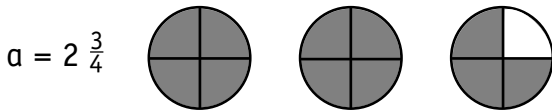
2 If I cut $2\frac{1}{2}$ pizzas into quarters, how many $\frac{1}{4}$ slices will I get? _____

a = 10

b = 10

c = 10
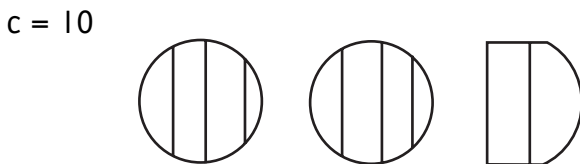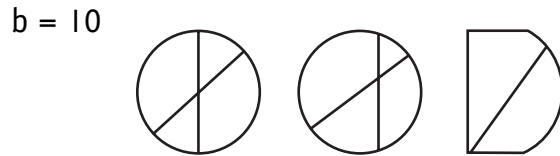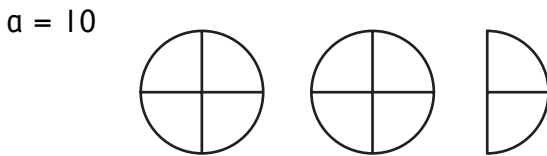
3 We need to use $\frac{1}{3}$ m of ribbon to tie each parcel. How many metres of ribbon will we use to tie 5 parcels? _____

a   1 m   1 m

b

c
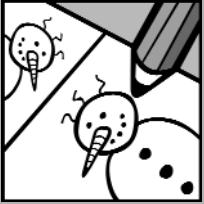
Name   *Date*

Playtime

Who likes to experiment when they play? Everyone!

1 Jack wants to build a tower with his blocks. He begins with 8 blocks on the bottom row and puts one less block on each row as he builds. How many blocks will he need to build his tower?

Answer

2 When Jack lines up his best Trumper Trucks, the line stretches right across the floor. In the centre of the line is his favourite, 'Trekker', and there are 6 others to its right. How many trucks are in the line?

Answer

Draw the line of trucks.

3 Jack races his trucks and the loser has to retire. He has 16 trucks racing, and they race off in pairs. How many races will he have before he gets the winner?

Answer
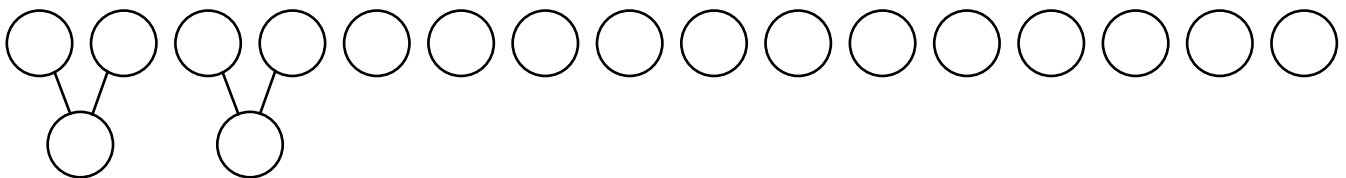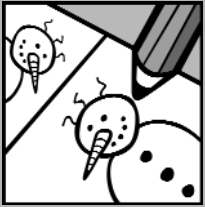
Name   *Date*

Number line diagrams 2

Draw diagrams to help you see how to solve these problems, using types of number lines.

1 Froggy Frog has made 3 leaps of 2 metres away from his pond then he makes 4 leaps of 1 metre each back towards his pond. How far is he from his pond now? _____

Complete the diagram.

2 m   **2 m**   **2 m**

pond
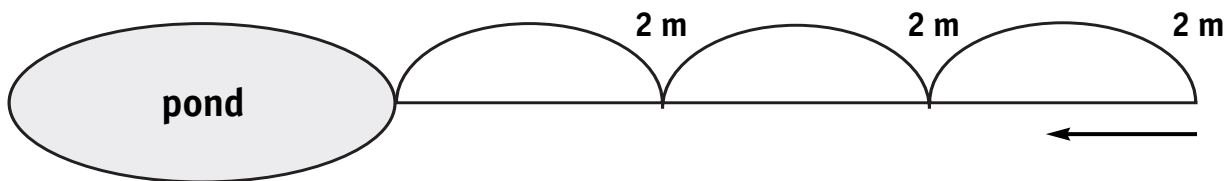
2 Year 4 raised £12 on Monday, £6 on Tuesday, spent £5 on advertising Wednesday, raised £12 on Wednesday and another £10 Thursday. Show this on the number line.

0   **10**   **20**   **30**   **40**   **50**
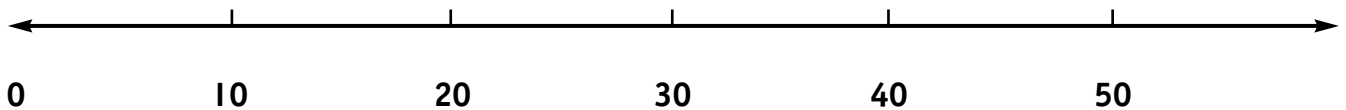
3 Bobby Beetle walks 2 m each day but has to rest every fourth day. How far from home will he be in 10 days? Show the solution on a number line.

Home
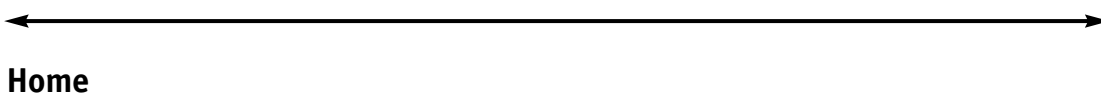
4 Evie began her project at 4 pm. She took 20 minutes to assemble all the materials, 10 minutes to make a plan, 15 minutes to lay out the background, 40 minutes to paint it and 20 minutes to add the finishing details. When did she finish her project?

(1 section = 10 mins)

4 pm
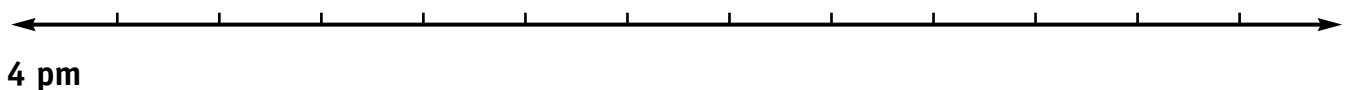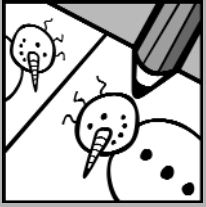
Name   _Date_

Everyday tasks 2

1 After the Nifty Knitters had knitted many squares, they asked the Speedy Sewers to sew them into rugs. However, they only told the Speedy Sewers to put 36 squares in a rug, not how they should be arranged. Every rug turned out differently. Draw diagrams to show how many different rugs were made using 36 squares in each rug.
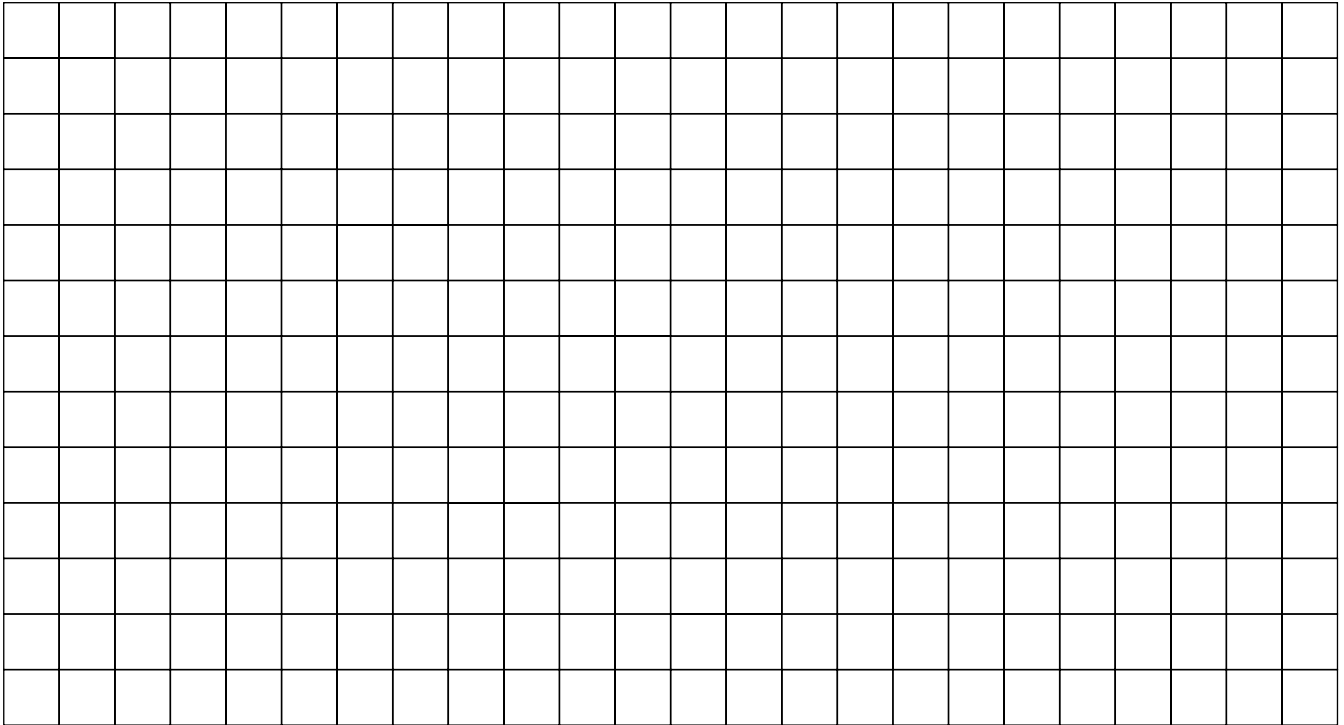
2 We had to pack new ping-pong balls into packages. We found that there were many different ways of packing 24 balls in a box. Draw the different ways the ping-pong balls could be packed in their single-layer boxes.
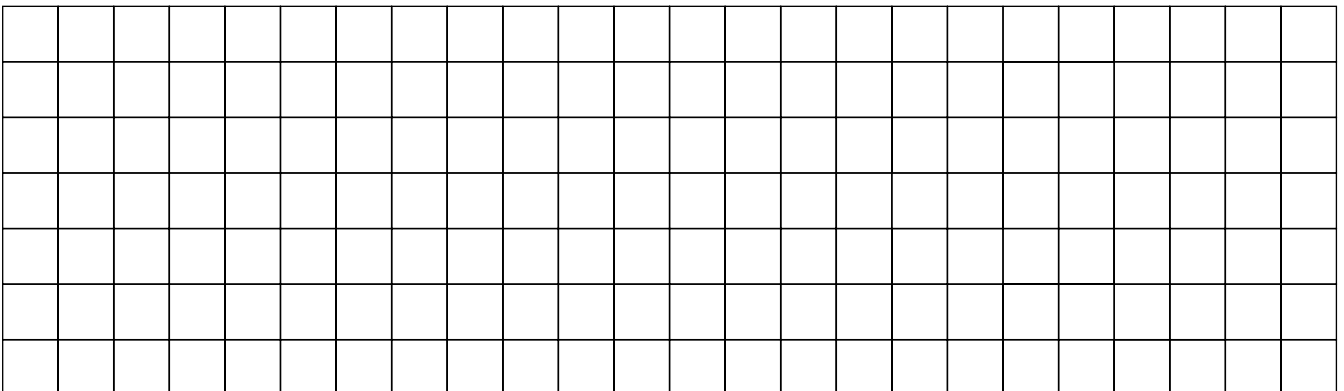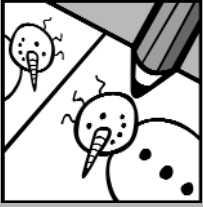
Name   *Date*

The trophy shelf

The Affaletic family plays many sports between them and they are amazingly successful at winning. They have many winner's trophies to keep.

1 Pedro Affaletic plays soccer and he won the Best Player Award in 2005, 2006 and 2007. How many different ways can he arrange them on the shelf before they will stand in the same place again? The first row has been done for you. Draw the different arrangements — label the years.

'05   '06   '07
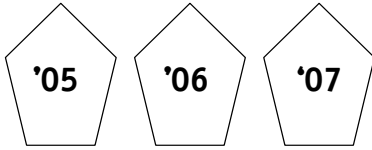
2 Angie Affaletic is a champion diver. Her trophies are for the 3 m Dive (1), 5 m Dive (2), Springboard Dive (3) and Synchronised Dive (4). How many ways can she arrange her trophies? The first row is done for you.

1 2 3 4
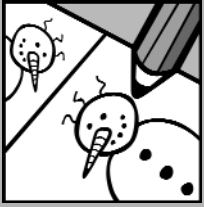
Name   *Date*

Tree diagrams

Use tree diagrams when you need to work out how many combinations of a set of options there are.

eg Jordan always likes tomato or cheese in his sandwiches. He will have lettuce, ham or avocado with the tomato or cheese. How many different choices does he have for sandwiches for his lunch?

TOMATO   **CHEESE**

tom & lettuce   tom & ham   tom & avocado   cheese & lettuce   cheese & ham   cheese & avocado
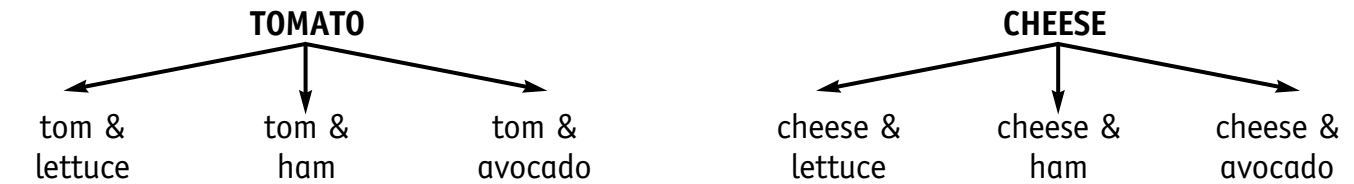
= 6 different sandwiches.

