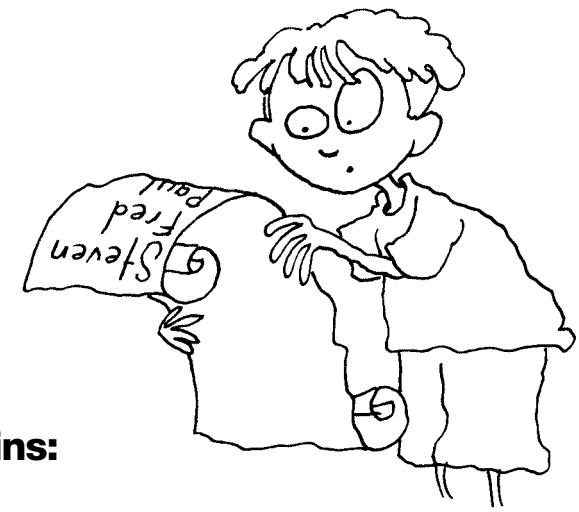
UNIT P8
Problem Solving
Middle Primary

Blake's Topic Bank

Problem Solving

Creating an Organised List

by **Sharon Shapiro**



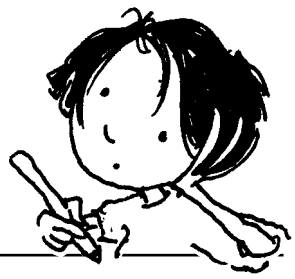
This unit contains:

- Teaching notes
- 3 teaching examples
- 1 BLM
- 18 task cards
- Answers

Problem Solving
Creating an Organised List

Sharon Shapiro

Middle Primary



The Problem Solving Process

It is important that students follow a logical and systematic approach to their problem solving. Following these four steps will enable students to tackle problems in a structured and meaningful way.

Step 1: Understanding the problem

- ❖ Encourage students to read the problem carefully a number of times until they fully understand what is wanted. They may need to discuss the problem with someone else or rewrite it in their own words.
- ❖ Students should ask internal questions such as, what is the problem asking me to do, what information is relevant and necessary for solving the problem.
- ❖ They should underline any unfamiliar words and find out their meanings.
- ❖ They should select the information they know and decide what is unknown or needs to be discovered. They should see if there is any unnecessary information.
- ❖ A sketch of the problem often helps their understanding.

Step 2: Students should decide on a strategy or plan

Students should decide how they will solve the problem by thinking about the different strategies that could be used. They could try to make predictions, or guesses, about the problem. Often these guesses result in generalisations which help to solve problems. Students should be discouraged from making wild guesses but they should be encouraged to take risks. They should always think in terms of how this problem relates to other problems that they have solved. They should keep a record of the strategies they have tried so that they don't repeat them.

Some possible strategies include:

- ❖ Drawing a sketch, graph or table.
- ❖ Acting out situations, or using concrete materials.
- ❖ Organising a list.
- ❖ Identifying a pattern and extending it.
- ❖ Guessing and checking.
- ❖ Working backwards.
- ❖ Using simpler numbers to solve the problem, then applying the same methodology to the real problem.
- ❖ Writing a number sentence.
- ❖ Using logic and clues.
- ❖ Breaking the problem into smaller parts.

Step 3: Solving the problem

- ❖ Students should write down their ideas as they work so they don't forget how they approached the problem.
- ❖ Their approach should be systematic.
- ❖ If stuck, students should reread the problem and rethink their strategies.
- ❖ Students should be given the opportunity to orally demonstrate or explain how they reached an answer.

Step 4: Reflect

- ❖ Students should consider if their answer makes sense and if it has answered what was asked.
- ❖ Students should draw and write down their thinking processes, estimations and approach, as this gives them time to reflect on their practices. When they have an answer they should explain the process to someone else.
- ❖ Students should ask themselves 'what if' to link this problem to another. This will take their exploration to a deeper level and encourage their use of logical thought processes.
- ❖ Students should consider if it is possible to do the problem in a simpler way.

Teaching Notes — Creating an Organised List

This strategy is similar to *Drawing a Table* (see Blake Education Topic Bank P2) but it is normally used when there is a greater amount of information available. It requires the information to be set out in a more systematic fashion so that the probable solutions can be clearly seen. Students need to follow a procedure or sequence to ensure all possibilities are listed and to prevent repetition.

When creating a list, one item should be kept the same or constant while the others change. The one that is kept constant should be examined to see if it has different values or components that can be listed.