1 Ralph the Radical Roof Builder builds roofs of tile or aluminium. He paints them either blue, red or brown. Draw your own tree like the one above to show how many different looking roofs he can produce.

TILE   **ALUMINIUM**

= _____ different roofs.

2 Grandma wanted to name her new puppy either Kandy or Krispy as its first name and Bandi, Dancer, Fancy or Skipp as its second name. How many different names does she have to choose from? Make your own tree to illustrate her choices.

= _____ choices.

Look for patterns

Rationale

The discovery of patterns in number makes mathematical relationships more interesting and engaging for young students. It unlocks many solutions to problems. Teaching patterns lays a foundation for the teaching of algebra. The ability to manipulate numbers using pattern formations, in order to solve problems, leads to a strong understanding of mathematical thinking.

Teaching *Look for Patterns*

The following items should be considered in the teaching of problem solving using Looking for Patterns.

A The types of patterns possible.

B The 4 main skills students are expected to master.

A Types of patterns possible

Discuss and record the types of patterns we see everyday – shapes, sizes, colours, numbers, letters, positions and combinations of these.

Have students give examples.

B Main skills

1 Make up and record

Students must be able to generate a pattern. P1, P5, P6, P8.

On large sheets of paper make up patterns using the criteria above.

Using magnets, display several at a time on a board. Discuss – Is it a pattern? Why? Why not?

2 Describe a pattern

Students learn to describe a pattern in words to convey its nature.

a Using words, explain the pattern. eg A square is followed by a triangle, then a circle and the pattern repeats.

b Write this down and check if others understand.

c Use position words and ordinal numbers in descriptions of patterns.

3 Complete a pattern given by someone else

Students determine the pattern and add to it.

Give the next 1 – 5 items in the pattern to demonstrate understanding of the pattern.

4 Give the rule for the pattern

Express the description in the form of a rule.

Explain in abstract terms how the pattern is formed. eg The sequence square, triangle, circle is repeated, or +2 + 4 and repeat, or subtract 0·5.

A pattern may be in an arrangement or in the form of a sequence.

eg **1, 2, 4, 8, 16**   or
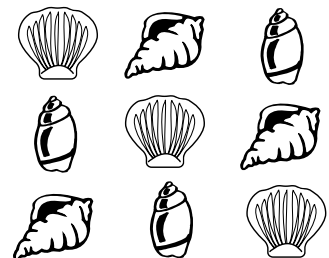
Worksheet 1
GRID PATTERNS

Children must draw their own patterns. They should be simple so that they can be repeated easily.

Vocabulary: ordinal numbers, position words, names of shapes – square, circle, triangle; names for lines – wavy, oblique, diagonal, repeat

Worksheet 2
STAMP PATTERNS

Students complete patterns using letters for the stamps to be placed.

Vocabulary: alternate, every second, under, over, next, last, middle, ordinal words

Worksheet 3
BOOKS ON THE SHELF

Students complete patterns with missing terms from the box.

Students complete patterns with missing terms which they give themselves.

Students order terms to form a pattern.

Vocabulary: as for Work sheets 1 and 2

Worksheet 4
NUMBER PATTERNS

Students complete patterns and give their rules.

Vocabulary: Use terms such as 'add 4', 'subtract 3', 'halve' to express the rule.

Students choose which number is out of place.

Vocabulary: multiples, odd, even, counting by, divisible by

Students sort numbers by qualities.

Worksheet 5
COLOUR WAYS

Students colour number patterns on a grid according to directions.

Vocabulary: alternate, diagonal, straight, every cell

Worksheet 6
BEAD PATTERNS

Students continue a given pattern of shapes and answer questions about the pattern.

Students give a rule and determine how many repeats of a pattern can be made.

Worksheet 7
LEAF PATTERNS

Students determine which shaped/sized leaf is missing from the pattern.

Vocabulary: large, small, alternate, diagonally, odd, even, full-, half-, quarter-turn

Worksheet 8
TOSS THE DICE PATTERNS

Supply counters.

The rules for the game are on the page and each child will have a copy. Review rules with class before beginning to play.

Name

Date

Grid patterns

Here's a tile pattern for the floor in Toby's playroom.

Use shapes or lines on your blank tiles to make your own patterns. Describe them.

1

_____

2

_____

3

_____

Name   *Date*

Stamp patterns

Freddy, the zoo keeper, likes rearranging his animal stamp collection. Sadly, he has forgotten how this pattern was supposed to finish. Help him by writing the letters for the missing stamps in their right places.

1

How is the pattern made? _____

2

How is this pattern made? _____

Name   *Date*

Books on the shelf

1 a Some labels have disappeared! Replace the missing labels.

AA	BA	CA	____	EA	____	GA	HA	____
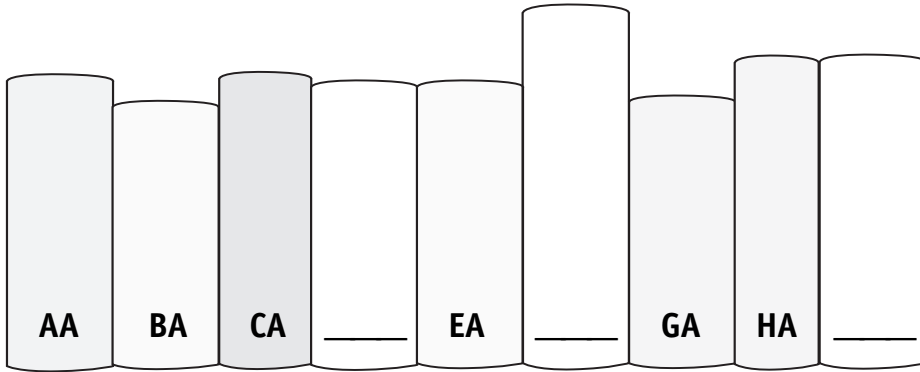
Choose the
correct letters
for the spaces.

AD ____ KA

DA ____ IA

DF ____ FA

b How is the pattern made? _____

2 a Now books have disappeared! Write in their numbers to help Libby, the librarian.

3.10	3.12	____	3.16	3.18	3.20	____	3.24	3.26	____	____	____
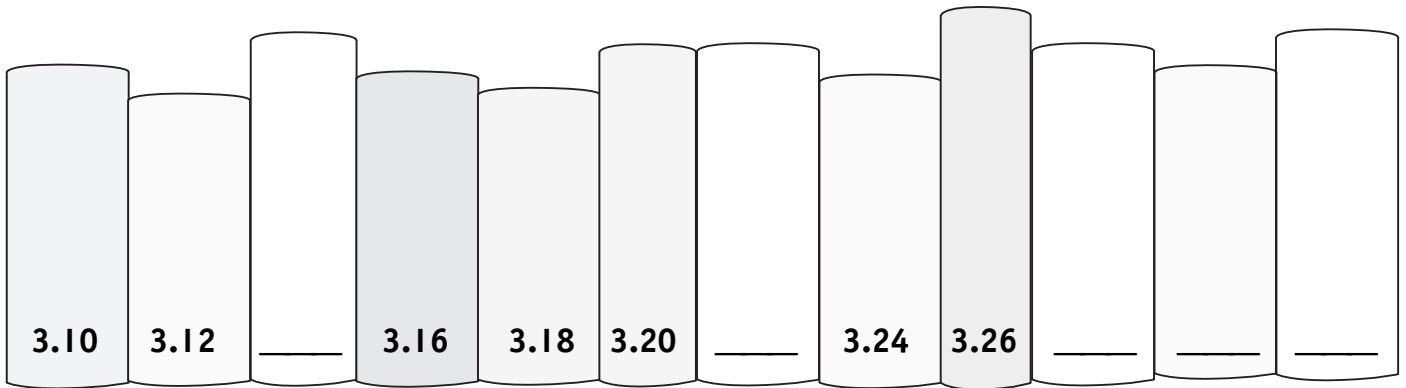
b How is the pattern made? _____

3 a Give Libby help by labelling these books in their correct order.

15N, 15L, 15P, 15O, 15T, 15S, 15Q, 15M, 15R

____	____	____	____	____	____	____	____	____
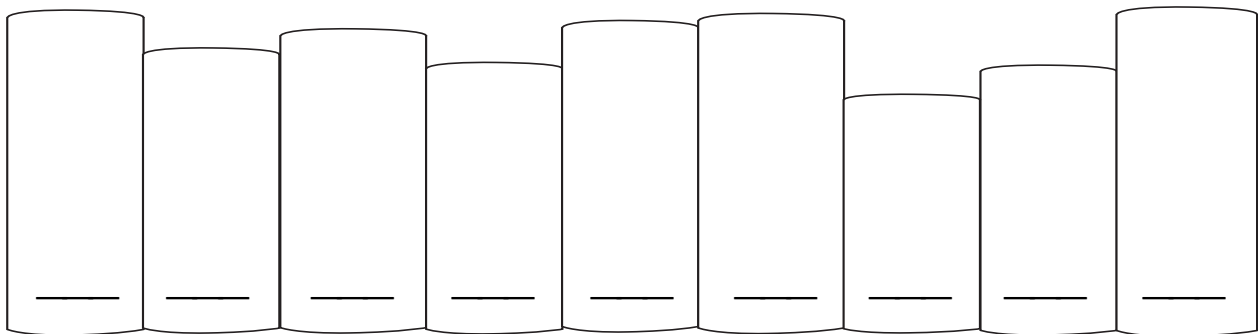
b How is this pattern made? _____

Name   *Date*

Number patterns

Professor Proseed can do anything with numbers. Best of all, he loves to put them into patterns, but sometimes his numbers get up to mischief and are lost.

1 Complete each number pattern. Give the rule for the pattern.

    a 12, 14, 16, 18, _____, _____, _____   _____

    b 25, 23, 21, 19, _____, _____, _____   _____

    c 10, 30, 50, 70, _____, _____, _____   _____

2 Circle the number that does not fit into the Professor's pattern. Give your reason.

    a 15, 20, 25, 30, 35, 53, 45   _____

    b 1, 3, 5, 7, 10, 11, 13   _____

    c 20, 30, 40, 52, 60   _____

> Whole numbers which are multiplied by 10 end in zero.
> Whole numbers which are multiplied by 2 are even.
> Whole numbers which are multiplied by 5 end in 5 or zero.

3 Look at these numbers.

    115, 70, 35, 20, 16, 24, 65, 30, 120, 42, 85

Sort them into the correct columns. Some belong in more than one column.

a Multiples of 10	**b Multiples of 2**	**c Multiples of 5**
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

4 What is special about 70, 30, 120 and 20? _____

_____

Name | *Date*

Colour ways

1 a Colour the *threes pattern* in your favourite colour.

b Colour the *fives pattern* in a contrasting colour.

c Choose another pattern of your own to colour.

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	32	33	34	35

2 Describe the patterns.

a *the threes pattern* _____

b *the fives pattern* _____

c your own pattern _____

3 a Using yellow, colour in 1 then every third box after that.

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	32	33	34	35

b Describe the pattern _____

Name   *Date*

Bead patterns

1 a Beddie Beader gets hopelessly confused and loses her place making necklaces. Help her! Continue the pattern of beads until you have used 6 squares.
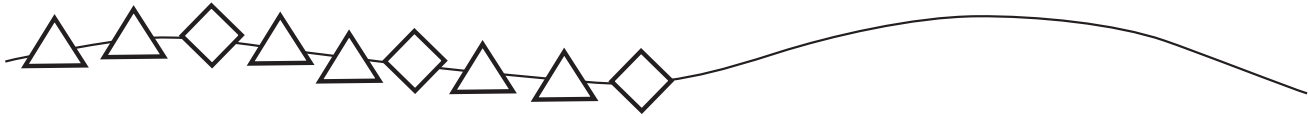
  b The pattern rule is 2 _____ , 1 _____ repeated.

  c For every square used, _____ triangles are used.

  d If 5 squares are used, _____ triangles are used.

  e If 12 triangles are used, _____ squares are used.

2 a To help Beddie again, continue this pattern of the beads until the end.
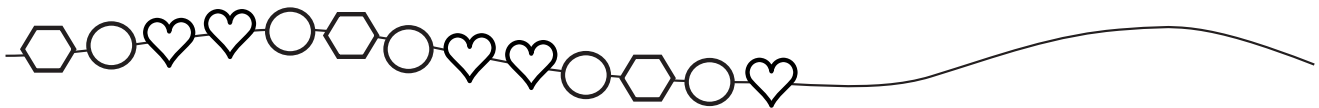
  b The rule for the pattern is _____

  c The pattern repeats after _____ beads have been used.

  d In each repeat of the pattern, _____ hearts are used, _____ hexagons are used
and _____ circles are used.

  e How many repeats of the pattern could Beddie make with 30 hearts? _____

3 a Beddie needs more ideas for her necklaces. Use all these beads to make your own pattern for her to copy.
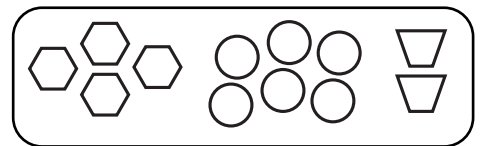
  b The rule for my pattern is _____

  c To add one more repeat of the pattern, you would need _____ more ◯ beads?

  d How many ◯ beads are used for every ▽ ? _____

  e How many ▽ beads are used for every 2 ⬡ ? _____
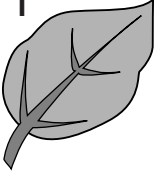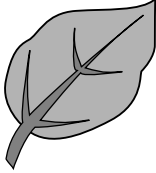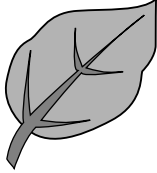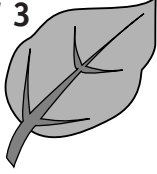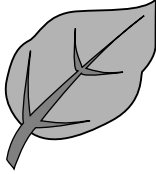
Name

Date

Leaf patterns

1 Pete likes to keep his leaf collection in perfect order. Place the letters for the missing leaves in their boxes to help him complete this pattern.

ROW 1			
ROW 2			
ROW 3			

A

B
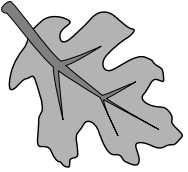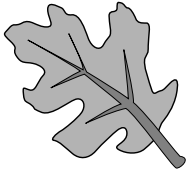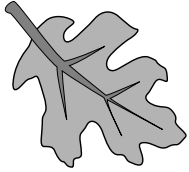
How did you work that out?

_____

_____

2 These leaves thought they would trick Pete but with your help they haven't a chance!
Place the correct letters for the missing leaves in the squares. Tell how you worked it out.

A

B

_____

Name   *Date*

Toss the dice patterns

A game for 2 players. Each has a copy of the player card.

- Label your card with your name.
- Player 1 throws 3 dice (eg 2, 6, 3) and records the results in order from lowest to highest on their grid (2, 3, 6).
- Player 1 then makes up and records a rule for the pattern they have made. Keep the rule a secret. (eg 2 x 3 = 6)
- Player 2 must try to guess the rule and give the next 2 terms in the pattern. (eg 3 x 3 = 9, 4 x 3 = 12) If they can do this, they take a counter for a point. If they can't, Player 1 gets the point.
- Player 2 now throws the dice and records on their grid. The game continues until each has had 5 turns.
- If the same pattern is thrown, the player must make up a pattern different from the one that has been used in a past throw, eg 2 + 3 + 6 = 11, 2 + 3 + 6 + 11 = 22.

Player card

Name _____

Die 1	Die 2	Die 3	Rule

Act it out

Rationale

Act it Out is similar to Draw a Diagram in some ways, but it involves the use of objects to clarify the solving of the problem. The use of objects makes it easy to move data around without committing pencil to paper and needing to erase or start again. Such things as squared paper, lollipop sticks, dice, blocks, cubes, pattern blocks, cards, string, measuring equipment, water, sand, as well as pencils and paper, scissors and glue will be required for these activities.

Teaching *Act It Out*

Follow these steps to teach Act It Out.

A Choosing suitable objects to use

B 4 main skills students are expected to master

A Choosing suitable objects to use

1 Squared paper – when designs, regular layouts, areas or perimeters are part of the problem.

2 Coloured pencils – when data needs to be shown differentially.

3 Blocks, cubes – are usually part of the given data of the problem.

4 Cards – when small pieces of paper need to be moved about separately.

5 Measuring equipment – when experimentation with various sizes is necessary.

6 Water, sand – often used in measuring mass and volume.

7 String – when length is part of the data.

B Main skills

1 Dexterity

Young children often find it frustrating to move small parts around a limited space. Use larger objects which are manageable for small fingers.

2 Level of understanding and ability to read instructions

Be sure to explain what is required in tasks that have complex instructions. The rules must be followed fully.

3 Expressing the solution and checking

Students need to demonstrate their solution as they will have no evidence of moves made with concrete objects.

4 Perseverance

For some students this is a real issue as many only want to finish quickly with a solution at the ready. The need to begin again, try another way, learn something and apply what is learned to another attempt is paramount here. Reward students who keep working to get a solution.

Handy hint

The 8 pages in this section could be placed at Learning Centres which students visit in rotation or according to a timetable. This would facilitate individual work and the teacher's supervision of completed tasks.

Worksheet 1
HELP THE ZOO

After they manipulate the lollipop sticks to solve the placement of the fences, have the students draw in the fences for the solutions.

Worksheet 2
BUILD IT BIGGER

This will prove to students that when you double the dimensions of a shape, you multiply the number of units in its measurements by 8, not by 2. Multiplication by 3 numbers can be explored here. Factors and multiples can also be reviewed in this work.

Worksheet 3
BLOCK MOVES

There will be space between blocks in #1 and #2. Studying the guidelines for each solution is necessary. Students should have each solution checked by the teacher before moving onto the next. Encourage them to check the data with the solution before claiming they are finished.

Worksheet 4
PENTOMINOES

These are interesting shapes with which students should become familiar. They may later use pentominoes to make other shapes, eg a rectangle, a square.

Worksheet 5
CARD TRICKS

Cards are easy to use in acting out a solution. These problems may be easy for older or more capable students to work out mentally, but for young or less able students, the acting out will assist their understanding of the problem situation and the mathematical strategy used in the solution. The terms *square number* and *triangular number* can be introduced.

Worksheet 6
TRAINING FOR THE GAMES

Markers such as those from another board game or small counters may be used. Two students can work on this together, each taking the part of a runner.

Worksheet 7
FIND YOUR WAY

Moves in this game are made in a similar fashion to the old game of Boxes. Players take turns to draw a line from one dot or cross to another (dot or cross), depending on their path choice. They will join their lines where possible but can be cut off by the other player. When this happens they should seek another path.

Worksheet 8
MATCHSTICK PROBLEMS

Solutions need to be checked as they are finished. Encourage students to persevere.

Name   *Date*

Help the Zoo

Keepum Happy Zoo has six animals to enclose and each animal must have a tree in its enclosure. They wish to build only three inside fences.

Use lollipop sticks as fences to help them plan where to put the inside fences.
There are two different solutions.

1

= tree
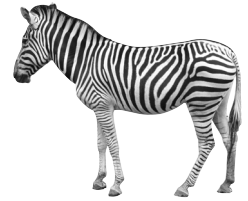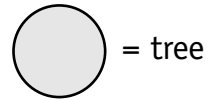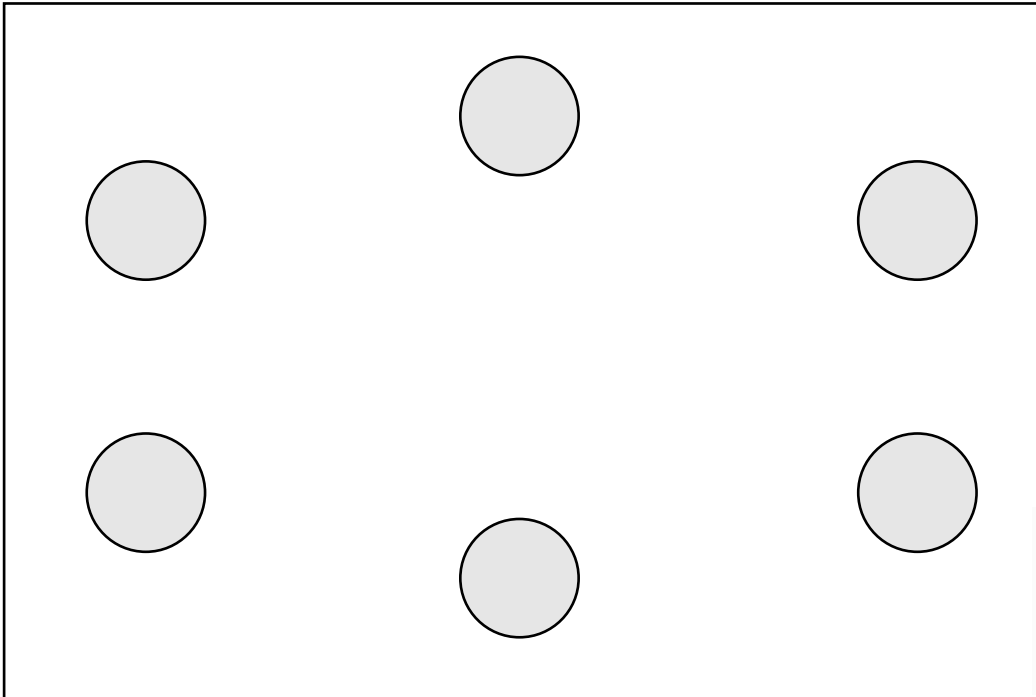
2
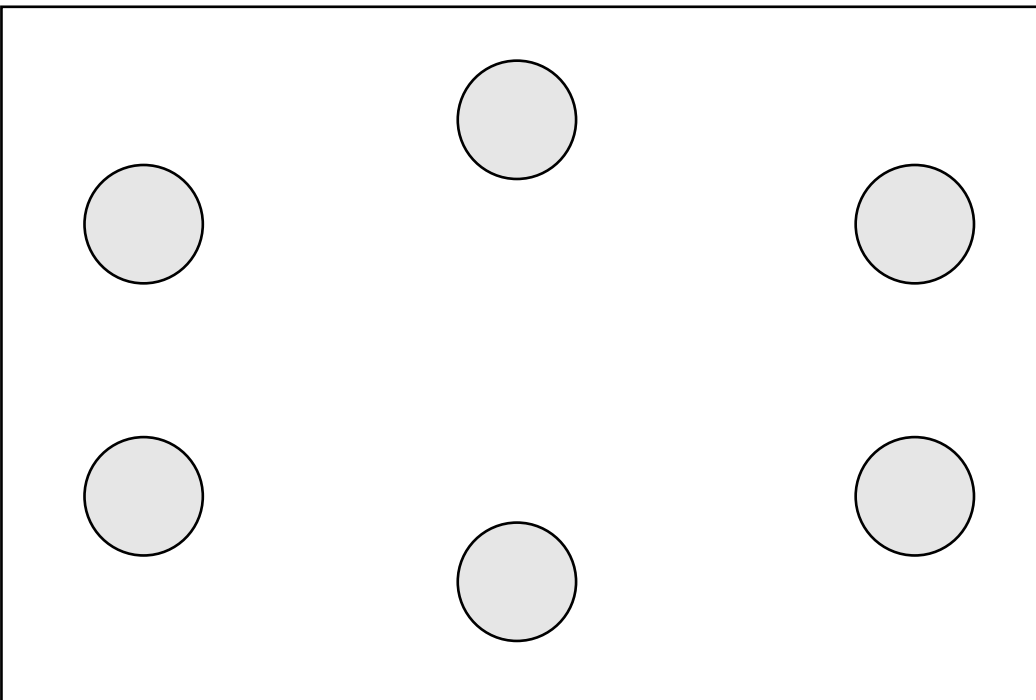
Name   *Date*

Build it bigger

Use shorts or centicubes to build your shapes.

1 Danny built a rectangular prism 2 cubes long, 1 cube wide and 3 cubes high. Benny made his twice as long, twice as wide and twice as high. How many cubes did he use?

Answer = _____
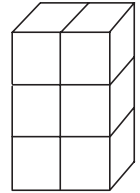
Write a number sentence to show how many cubes Benny used.

_____ long x _____ wide x _____ high = _____ cubes

2 Benny made another rectangular prism 3 cubes long, 2 cubes wide and 5 cubes high. Danny built his 1 cube wider and twice as high. How many cubes did he need?

Answer = _____
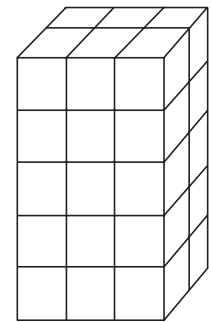
Write a number sentence to show how many cubes Danny used.

_____ long x _____ wide x _____ high = _____ cubes

3 Franny decided to build her rectangular prism 10 cubes long, 6 cubes wide and 6 cubes high. She used 360 cubes. There weren't many left. Her little sister could only build one half as long, half as wide and half as high. How many cubes would she need?

Answer = _____

Write a number sentence to show how many cubes she used.

_____ long x _____ wide x _____ high = _____ cubes

4 How many different rectangular prisms can be built with 36 cubes?

Answer = _____

Name

Date

Block move

Use blocks to make these arrangements. A block is touching another if a flat surface is touching another flat surface. Edges and corners touching are also allowed. Draw your arrangements.

1 Arrange 10 blocks so that each touches two and only two other blocks.

2 Arrange 10 blocks so that each touches three and only three others.

3 Arrange 10 blocks in three piles so that there are only even numbers in each pile.

Number sentence: _____

4 Arrange 11 blocks in three piles so that there are only odd numbers in each pile.

Number sentence: _____

5 Arrange 12 blocks into 2 piles so that there are 3 times as many blocks in one pile as in the other.

Number sentence: _____

6 Arrange 12 blocks into 2 piles so that one pile has half as many blocks as the other.

Number sentence: _____

Name   *Date*

Pentominoes

Pento means five. A pentomino is made of 5 joined squares.
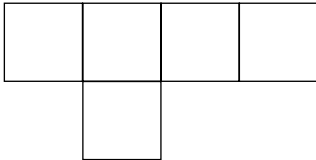
This is a pentomino.   **This is not.**
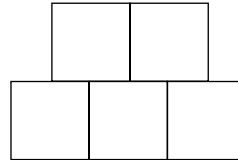
Squares join fully along one side.

There are 12 pentominoes altogether.

Using 5 paper squares make 6 pentominoes. Draw them on this page.