Students should get into the habit of writing down the process they are using.

The following skills should be developed when working with this strategy.

Work sequentially

Decide on a starting point then work methodically.

Example:

The school captain and vice-captain are to be chosen from seven prefects. How many different choices can be made?

Let the symbols A B C D E F and G stand for the seven prefects.

AB	BA	CA	DA	EA	FA	GA
AC	BC	CB	DB	EB	FB	GB
AD	BD	CD	DC	EC	FC	GC
AE	BE	CE	DE	ED	FD	GD
AF	BF	CF	DF	EF	FE	GE
AG	BG	CG	DG	EG	FG	GF

42 choices can be made.

Filling in the gaps after working out a pattern

This skill challenges students to visualise and create imaginative pictures. The results are then listed.

For example:

Various animals are split in half and different combinations of the tops and bottoms are created. The animals used are a fish, dog, cat, mouse, guinea pig and rabbit. How many different combinations can be made.

Top	Bottom
fish	dog
	cat
	mouse
	guinea pig
	rabbit

There are five combinations for every top of an animal.

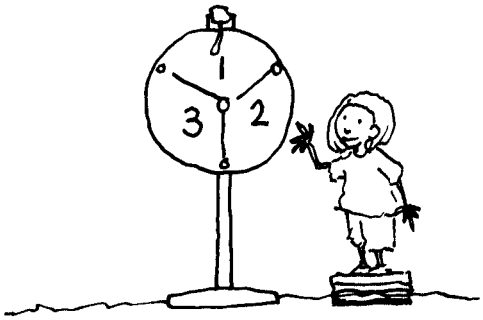
The answer is 6 x 5 = 30.

Combinations of numbers

At times, students are given problems that ask them to combine a series of numbers.

Example:

A game at the school fete involves three spins of a dial with the total of the three numbers spun giving you one of the prizes. How many prizes are needed?



Students will need to work systematically. They should start by listing all the possible combinations using one.

1+1+1=3	2+1+1=4	3+1+1=5
1+1+2=4	2+1+2=5	3+1+2=6
1+1+3=5	2+1+3=6	3+1+3=7
1+2+1=4	2+2+1=5	3+2+1=6
1+2+2=5	2+2+2=6	3+2+2=7
1+2+3=6	2+2+3=7	3+2+3=8
1+3+1=5	2+3+1=6	3+3+1=7
1+3+2=6	2+3+2=7	3+3+2=8
1+3+3=7	2+3+3=8	3+3+3=9

Notice that some answers are the same. Only one prize is needed for each possible answer. The possible answers are: 3, 4, 5, 6, 7, 8 and 9. Therefore they will need 7 prizes altogether.

Teaching Examples

Creating an Organised List

EXAMPLE 1

Shaun has three toy cars that he keeps on his bookcase. One is a Honda, one is a Toyota and the third is a Mazda. He likes to change the order in which he displays them. How many different ways can he do this?

Understanding the problem

What do we know?

Shaun has three toy cars. They are a Honda, a Toyota and a Mazda.
Shaun changes the order in which he displays the toy cars.

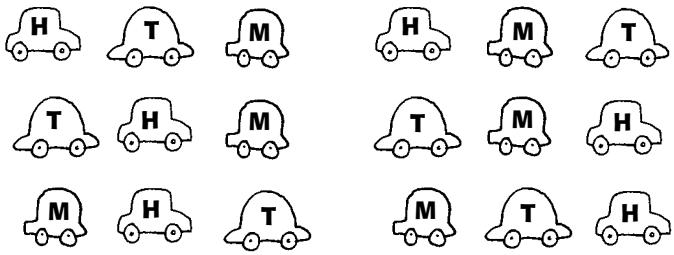
What do we need to find out?

Questioning:
How many different ways can they be displayed?
Will the display start with a different type of car each time?

Communicating a solution

Place the Honda first, then place the other cars in their two possible positions.