Share your results with a friend. Find out what all 12 pentominoes look like.
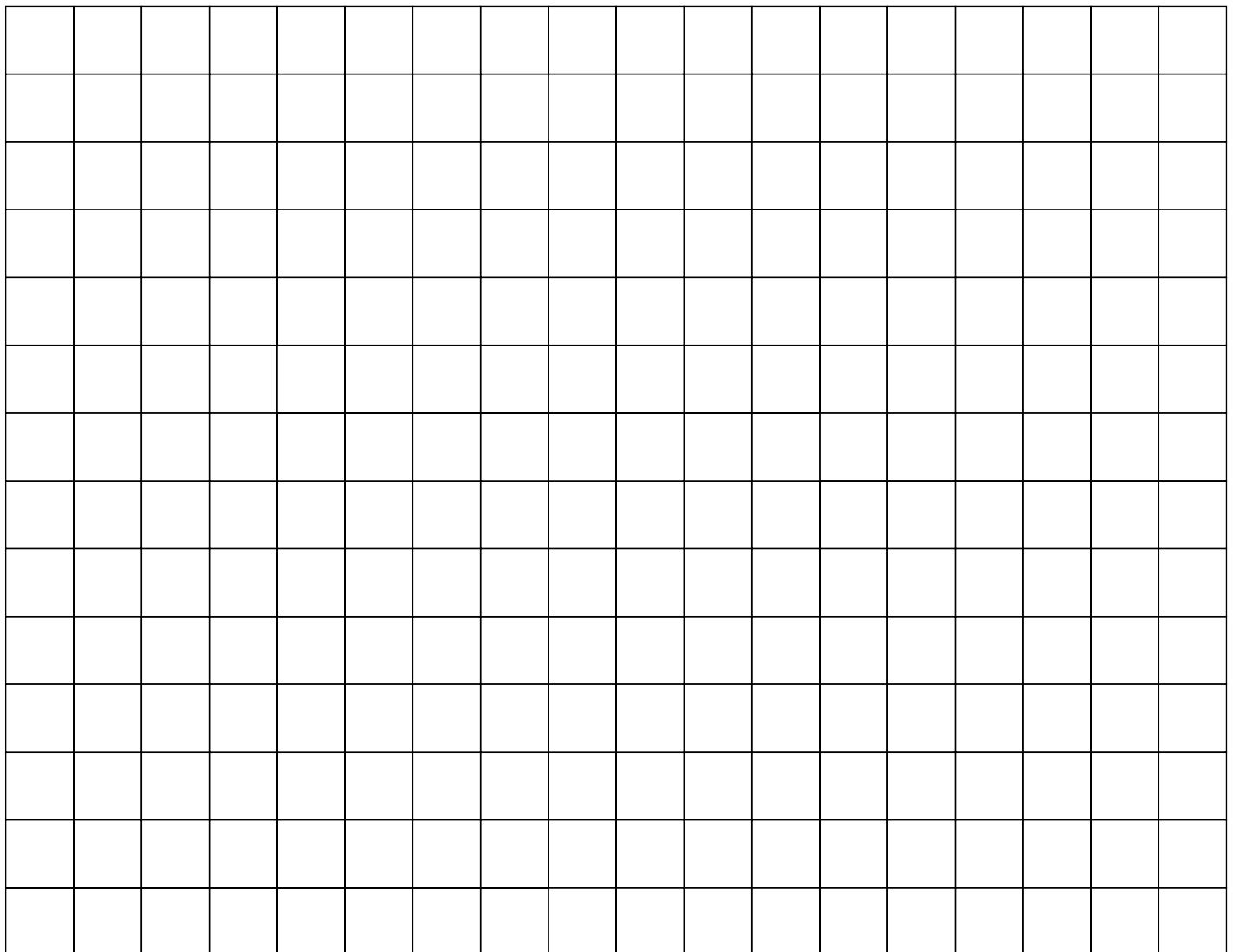
Name

Date

Card tricks

Use playing cards from a normal or blank playing card pack to act out and find the solutions to these puzzles.

1 Jamie and Jancie each have 24 cards. They made up a game where every time Jamie loses 1 card, Jancie loses 3. When Jancie has lost all her cards, how many will Jamie still have left?

Answer =

2 You hold 20 cards. You must discard them all in 5 moves, but each move must discard a different number of cards. How can you do this?

Answer =

3 What is the biggest triangle you can make with a pack of 52 cards? The triangle is built using 1 card in the first row, 2 in the second row, 3 in the third row etc. How many rows will your triangle have? How many cards are used?

Answer = _____ rows, _____ cards

4 What is the biggest square that you can make using the 52 cards of the pack?

This is a square.
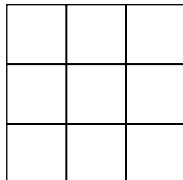
This is not.
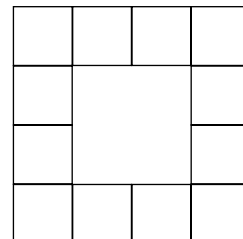
Answer = _____ rows, _____ cards

Name   *Date*

Training for the games

In training for the Mini Marathon at the next Mini Mad Games, Mini Max has to complete 2 km jogging, while his older brother Maxi Mak covers 3 km.

1 Use coloured marks for each runner.

START   **9 km**

36 km

27 km

18 km

2 How many kilometres does Mini Max run while his brother runs 36 km? _____

Name　　　　　　　　　　　　　　　　　　　　　　　　　　*Date*

Find your way

Two players.

One player plays on the Dots, one plays on the Crosses. Players take turns.

The Dots player must try to make a path from side to side of the board by joining dots one a time. The Crosses player must try to make a path by joining crosses from top to bottom of the board. You may not cut across your opponent's path, but must go around it. The object is to try to cut off your opponent to stop them from reaching their goal.

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Name   *Date*

Matchstick problems

Use 17 matchsticks or toothpicks and make 6 squares.
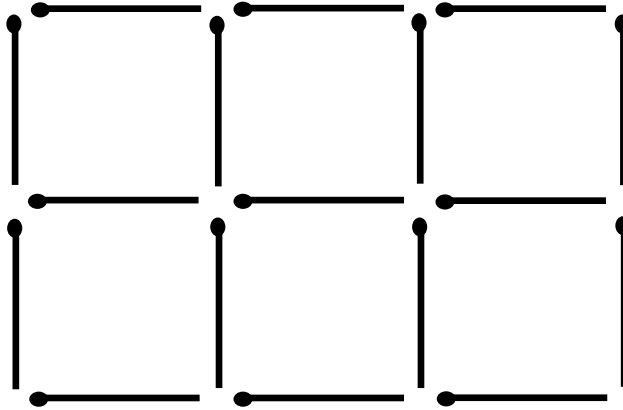
Draw each solution.

1 Take away 1 match to make only 5 squares.

2 Take away 3 matches to make 4 squares.

3 Take away 4 matches and make 3 squares.

4 Take away 2 matches and make 2 rectangles and 2 squares.

5 Take away 3 matches and make 2 rectangles and 1 square.

6 Move 3 matches and make 5 squares.

Make a list

Rationale

Making a list is a way to organise information so that all possibilities of a solution are seen and set out. Systematic thinking and working are necessary for success in this form of problem solving as it is necessary to work methodically through the possibilities. Drawing a tree diagram is similar to making a list, but the list is easier for young students to organise. A list may also be a table.

Teaching *Make a List*

The following should be noted when teaching problem solving using Make A List.

A When to use Make a List

B Main skills to master

A When to use Make a List

Use Make a List when you need to write down different options and count the total at the end. eg How many ways can I arrange 3 items? Each possibility needs to be recorded in a systematic way, so a list is required as a record of your thinking.

B Main skills

1 Working methodically

Students must be able to decide on a starting point, then work methodically through each item, exhausting all possibilities for that item before moving to another item. eg A with B, A with C, A with D, then on to B with C, B with D etc.

2 Physical setting out of a list

Students must recognise that they need enough space to set out a list and that rough working is part of the process. They may need some scaffolds at first and for this reason, these problems sometimes include a starting point. Some students may work without these and some may always require this assistance.

3 Visualising

Students need to try to picture the combinations so they know when they have all possibilities.

4 Recognising repeat combinations

Students must recognise that there will be repeats, which are not included, unless the problem requires it. eg A with B is the same as B with A, except where the order of the items makes a difference in the combination and should therefore be included.

Lists become tables

Lists may be made into a table, especially where advanced students are ready to recognise this step.
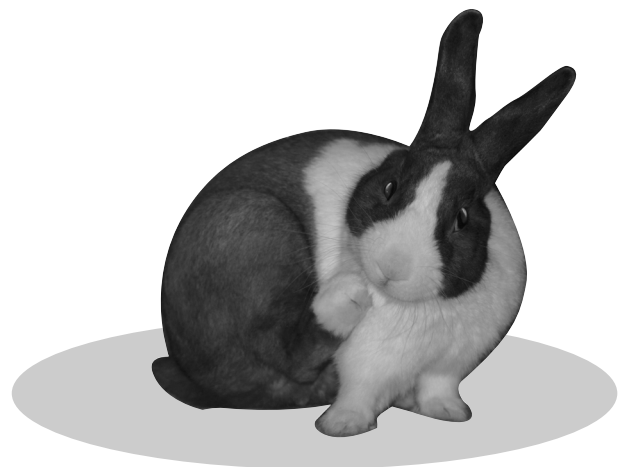
Worksheet 1
NUMBERS

Students will write the numbers across the page, making sure each obeys the rule given.

They should check that they have answered the question at the end, either *How many numbers?* or *How many different ways*?

Worksheet 2
SORTING MULTIPLES

These lists go down the page. Students make a list as they scan through the collection of numbers in the star. They should scan the numbers in methodical fashion, across the page. They should not cross off those listed as some will be listed more than once. Questions 2, 3 and 4 comprise numbers found from lists already made.

Vocabulary: multiples

Worksheet 3
CHRISTMAS DECORATIONS

These lists go across the page. Work together at first to write each colour in a set. Next, change the order but have students write the colours again, and so on until all arrangements are exhausted. The paper chain is a simple scaffold to follow for making a list. In the subsequent problems, the list is made across the page too. Show students how they have made a list with the different combinations.

Vocabulary: combinations, alternatives

Worksheet 4
DRESSING UP

Work across the page again. Students should be getting familiar with the setting out now. Question 2 shows how to continue the lists with a common element, with the use of the arrow. It stands for *goes with*. Students should try to employ this strategy for themselves.

Worksheet 5
IN THE GARDEN

Each list is reading across the page. Monitor students' responses – have some students read out their lists. Check for accuracy. Give less and less support as they attempt each problem on the page.

Worksheet 6
ON THE FARM

Make sure students understand the setting out of the different lists. On the board, review how lists are filled in. Some work across and some work down. Discuss the appropriateness of this setting out. Check that students are completing lists correctly before they work on their own. The aim is to see that they learn the process of making lists, not only the solving of problems.

Worksheet 7
ARE YOU READY TO ORDER?

Arrows to indicate *goes with* will be used here. After writing the first food items on the left, make the list across the page. Question 3 gives clear setting out to assist with the three choices to accompany each whole pizza.

Worksheet 8
JUST HAVING FUN

Allow students the chance to experiment with their own setting out. Share students' outcomes and have them explain their choices of setting out and their solutions. For handshakes in Question 3, pairs of names must be recorded.

Name   *Date*

Numbers

1 When you write the numbers 0 to 50, how many times do you write the digit 4?

2 When you write the numbers from 1 to 100, how many times do you write a multiple of 12?

3 From 100 to 200, including 200 but not 100, how many times do you use the digit 0?

4 Between 100 and 200, how many numbers read the same forwards as backwards?

5 How many house numbers can you write using only the digits 3, 4 and 5?
Each digit can only be used once in any house number.

6 In the first 20 numbers after 1 000, how many zeros do you write?

7 How many different ways can you pay £1 using only silver coins?
Draw the ways.

Name   *Date*

Sorting multiples

24   16   37   40   15

9   18   6   5   45   25   38

30   31

11   42   65

17
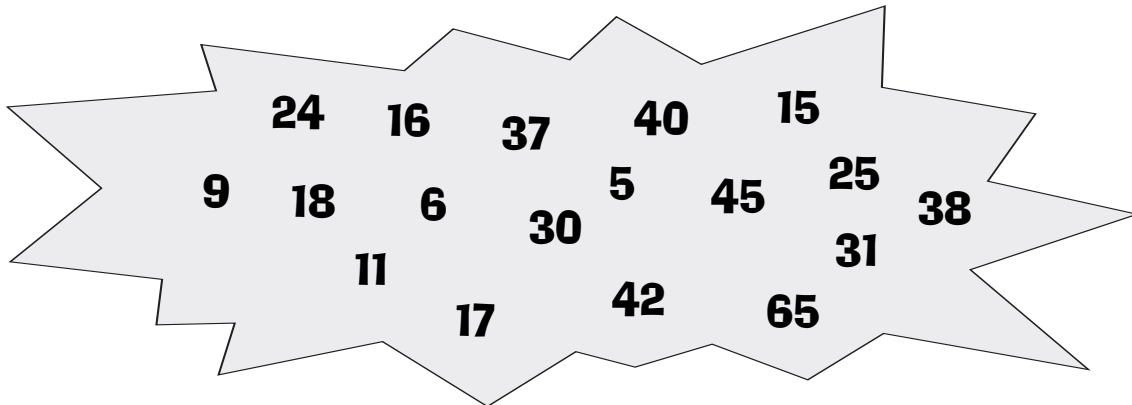
l Make a list of all the:

a even numbers.   **b** odd numbers.   **c** multiples of 5.

d multiples of 3.   **e** numbers less than 20.   **f** numbers over 30.

2 Which numbers are odd numbers and multiples of 3? _____

3 Which numbers are even numbers over 30? _____

4 What are two other groups that you can make from your lists?

_____

_____

Name   *Date*

Christmas decorations

1 Ginny, Jamie, Cindy and Kerrie want to make paper chains with green, red, gold and silver paper. How can they make four different looking chains if they all use the same colours? Colour the loops to show your answer.

Ginny
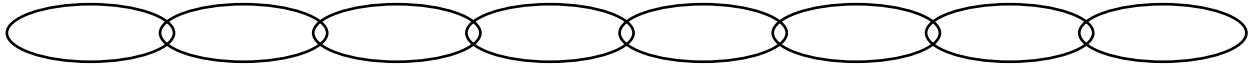
Jamie
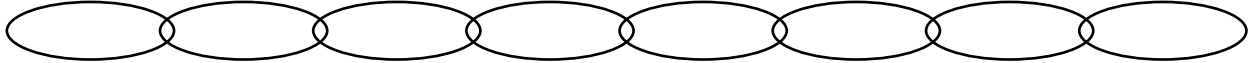
Cindy
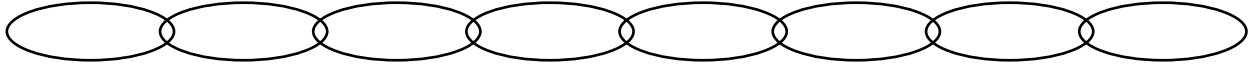
Kerrie
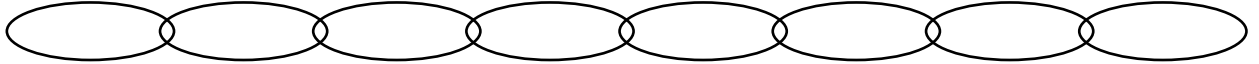
2 For her Christmas tree, Gran likes to choose a different colour scheme each year. She has gold balls and green balls, gold tinsel and silver tinsel, pink stars and yellow stars. How many different combinations of balls, tinsel and stars can she have before she has run out of choices?

Balls   **Tinsel**   **Stars**

3 For Christmas dinner at our house, we set the table with a plate, a napkin, a spoon and a glass. There are red or white plates, red or white napkins, blue or gold glasses and blue or gold spoons. There should not be any of the same colours together in a set. How many sets can you make?

Make your list on the back of this page. Use these headings.

Plates   **Napkins**   **Spoons**   **Glasses**

Name

Date

Dressing up

1 For my birthday party I buy a black lace skirt but can't make up my mind about a top to go with it. I buy a pink top and a white top, a pink shawl and a silver shawl. How many outfits do I have to choose from when I dress for my party?
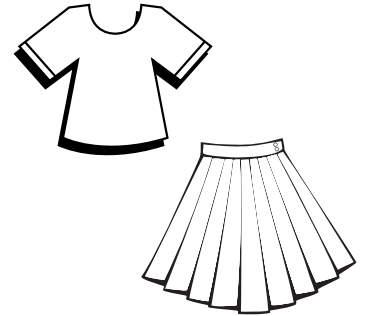
black skirt, white top, _____

black skirt, white top, _____

black skirt, pink top, _____

black skirt, pink top, _____

(**Solution**)

2 Going mountain climbing, Jacko was told he would need many different outfits to cater for the changing conditions when he climbed. He would need long pants and short pants, a long-sleeved shirt and a short-sleeved shirt. He would need to take a fleece jacket and a waterproof jacket as well. How many different ways could he dress to handle different weather conditions?

long pants

short pants
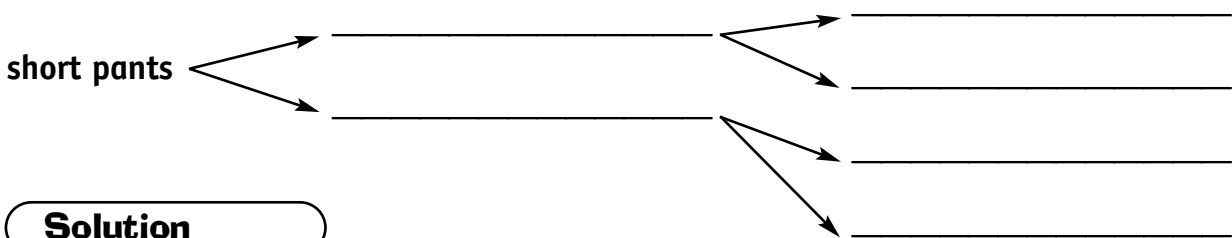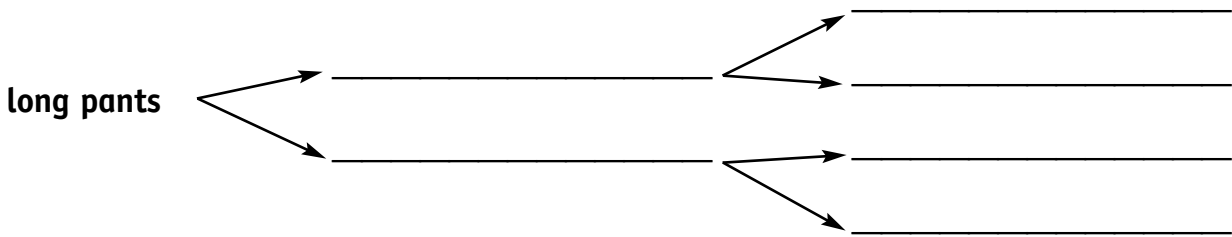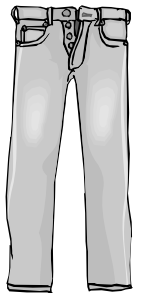
(**Solution**)

3 I have green shorts and blue shorts, a red T-shirt and a blue T-shirt as well as a grey hat, a blue hat and a green hat. What are the outfits that I may choose to wear during my holidays?

Make your own list on the back of this page. Start with:

green shorts

blue shorts
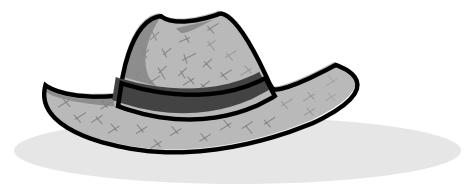
Name   Date

In the garden

Aunt Jo-Jo is a keen gardener and each Spring she plants many flowers.

1 How many different arrangements can she make with her tulips, daffodils and daisies in rows along the fence? ⬭

1st Row   **2nd Row**   **3rd Row**

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

_____   _____   _____

2 Aunt Jo-Jo has many garden tasks to do. She needs to water, weed, sweep and clip. She can do 2 things per day, each day for 4 days. What are two ways she can plan her jobs so that all the jobs get done twice in the 4 days?

a **Mon** _____   b **Mon** _____

    Wed _____   **Wed** _____

    Fri _____   **Fri** _____

    Sat _____   **Sat** _____

3 Aunt Jo-Jo's favourites are roses, lilies and daisies. If she is asked to take a total of 4 flowers to her friend, what possible choices can she make with her favourites? ⬭

Use the back of this page to write your list.

4 On Mondays, Aunt Jo-Jo will spend 10 minutes in the garden and each day after that she will spend 6 minutes longer. For how long will she be in the garden on Sunday?

Monday – 10 min, Tues _____

_____

Name   *Date*

On the farm

When it's spring on the farm, there is a lot happening. New animals are born and the farmer has many chores to carry out.

1 The five rabbits in the valley each have 1 baby a year. How many rabbits will there be altogether after 3 years?

(_____)

1st Year	**2nd Year**	**3rd Year**
Rabbits _____	Rabbits _____	Rabbits _____
Babies _____	Babies _____	Babies _____
Total _____	Total _____	Total _____
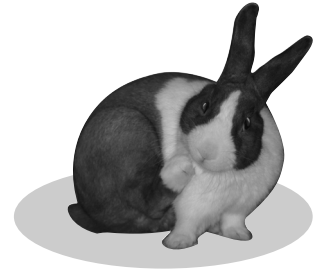
2 Farmer Ted sells his wheat for £40 a bag in September, and £5 more for each bag every month after that. In what month will he be getting £65 per bag of wheat?

(_____)

Sept.	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**
_____	_____	_____	_____	_____	_____	_____	_____

3 Starting with 160 sheep in August, Farmer Bob has to sell half of them in September, then half of the sheep that are left in October and so on, until he only has 5 left. In what month will that be?

(_____)
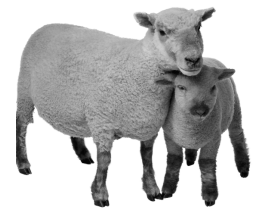
4 The shed roof needs painting, so Farmer Mike begins by doing 8 hours of painting on Tuesday, but can only paint for 7 hours on Wednesday, 6 hours on Thursday and so on, working one hour less every day. If it takes 32 hours to paint the roof, on what day will he finish?

(_____)

Name   *Date*

Are you ready to order?

1 At the school canteen, children can order sandwiches and fruit. There are ham sandwiches and cheese sandwiches, as well as apples, mandarins and bananas. What are the different combinations possible?

2 At the Juice Bar, you can order mango, strawberry or banana smoothies with chocolate topping, sprinkles or cream on top. What are the 9 different choices you could make?

3 Pete's Pizza Parlour is trying a new promotion. Pete will allow half-and-half order on the second pizza if you order the first pizza with only one topping. He has supreme, pepperoni, vegetarian and seafood available. What are the different choices of a single topping plus a half-and-half?
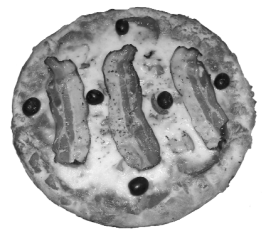
Supreme with	**Pepperoni with**	**Vegetarian with**	**Seafood with**
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Name

Date

Just having fun

1 With two dice, how many combinations could you throw for a total of more than 8?

2 On my next trip I would like to visit three interesting places. They are Maximup, Liftimup and Lookinup. I can visit these towns in any order as they are close to each other. How many different itineraries could I arrange?

3 After the Chess Championships the four contestants, Boris, Marcos, Feldus and Paulos, shook hands. How many different handshakes were made?
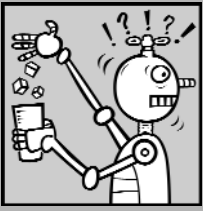
Work backwards

Rationale

This method is used when information is given about the end result, but many unknowns still exist. When the answers at the start or in the middle of the problem are not known, use Working Backwards to find those answers.

Teaching *Work Backwards*

Look at the information given. Determine what is known and what is unknown. Highlight the piece of information which is a definite answer. It is valuable if the students can determine whether the end result will be *more or less* than the piece of information that is given. They will need to also determine which process they are using for each piece of the problem, eg addition, subtraction, etc. The following understandings are required:

A Strategy for using Working Backwards

B Main skills

A Strategy

1 Discuss which data is the answer at the end.

2 Discuss which data is to be found.

3 Highlight data to be used in the calculation.

4 Use diagrams or the equation method to set out working.

5 Have students explain their answer and how their solution is proven correct by application to the original data.

B Main skills

1 **Determining which data is the given or certain piece of information**

2 **Determining other data to be used**

3 **Estimation**

   Decide whether the answer will be more or less than the given information.

4 Using the diagram method

Use this where an equation is drawn using the pieces of data and the signs of the process, eg addition or subtraction etc.
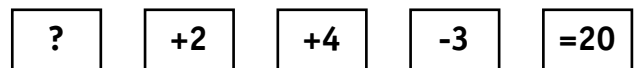
?	+2	+4	-3	=20

5 Using the equation only method

Write an equation from the given data, using a symbol or letter for the unknown.

$T + 2 + 4 - 3 = 20$ *Therefore* $T = 20 - 2 - 4 + 3$; $T = 17$

6 Check

Test the guess against the data in the problem, or by adding the guesses to be sure they make the correct total.

7 Explain

Have students explain why their calculation is correct. How does it meet the criteria in the original problem?

Worksheet 1
IN THE SUPERMARKET

Use of the diagram is introduced. Students determine the given piece of information and write it in the last box. The unknown piece of information is indicated as a ? in the first box if that is the required unknown. Teach how the opposite process is used to work backwards. Reread every solution, using the original information, to check for accuracy.

Worksheet 2
TRAVELLING ON

Make sure students are correct in determining which information is to be used. It is not necessary to consider all the information, eg two hours before lunch in Q1.

Worksheet 3
GOING TO THE ZOO, ZOO, ZOO

Here, working backwards utilises the Make a List strategy. This is used when several results, all related to one given piece of data, are to be found. Again, determine the given information and write it down as part of the answer. Use the given information and calculate the rest accordingly. In these problems, *working backwards* is easy to understand as the given information is near the end and the rest is found before that.

Worksheet 4
TESTING TIME

Use the setting out as given for worksheet 3, ie find the given information, put it in a list, then build the list working backwards through the data.

Worksheet 5
SALES PITCH

Practise the strategy as taught. Students should demonstrate a good understanding of the strategy by giving their own version of a story to go with this data.

Worksheet 6
USING THE EQUATION

Introduce writing an equation in place of the diagram and the list. This is used when one result needs to be found using all the data. Introduce the term *inverse operation*. Discuss the meaning of *inverse* and show how the operation changes to its opposite when working backwards.

Vocabulary: inverse operation

Worksheet 7
WHAT'S MY NUMBER?

This extends the skill of using equations and learning to work backwards from the end, by inverting processes. Students reread the clues and check that the solution makes sense. Make sure mental working is supported by written or oral working.

Worksheet 8
OUT AND ABOUT

Again, this sheet gives practice at telling a story to match given information. It can be as realistic or humorous as required.
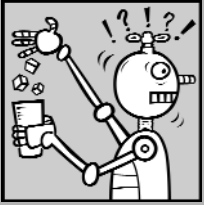
Name *Date*

In the supermarket

Example: At 1 pm, three people enter the supermarket and at 1:05 pm, five others enter. At 1:10 pm, two more enter, and there are now 15 people in the supermarket. How many were in the supermarket before 1 pm?

	1 pm	1:05	1:10	
?	**+ 3**	**+ 5**	**+ 2**	**= 15**
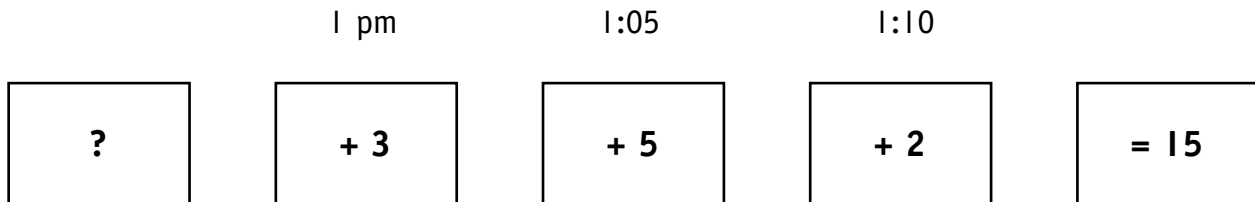
Work backwards using the opposite process.

15 − 2 − 5 − 3 = _____ (the number of people in the supermarket at 1 pm).

---

1 Between morning tea and lunch, Jess unpacked 12 boxes, then another 10 by afternoon tea and a further 8 before tea. In total she had unpacked 39 boxes. How many did she unpack before morning tea?