Example:



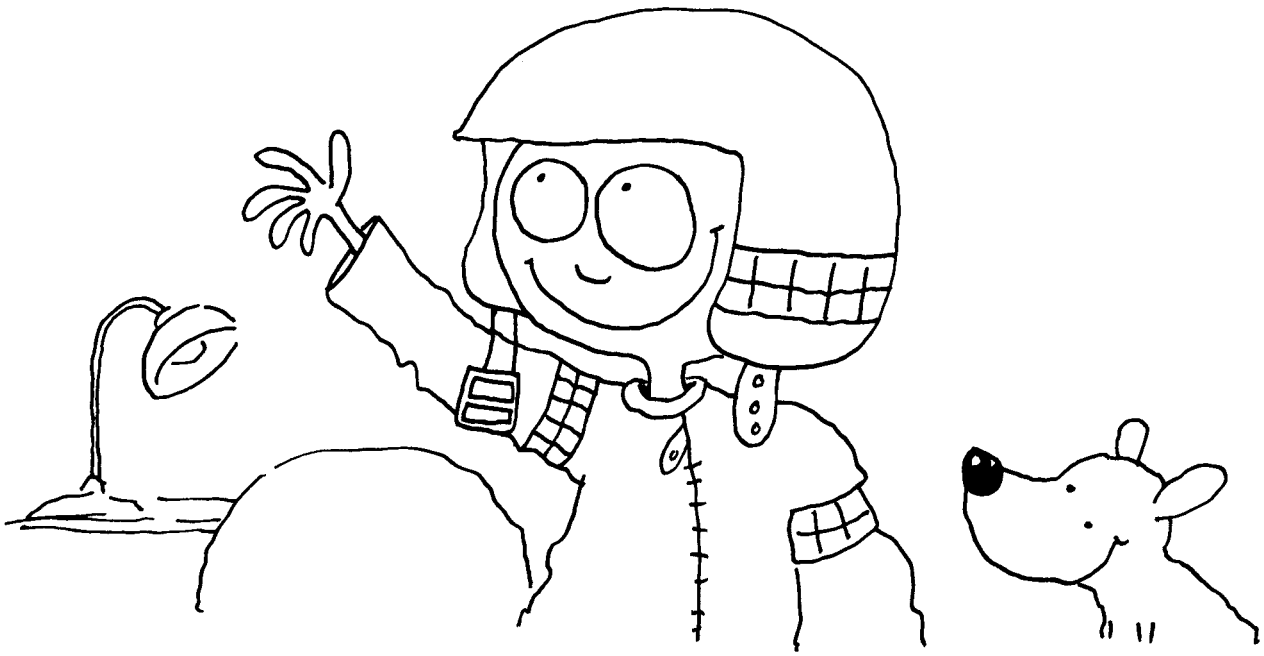
There are six different possibilities.

Reflecting and generalising

By giving each car a turn to be first and manipulating the other two cars we find there are six possible displays.

Extension

A similar approach can be tried using four objects, and then five.



EXAMPLE 2

Jane is dressing for a party and is struggling to decide what to wear. She has a black shirt, a white shirt and a T-shirt. She has a pair of jeans, black pants and a skirt. How many different outfits can she wear?

Understanding the problem

What do we know?

Jane has three shirts: a black shirt, a white shirt and a T-shirt.
She has a pair of jeans, a pair of pants and a skirt.

What do we need to find out?

Questioning:
How many different outfits can she wear?

Communicating a solution

Put the black shirt on and create the possible outfits. Repeat this with the other shirts.

black shirt	jeans
black shirt	black pants
black shirt	skirt
white shirt	jeans
white shirt	black pants
white shirt	skirt
T-shirt	jeans
T-shirt	black pants
T-shirt	skirt