				= 39
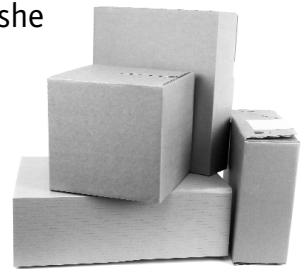
2 Four packs of Wombats were taken from the shelf by teenagers, then another five were picked up by Fran's mother before Ted's Gran bought six more for his birthday party. This left just 2 packs on the shelf. How many were there at the start?

				= 2

3 There was a rush on dog food at the end of the day. Mr Barque, the Vet, bought a huge trolley full, Mrs Poodle bought 12 cans, Miss Pooch bought 15 cans and Sonny Bitem bought 9 cans. A total of 60 cans had been bought. How many cans did Mr Barque buy?
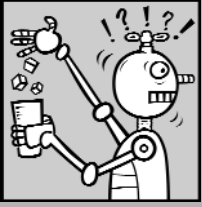
Name   *Date*

Travelling on

1 Uncle drove for two hours before lunch. He then drove 60 km after lunch, 80 km after afternoon tea and 70 km after dinner. Altogether he drove 300 km. How far did he travel before lunch?

2 Mr Shellco, a forgetful man, forgot how many kilometres he drove for work on Monday, but he remembered driving 100 km on Tuesday, 150 km on Wednesday, 80 km on Thursday and 120 km on Friday. If he ended the week with 550 km on the odometer, how many kilometres did he travel on Monday?

3 I know that I rode 5 km on Monday, 6 km on Tuesday and I stayed home on Wednesday and Thursday. On Friday, I rode a further 8 km and on Saturday I forgot to check. I know I have ridden my bicycle for 25 kilometres during the week. How many kilometres did I ride on Saturday?
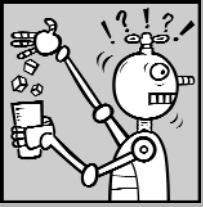
Name   *Date*

Going to the Zoo, Zoo, Zoo

1 Jilly Jumper, the kangaroo, is training for the Animal Olympics. She has so far jumped 1 m further than her sister, Jazzy, who jumps 2 m further than her friend, Bouncer, who has jumped 4 metres.

How far has Jilly jumped? (   )

Bouncer

Jazzy

Jilly

2 Card collecting is a great hobby for the attendants who are in the Zooper Dooper Club. Zoo-goo cards are the craze. Lennie has 50 more than Denny, who has 20 less than Fozzie. Fozzie only has half as many as Beebie the champion, who has 200. How many does each boy have?

Beebie

Fozzie

Denny

Lennie

3 The movie *Home on Our Planet* opened last week at the Zoom-in Theatre. On Thursday, the largest crowd was 200 greater than on Friday. Friday's crowd was 100 less than Saturday's, which numbered 600. Sunday was quieter, with 150 less than Saturday. What was the total number of people at the movies Thursday, Friday, Saturday and Sunday?

(   )
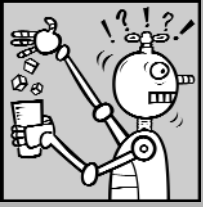
Name   *Date*

Testing time

1 In spelling tests for the week, Jasmine did poorly in Editing, 3 marks lower than in Dictation. In Word Spelling, she was 2 marks better than in Dictation and in Prefixes she gained 1 more mark than in Word Spelling. Prefixes was her best score at 18 out of 20. What were all her scores?

Working on a list: **Check**

2 In the Maths test, Jennifer scored best at Number, gaining 10 more marks than in Shapes. In Data she gained 6 less than in Shapes, but 8 more than in Measurement. She was sad about her worst mark, which was in Measurement where she gained only 20 out of 50 marks. What were all her marks in Maths?

Working on a list: **Check**
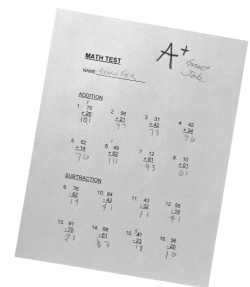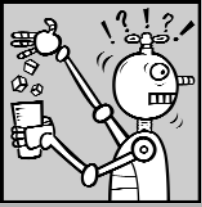
Name   *Date*

Sales pitch

1 Sales of the new CD *Rockin' Lullabies* have reached a fever pitch. 50 more CDs were sold on Saturday than on Friday, and 20 more had been sold on Friday than on Thursday. On Wednesday, sales were quiet with 10 less than Thursday being sold, but even then it was a Wednesday record at 35 sold. How many CDs were sold each day?

Working on a list: **Check**

2 While doing a stock check, Aimie found that some CDs had gone missing from the store shelves. She remembered that at last check there were 100 CDs, but now there are only 65. She remembered selling 12 on Thursday, 10 on Friday and 6 on Saturday, so there is definitely some difference. How many are missing?

Working on a list: **Check**

3 Make up your own story for this data.

Pounds Saved for Christmas Shopping.

| Davey = Mum + 4 | Mum = Pollie + 6 | Pollie = Len – 15 |

| Len = Stevie x 2 | Stevie = 26 |

Complete: Stevie = _____ Len = _____ Pollie = _____ Mum = _____ Davey = _____
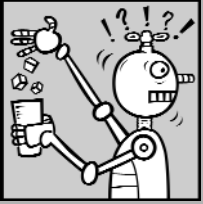
Name   *Date*

Using the equation

Write an equation for the story. Use a letter for the unknown. Then work backwards. This is called using the *inverse operation*.

Example:

Darin can't remember how many **Marbles** he had last Sunday. He now has 42. Since last Sunday, he remembers losing 4 (− 4) and winning 5 (+ 5) and another 3 (+ 3). How many did he have last Sunday?

M − 4 + 5 + 3 = 42

Using the opposite signs   **M = 42 + 4 − 5 − 3; so M = 38 marbles.**

He had 38 marbles.

---

1 Darin's sister, Peggy, bought a packet of marbles, then won 4 from Darin and lost 6 to her friend. She now has 22 marbles. How many marbles were in the pack?

2 The boss of the YY Ranch never knows how many cattle he has, but at the start of January he sold 20, bought 52 and 13 died from eating poisonous leaves. Then he had 69, which was more than he thought he had. How many did he have at the start of January?
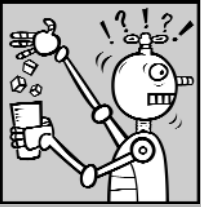
Name *Date*

What's my number?

As you read the problem write down the working as a number sentence. Then work it backwards.

1 I am thinking of a number which, when I add 17 and take away 14, becomes 30.

* + 17 – 14 = 30

* = 30 – 17 + 14 My number is _____

2 My number is twice Con's number and Con's is one quarter of Rob's, whose number is 12. What is my number?

12 divided by 4 = Con's number. Con's number times 2 = my number.

Number sentence = _____

My number is _____

3 My number minus 6 is Jinny's number. Jinny's number is half of Benny's number, which is 50. What is my number?

Number sentence = _____

My number is _____

4 My favourite number is 2 less than Hopi's favourite number, which is 10 times Nat's number. Nat loves the number 5.

Number sentence = _____

My number is _____

5 When my number is divided by two and 15 is added I have 26 in total.

* divided by 2 + 15 = 26 *** = (26 – 15) x 2**

My number is _____

6 When the number I am thinking of is multiplied by 9 it is 15 less than 60. What is my number?

Number sentence = _____

_____ My number is _____
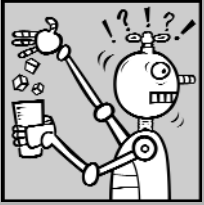
Name   _Date_

Out and about

1 When I bought petrol at the garage near my home I paid with a note and received £3.50 change. I had bought a chocolate for £1.50 and the petrol cost £15. What note did I give the attendant?

_____
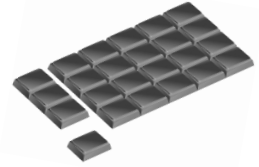
2 When I had travelled 360 km on my trip, I had reached half way. After another 60 km I stopped for the night and next morning travelled another 100 km. How many more kilometres do I still have to drive?

_____

3 **Tell your own story.**

Trip of a lifetime

| Day 1 = Day 2 + 50 km | Day 2 = Day 3 – 50 km | Day 4 = Day 3 + 100 km | Day 4 = 500 km |

Day 1 = _____

_____
_____
_____
_____

4 **Tell your own story.**

Sales of souvenirs

| Monday = Tuesday - £40 | Tuesday = Wednesday + £25 | Wednesday = Thursday |
| Friday = Wednesday - £20 | Saturday = Friday + £15 | Saturday = £55 |

Total = _____

_____
_____
_____
_____
_____

Trial and error

Rationale

This method is used when there is no obvious way to calculate the solution to the problem. Trial and Error describes exactly what the strategy comprises; trialling a guess and expecting that it may not be correct. This method is also called *Guess and Check*.

Teaching *Trial and Error*

Making a reasonable estimation is the key to getting started with this strategy. Students need to be able to make good estimates. They also need to be able to understand how to check their guess against given criteria. The following understandings are required.

A Strategy for using Trial and Error

B Main skills

A Strategy

1 Discuss which data is to be used to determine a guess. Also ask which words give clues, eg more than, twice as much.

2 Write down all parts of the guess.

3 Check the guess according to the data and adjust either up or down. Repeat the procedure.

4 Have students explain their guesses and how they can prove whether their solution is correct.

B Main skills

1 Determining which data is to be used in the first guess

Which data is not useful at all? Highlight the important data.

2 Estimation

There is a skill in knowing roughly what the first guess should be. Look at the numbers involved. Ask children what is <u>reasonable</u>. Discuss how to arrive at a reasonable guess using the data in the problem. Will the guess be higher or lower than any numbers which are given as data?

3 Check

Test the guess against the data in the problem.

4 Adjusting up or down

When the first check proves to be incorrect, discuss how to determine whether the next guess should be larger or smaller. What data helps make this decision? Guide students through the determination of another guess.

5 Working

Explain that all working should be left in place as a record of the solution process. Students often think that working should be dispensed with if it is incorrect, but in problem solving the way a solution was achieved is important.

6 Explain

Have students explain why their guess is correct. How does it meet the criteria?

Worksheet 1
GOOD OLD GRANDPA

Some estimation is required. Encourage careful reading of the puzzle first, then a fair estimate for Guess 1. Who has the most? Who has the least? Discuss whether, after Guess 1, guesses should then be higher or lower to achieve the correct solution. Guesses are set out down the page in each space.

Worksheet 2
THE SCARF KNITTERS OF SCANDIA

After reading the puzzles, students highlight or underline the most informative material, eg 10 balls, Bella as many as Florrie and Julia together. Emphasise the importance of leaving all incorrect working in place.

Worksheet 3
VET'S VICTORIES

Students read carefully, highlight most important information and make an estimate for Guess 1. Encourage them to verbalise their thinking. Even fast thinkers can have problems explaining their working in words. Working in pairs, explaining to each other as they go, would be a valuable problem-solving strategy here.

Worksheet 4
SHOPPING SPREE

Stress the importance of reading each piece of information and pausing to consider its meaning. Work vertically, leaving each set of working in place.

Worksheet 5
COIN COUNTING

Being able to read the unusual names in puzzles and problems is not important. Make sure students do not stop at reading names. Highlight the important information and check it at the end.

Worksheet 6
TOP TOYS STOCKTAKE

Explain what a stocktake is. Students may have seen this happening in stores. Remind them to highlight only important information. Some information is not to be used, eg on a shelf, some more in a box, a heap in the corner and a few in a bag.

Worksheet 7
FOOTY FEVER

Some discussion about football and what students already know about various football codes will be valuable. Make sure they also know what the question asks and, therefore, what their answers should say.

Worksheet 8
VACATION TIME

Following this page of tasks, students should be given the opportunity to make up their own *Guess and Check Puzzles* for the class to solve.

Name   *Date*

Good old Grandpa

Grandpa John always shares treats between his 4 grandchildren in different ways. They have to find the answers to puzzles for each treat they receive. Can you solve the puzzles set by Grandpa John?

1 26 candy canes

There are equal numbers for the twins Jinny and Jack, 4 more for Tina, and another 2 more for Sandie.

	Guess 1	Guess 2	Guess 3	Guess 4
Ji	_____	_____	_____	_____
Ja	_____	_____	_____	_____
T	_____	_____	_____	_____
S	_____	_____	_____	_____
	Check 1 _____	Check 2 _____	Check 3 _____	Check 4 _____
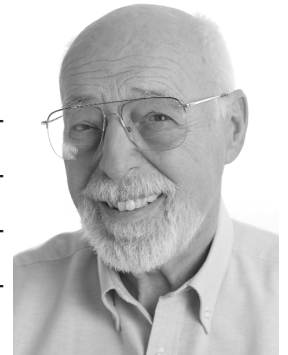
2 £100 to share at Christmas

The largest amount is for Sandie, half as much for Tina, £10 for Jack and three times as much as Jack for Jinny.

	Guess 1	Guess 2	Guess 3	Guess 4
Ji	_____	_____	_____	_____
Ja	_____	_____	_____	_____
T	_____	_____	_____	_____
S	_____	_____	_____	_____
	Check 1 _____	Check 2 _____	Check 3 _____	Check 4 _____

3 20 chores to do

There are equal chores for Jinny and Jack and equal chores for Tina and Sandie but theirs total 4 more than Jinny and Jack's.

	Guess 1	Guess 2	Guess 3	Guess 4
Ji	_____	_____	_____	_____
Ja	_____	_____	_____	_____
T	_____	_____	_____	_____
S	_____	_____	_____	_____
	Check 1 _____	Check 2 _____	Check 3 _____	Check 4 _____

Name   *Date*

The scarf knitters of Scandia

The Scandalous Scarf Knitters of Scandia are clicking away to finish their families' scarves for the cold winter.

Bella knits fastest, Julia knits a little more slowly and Florrie is slowest.

1 When they have used 10 balls of wool, Bella has used as many as Florrie and Julia together. How many balls of wool has each used?

Bella   _____

Julia   _____

Florrie   _____

Show working

Guess: _____

Check _____

Guess: _____

Check _____

2 When 20 balls of wool have been used, Bella and Julia together have used 3 times as many as Florrie. How many has each used?

Bella   _____

Julia   _____

Florrie   _____

Show working

Guess: _____

Check   _____

Guess: _____

Check   _____

3 When the scarves are finished, Bella's is twice as long as Julia's which is twice as long as Florrie's. Altogether they measure 7m in length. What does each scarf measure?

Bella's   _____

Julia's   _____

Florrie's _____

Show working

Guess: _____

Check _____

Guess: _____

Check _____

Vet's victories

Name

Date

Dr Harry Healum is the best vet and he loves the animals in his care.
Nursie Nursum tries to help but the animals don't do what she orders.

1 Dr Harry had to give injections to 6 mice, 3 rabbits and 5 chickens. The next day, there were the same number of chickens, but there are now 3 times as many mice as rabbits. If there is a total of 21 little animals, how many of each are now in the vet's office?

	Guess 1	Guess 2	Guess 3	Guess 4
Chickens	_____	_____	_____	_____
Mice	_____	_____	_____	_____
Rabbits	_____	_____	_____	_____
	Check 1	Check 2	Check 3	Check 4
Total	_____	_____	_____	_____

2 There seem to be more and more dogs coming in for treatment and less and less cats! When there were twice as many dogs as cats, Nursie was in control, but four more dogs arrived and now there are three times as many dogs as cats and they are fighting.

How many dogs and cats are there now?

	Guess 1	Guess 2	Guess 3	Guess 4
Dogs	_____	_____	_____	_____
Cats	_____	_____	_____	_____
	Check 1	Check 2	Check 3	Check 4
Total	_____	_____	_____	_____

3 In the budgies' department, there is chaos! They won't stay in their own cages. The largest cage should have 3 more budgies in it than the medium cage, which should have 2 more than the smallest cage.

There are 28 budgies altogether, so how many should be in each cage?

	Guess 1	Guess 2	Guess 3
Large	_____	_____	_____
Medium	_____	_____	_____
Small	_____	_____	_____
	Check	Check	Check
Total	_____	_____	_____

Name   _Date_

Shopping spree

The Byalotte Family went out to do all their holiday shopping. They were very secretive about what they had bought and would only tell the total amounts they spent. Can you find out exactly what they bought?

1 Bindi bought 3 cards to the value of £10.00.

Which cards did she buy?

Guess 1	Guess 2	Guess 3
_____	_____	_____
_____	_____	_____
_____	_____	_____
Check 1	Check 2	Check 3
Total _____	Total _____	Total _____

Thank You Cards	**£2.75**
Christmas Cards	**£3.50**
New Year Cards	**£3.00**

2 Sammo spent £50 on three different CDs.

Which ones did he buy?

Hoota Nanny	**£19**
Cry Baby	**£21**
Dance Mad	**£18**
Bad Boys	**£15**
Silly Songs	**£16**

Guess 1	Guess 2	Guess 3
_____	_____	_____
_____	_____	_____
_____	_____	_____
Check 1	Check 2	Check 3
Total _____	Total _____	Total _____

3 When the family went to lunch Daddo took out a £50 note to pay for their choices. There were 2 of some items and 4 of another. In total there were 8 items in the order and Daddo received £6 change. What did they buy?

Hamburger	**£6.50**
Chicken	**£8.50**
Fruit Salad	**£3.50**

Guess 1	Guess 2
_____	_____
_____	_____
_____	_____
Check 1	Check 2
Total _____	Total _____
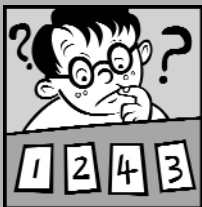
Coin counting

Name   *Date*

To raise money for their special charity, the Tiny Kindy Kids in Karingsville have all raided their piggy banks. They are such tiny kids, they don't know the value of their donations, so the Bigga Kindy Kids help out in the count up. Can you help as well?

1 Kara has seven coins totalling £1.50. They are all silver coins but no 5 pence pieces. What coins has she brought?

Guess 1   _____+ _____+ _____+ _____+ _____+ _____+ _____=_____

Guess 2   _____+ _____+ _____+ _____+ _____+ _____+ _____=_____

Guess 3   _____+ _____+ _____+ _____+ _____+ _____+ _____=_____

Answer = _____

2 Kolinn has brought £7.40 with just four pairs of coins. What are they?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer = _____

3 Krinkle and Krankle brought in a pile of £1 and £2 coins worth £10. There are three times as many £1 as £2 coins. How many of each are in the pile?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer = _____

4 Mr Kinde opened his wallet and gave £20 in three notes and three coins. What could they be?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer = _____

Name　　　　　　　　　　　　　　　　　　　　*Date*

Top Toys stocktake

At the end of the year, Top Toys does a stocktake of all goods in the store. Mr Bigge has some short cuts for his staff to follow if they are paying attention. Otherwise they have to count every item and record all the numbers. See if you can help the staff by solving the short cuts.

1 There are 80 packs of Super Stringos for making string patterns on fingers. There are 3 colours – twice as many blue as red, three times as many green as red. How many packs of each colour are there?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer =

2 There are 40 Lazer Laskers on a shelf, some more in a box and a heap in the corner. There are 30 less in the box than in the corner and altogether there are 200 Laser Laskers to be checked. How many in each place?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer =

3 35 dolls were bought at the beginning of the year. 10 dolls have been sold, and the rest are still waiting to find a home. There are 7 Cutie Cathys and half as many Bubby Dollies as Sukie Sues. How many Bubby Dollies and Sukie Sues are there?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer =
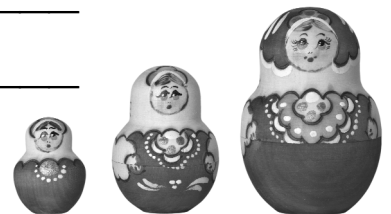
Name

Date

Footy fever

Every code of rugby has different rules and different scores. How do you score as a rugby fan, working out these scoring puzzles?

1 After 5 rounds of rugby, the leading team is only 2 points ahead of second place and 6 points ahead of third place. The total of points for the three teams is 16. How many points has each team been awarded so far?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer = _____

2 In rugby league, a **try** is worth 4 points, a **conversion goal or penalty goal** is worth 2 points and a **field goal** is worth 1 point. Write down 5 ways a team could score 30 points, with no more than 2 field goals each game.

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Guess 4 _____ = _____

Guess 5 _____ = _____

3 In Australian Rules, a **goal** is worth 6 points and a **behind** is worth 1 point. The Boggy Bulldozers scored 125 points. They scored more than 15 goals and less than 25 behinds. What might their scores have been?

	Guess 1		**Guess 2**		**Guess 3**	
Goals	_____		_____		_____	
Behinds	_____		_____		_____	
Check	_____		_____		_____	

Answer = _____

Name

Date

Vacation time

When the Flinders family went away on holiday, it was always a voyage of discovery. See if you can solve the puzzles they found on their travels.

1 When driving 1200 km across the Nullabor Plain, they allowed 4 days for the trip. They travelled 250 km the first day and a different number of km on each of the other 3 days. How far did they go each day?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer =

2 When they bought lunch each day they found that drinks always cost less than sandwiches but were 3 times the cost of fruit. If a lunch of one sandwich, one drink and one apple cost £10, what are the separate costs?

Guess 1 _____ = _____

Guess 2 _____ = _____

Guess 3 _____ = _____

Answer =

3 Finding a tourist town was always great fun. At Kangarooby, Dad granted each child £30 for the day, to be spent on rides, only repeating one ride. In what way could they spend their £30 and get the most number of rides possible?

	Guess 1	Guess 2	Guess 3
Big Pocket Ride £9	_____	_____	_____
Bounding Bouncer £8	_____	_____	_____
Joey Jump £5	_____	_____	_____
Leaping Leena £12	_____	_____	_____
Sleepy Swing £4	_____	_____	_____

Answer =

Logical reasoning

Rationale

Logical Reasoning is used when we have to consider many pieces of data, decide what goes where, organise it and address one part at a time. The solving of many types of puzzles from everyday life falls into this category.

Teaching *Logical Reasoning*

The following items should be considered in teaching problem solving through Logical Reasoning.

A Different strategies

B 4 main skills

A Different strategies

Logical Reasoning involves the use of many methods to solve problems.

It can include:

1 trial and error

2 using a diagram

3 using a chart, a table or a list

4 using a matrix.

Chiefly, the student must understand what they are being asked, what information is to be used and the order in which it should be used.

B Main skills

1 Read the problem with understanding

Highlight the actual question. This is the most important step as the question and the data often contain tricks or twists that can confuse students.

2 Plan

Decide on the data to be used. Highlight it, leaving out unnecessary words.

3 Decide on the strategy to be used

Explain why. Each problem has one strategy that will be more applicable than others.

a Trial and error – data lends itself to a guess being made. Before guessing students must decide on whether answer will be larger/smaller than given data. Guesses are made and trialled, each getting closer to the final answer.

b Use a diagram – data requires pictures or representations of objects to be drawn to place them in a position.

c Use a chart, table or list – data requires organisation and separation from the narrative of the problem to be expressed in a simplified form, eg Jim = 5, Jane = 4.

d Use a matrix – data requires organisation from two or more points of view. This is like a multi-way list, so two axes are used.

4 Work a solution

Apply the strategy. The strategies all require some 'writing down' of data and in this form it can be worked far more successfully than mentally. Insist that students write down their working, even if they can do the problem mentally. Teaching the steps of logical reasoning is more important than obtaining answers.

5 Check

Reread the problem and check it against your solution.

Worksheet 1
RACING PUZZLES

Reading the problem carefully is again paramount. Have problems read aloud and question comprehension. Pausing at correct places to obtain best meaning is important to young children. Highlight. Work through data, placing names on the appropriate shape in the race. Check by re-reading and checking that the picture correctly illustrates what has been read.

Worksheet 2
STEP BY STEP

Read the problems. Highlight necessary data leaving out superfluous information. Write down items and numbers in the form of tallies, eg IIIII, without crosses. When items are to be subtracted, cross out the tallies. This can be done sequentially as read from the problem. Reread to check. Count and record final totals.

Worksheet 3
COLOUR ME SMART

This requires thought before action. Students need to carefully consider each move before they make it. Should they require a new start, allow use of supplied squared paper to try again. Some students may enjoy finding several different solutions. Remember – the process and the thinking demonstrated are more important than solutions.

Worksheet 4
CLAIM YOUR PATCH

This is a group version of the previous page. A group of up to four should play. It requires thinking before making a move, as the intention is to frustrate other players. Reward all players who play a constructive and happy game!

Worksheet 5
CRUMMY CALCULATOR

A thinking exercise of everyday problem solving. How can I do something when the mechanism does not work? There is always a way. These problems reinforce some number concepts such as $9 \times 6 = 9 \times 5 + 9 \times 1$. This would be one way to cope with the malfunction of the '6'.

Worksheet 6
USE A MATRIX

The matrix is like a two-way list. Where problems require two solutions for each piece of data, this is the ideal strategy. Explain how the example works by pointing out the placement of each piece of data. Explain how each clue can be obtained by deduction, which is often about *what is not* as much as *what i*s. Write in each piece of data as it is solved. Check by rereading the problem, considering the solutions in the matrix.

Worksheet 7
BALANCE IT OUT!

These problems require the students to think clearly about, and verbalise, the given information. For example; given that $a = 2b$, and $b = 2c$, then $a = 4c$. Students would use the words *square*, *triangle*, *circle* but they are thinking algebraically when they do this. Allow them the opportunity to speak about these problems and discuss their findings with each other.

Worksheet 8
MIXED

Students choose the strategies that will work best for them.

*Name*   *Date*

Racing puzzles

Read the problem carefully. Highlight the necessary data and the question. Go through the data again and write down each racer in order, as you work out its place. Check by re-reading the problem and checking each answer with a tick.