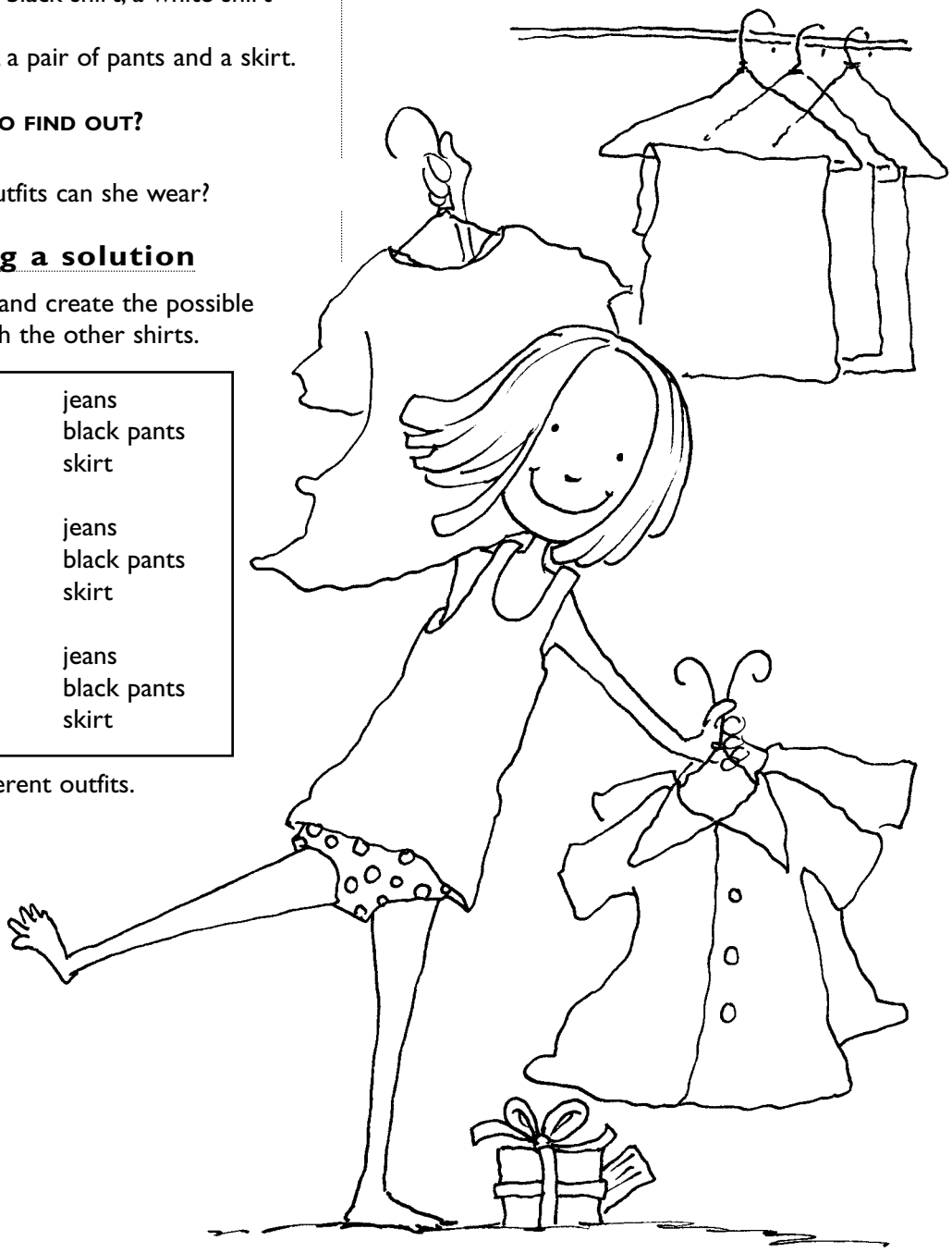
She can wear nine different outfits.

Reflecting and generalising

By giving each shirt a turn to be first, and pairing it with each possible other item in turn, we find that there are nine possible outfits.

Extension

Repeat the problem introducing a third or fourth item, for example shoes or hats.



EXAMPLE 3

Six people have to shake hands with each other. How many handshakes will there be?

Understanding the problem

What do we know?

Six people shake hands with each other.

What do we need to find out?

Questioning:
How many handshakes will there be?

Communicating a solution

There are six people, but each person will only shake hands five times, as they will not shake hands with themself.

Person 1 shakes hands with person 2
Person 1 shakes hands with person 3
Person 1 shakes hands with person 4
Person 1 shakes hands with person 5
Person 1 shakes hands with person 6

Person 2 shakes hands with person 3
Person 2 shakes hands with person 4
Person 2 shakes hands with person 5
Person 2 shakes hands with person 6

Person 3 shakes hands with person 4
Person 3 shakes hands with person 5
Person 3 shakes hands with person 6