1 When the minibeasts in the kitchen decided to have some fun at night, they chose to have races across the floor. In the relay, the beetles beat the mozzies who were ahead of the crickets. Flies came in just ahead of the cockroaches, who were last, but behind the crickets. In what order did the minibeasts finish?
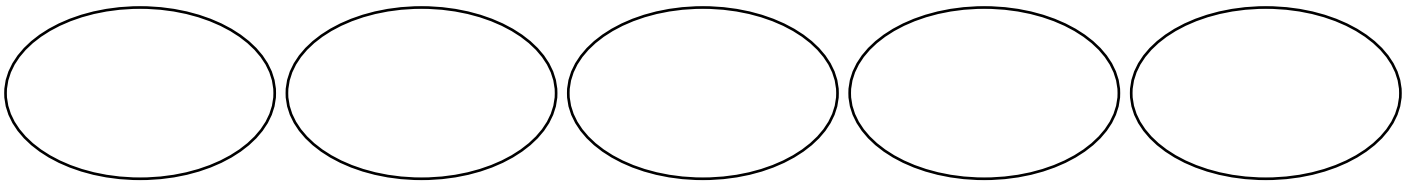
Check

2 At the opening of the Soccer Carnival, Get Fit races were held for all junior Soccerees. Adam came first, ahead of Gabby and Nev. Troy beat Coll but they were both behind Nev. Sam was last, just behind Yan who was behind Ben. In what order did the Soccerees finish?
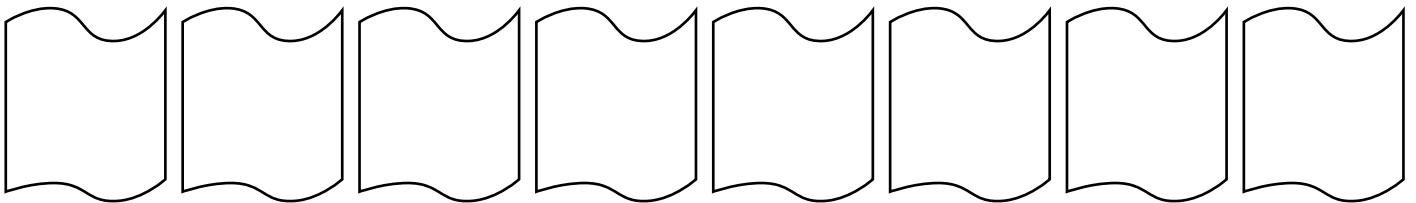
Check

3 On the harbour one Sunday, we watched the yacht races. In the Mini Mogos, Jozo raced away at first but the race was won by Go-go. Hobo came in between Go-go and Jozo. Behind Jozo came Flo-jo, To-go and No-go in that order. After a protest, Bobo, who finished last, was given the place ahead of No-go. In what order did they finish?
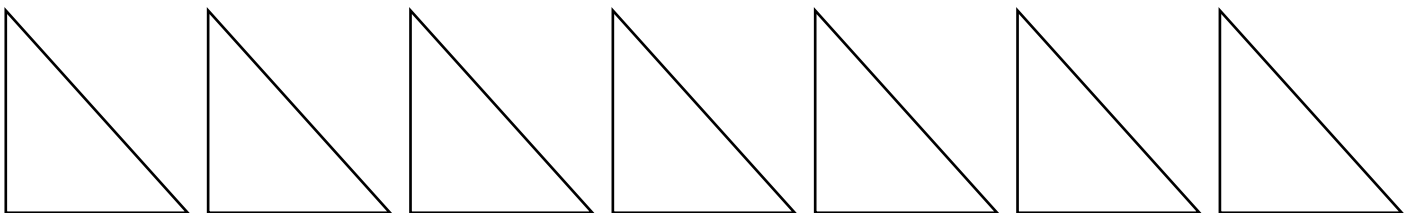
Check

Name   *Date*

Step by step

1 Christmas shopping was always a trial for Aunty Glad. This year she thought that making the decision to buy caps for all her nieces and nephews would help her get through the chore quickly. She chose 8 blue caps quickly, then thought that mixed colours would be best, so she put 4 blue caps back and found 3 green ones and 2 striped ones instead. Then she found flowered caps and exchanged 1 striped for 2 flowered caps. There was a special on Pitchem baseball caps, so she put back another 2 blue caps and chose 4 Pitchems in their place. How many caps does she now have?

_____

2 On our way to the *Camp of a Lifetime*, we bought canned food for the whole week, as we would have no shops close to the camp. We bought 5 cans of baked beans, 3 cans of chopped tomatoes, 6 cans of peas and 2 cans of mushrooms. Then we found that whole tomatoes were cheaper than chopped, so we put back 2 cans of chopped tomatoes and took 3 cans of whole tomatoes in their place. The 2 cans of mushrooms turned out to be damaged, so we put them back and grabbed 4 cans of asparagus instead. If 4 of us expect to carry 5 cans each, can we carry the load?

_____

How many more cans would we each carry to meet our goal? _____

Name

Date

Colour me smart

1 Colour this board so that every square is a different colour to its neighbouring (adjacent) squares. Use only red, blue and yellow. Same colours may touch at corners only.

How many squares did you colour without putting the same colour on adjacent squares?

_____

Well done!

2 Place the given symbols in each of the remaining squares so that none is beside, under or above a similar symbol.

O			I		
					I
		X			
				X	
	O				
I				O	

3 Try this bigger one!

O				X			
	I						
					O		
X							
		O					
				X		I	
I	O						
			I		O		

What pattern helped you to complete the square according to the directions?

_____
_____
_____

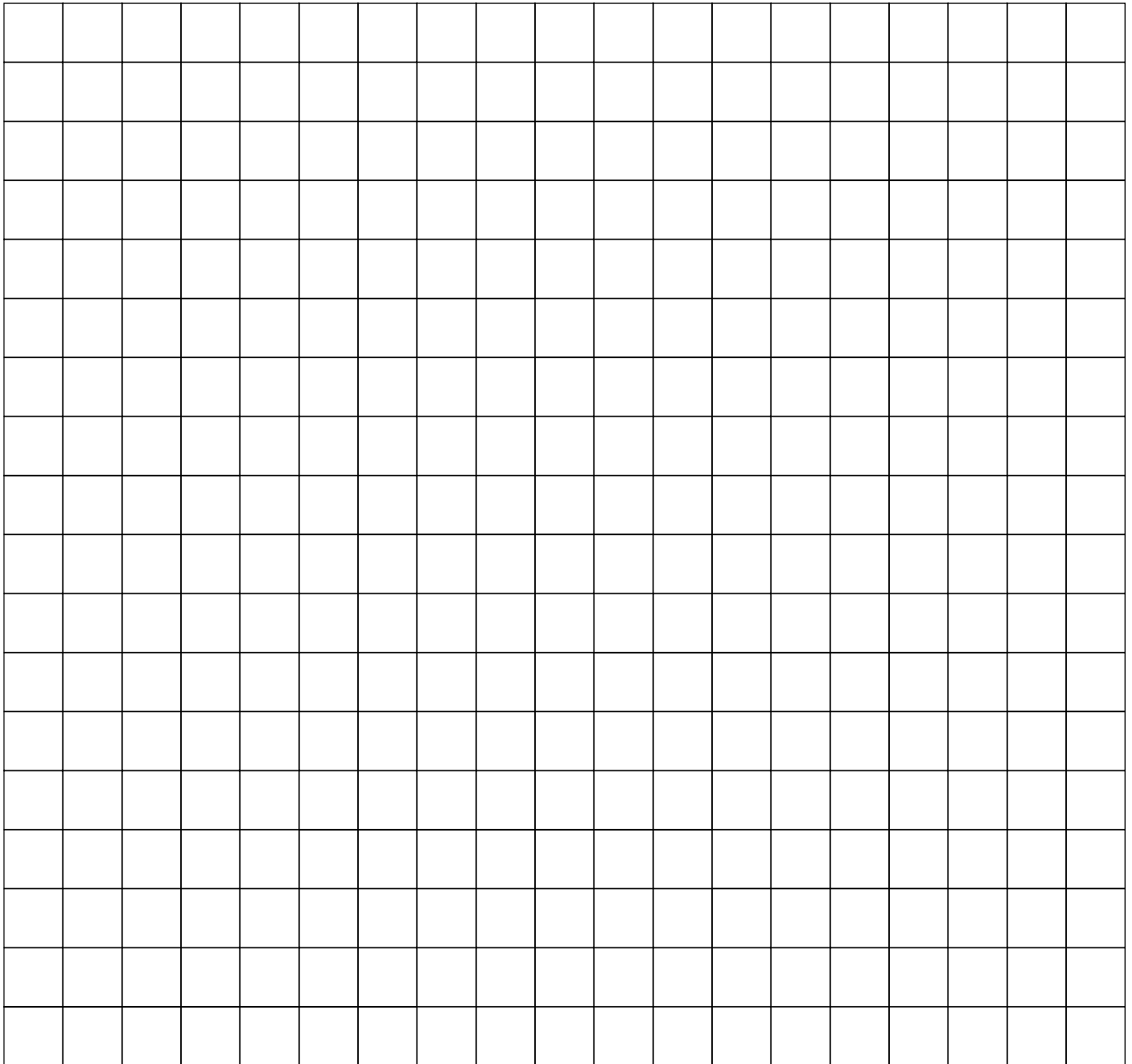*Name*   *Date*

Claim your patch

You will need up to 4 players to play this game.

- Each player has a coloured pencil or crayon different from everyone else's.
- Each player in turn draws and colours a rectangle or square greater than 1 but less than 13 squares in area, with a perimeter not more than 20 cm. That is their Patch. Each player's new Patch must not be adjacent to any other of his or her Patches, except at the corner.
- Continue to claim Patches in turn until one player cannot claim a Patch.
- All other players are winners.

Name

Date

Crummy calculator

Every day, a different key on my calculator breaks but the number can still appear in the display. How can I get correct answers if I can't use the broken key?

I The ⟨**7**⟩ is broken. Write down my different method.

   a 3 + 7 + 11 = _____

   b 6 + 4 + 17 = _____

2 The ⟨**5**⟩ is broken. Write down my different method.

   a 5 x 27 = _____

   b 8 x 15 = _____

   c (16 x 5) + 5 = _____

3 The ⟨**9**⟩ is broken. Write down my different method.

   a 53 − 19 = _____

   b 67 + 19 − 8 + 9 = _____

   c 164 − 39 = _____

   d 99 + 17 − 2 = _____

4 The ⟨**4**⟩ is broken. Write down my different method.

   a 14 x 60 = _____

   b 45 + 32 − 4 = _____
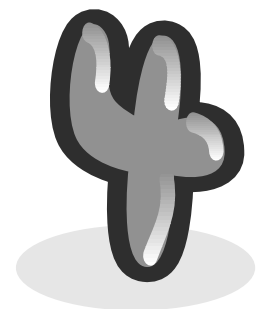
Name   *Date*

Use a matrix

**A matrix will help you to record data in an organised way.
The answer will be easy to see.**

Example: Jo lives in a blue house and drives a Nolden. Lucy does not live in a white house. The person in the cream house drives a Sconda. Jim drives a Dorf. Where does Lucy live?

This matrix tells us that Jo lives in a blue house and drives a Nolden. Jim lives in a white house and drives a Dorf, and Lucy drives a Sconda and must live in the cream house.

Name	House	Car
Jo	Blue	Nolden
Jim	White	Dorf
Lucy		Sconda

Try these!

1 The Crime Squad is looking for a suspect with black hair and green eyes. Three suspects, Dread, Fred and Greg, have different coloured eyes – blue, brown and green. Dread has the same coloured eyes as hair; Fred has green eyes and doesn't have blonde hair; the blue-eyed man does not have brown or black hair.

What are the features of each suspect?

Name	Hair	Eyes
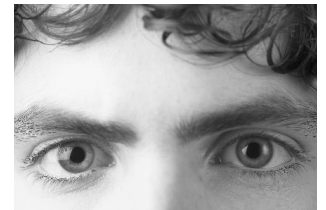
2 Mrs Griggs would like to know who plays in the park near her home. The children tell her that Van is 9 years old and owns a puppy. The only girl, who is 10, has fish. The child who owns a cat is 11 but is not called Cathy. Nemo keeps an axolotl and is two years older than the fish owner. Mrs Griggs is left to work out Sam's age and pet. Can you help?

Name	Age	Pet

Name   *Date*
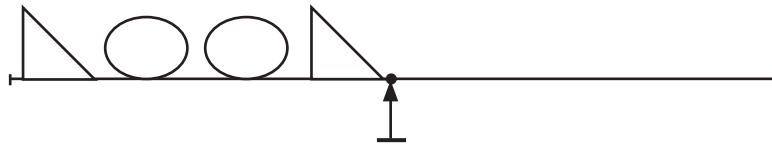
Balance it out!

Look carefully at each set of balances. Consider the information, then work out how many squares will balance the last scales. Draw them on the scales.
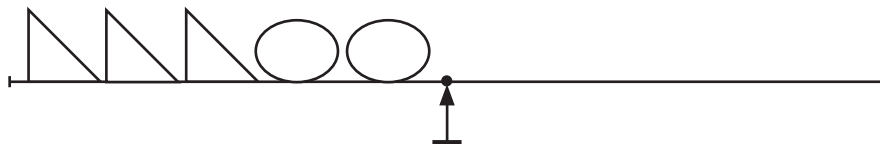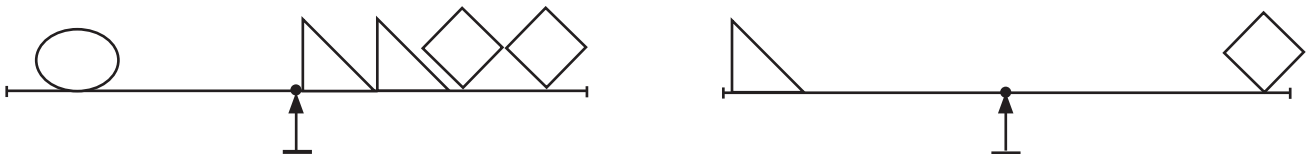
1

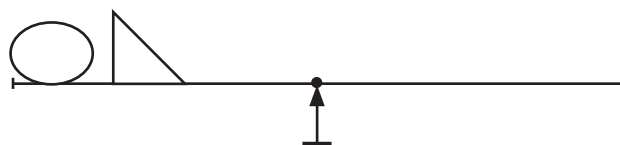**How can you balance these using squares?**

2

How can you balance these using squares?

3

How can you balance these using squares?

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*Name*   *Date*

Mixed

Choose the best strategy to solve these problems.

1 On their holiday, the Greebies boasted that the temperatures had never gone too high or dropped too low. On Monday, the temperature was 3° more than on Sunday, which had been 2° less than on Saturday. Saturday's temperature was 22°C, which was 4° less than Friday's had been. What were the temperatures for each day during the holiday?
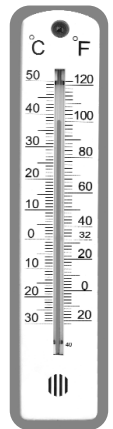
2 A proud little monkey tried to gather more grapes than his brothers and sisters. He brought home 40 grapes from the forest, but dropped 10 at the gate. He could only pick up 5 of these, and his mother gave him 8 more from her bundle. Stealthily, he stole 10 from his sister's basket but his mother made him give half of those back again. How many grapes did he end with?

3 Arrange the letters of the alphabet in a line so that:

- no vowels are beside each other.
- no letter is beside one which is next to it in alphabetical order.
- 's' is not between 'j' and 'f'.
- 'a' is not first and 'z' is not last.

_____

4 Jay, Kay and May, all a year apart in ages, like to measure their heights regularly. May is not the shortest but she is the oldest. Jay is 9, between Kay and May in age, and is 10 cm shorter than Kay. Kay is 135 cm in height and is the youngest. May is 20 cm taller than Jay. What are the girls' heights and ages?

Name	Age	Height