Person 4 shakes hands with person 5
Person 4 shakes hands with person 6

Person 5 shakes hands with person 6

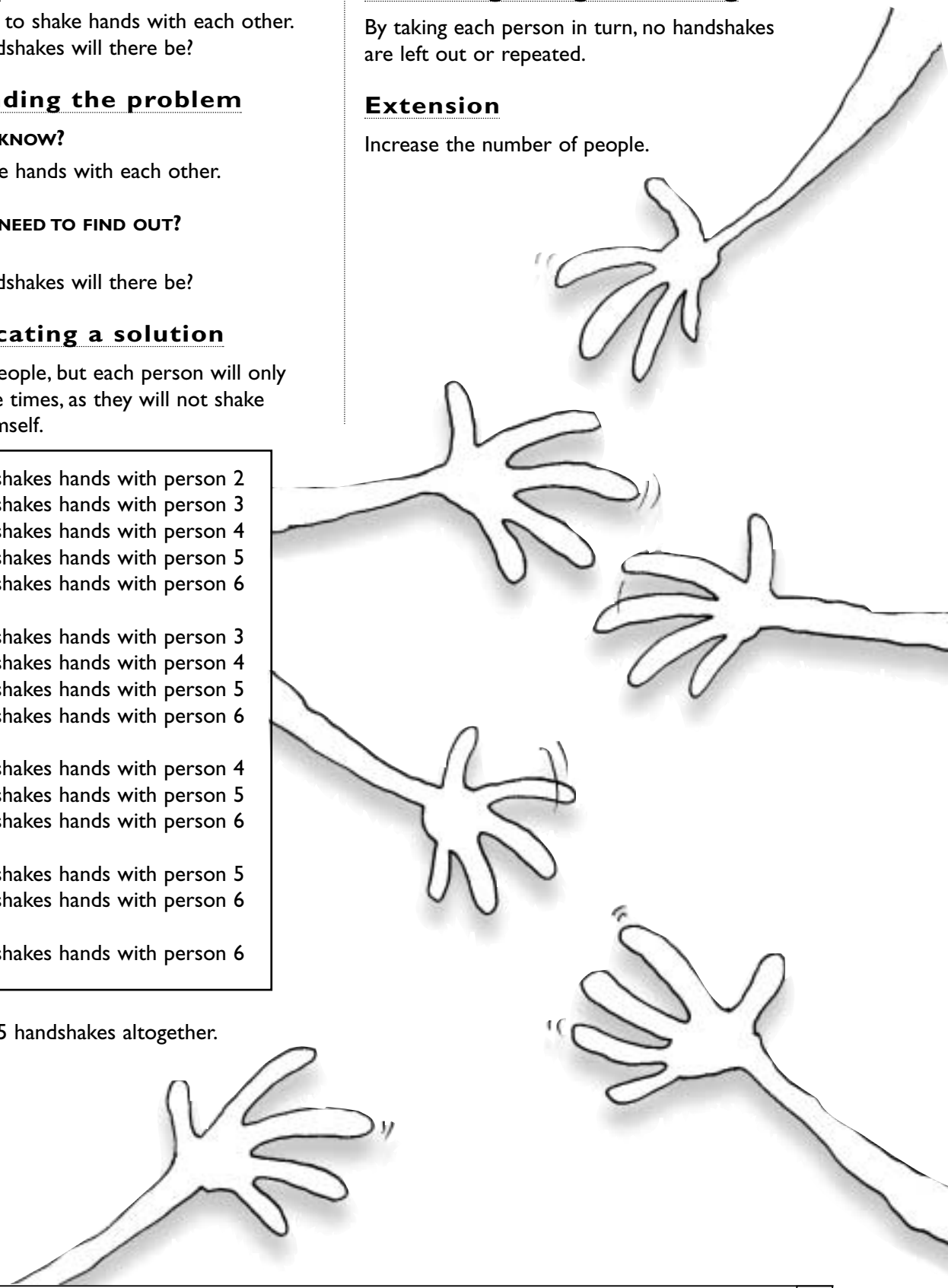
There will be 15 handshakes altogether.

Reflecting and generalising

By taking each person in turn, no handshakes are left out or repeated.

Extension

Increase the number of people.



BLM Creating an Organised List

★ Understanding the problem

List what you know .....

.....

.....

★ What do you need to find out?

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

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★ Planning and communicating a solution

Are you working sequentially? Can you develop a pattern?

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★ Reflecting and generalising

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

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★ Extension

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

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PROBLEM SOLVING TASK CARDS - Creating an Organised List

Problem 1

Space

Level 1

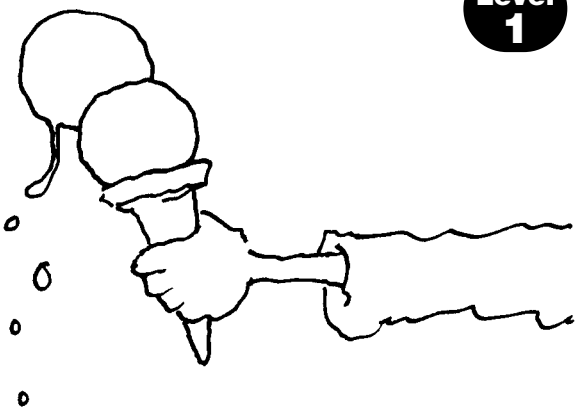
David, Brett, Jemma and Carmel are lining up to go to the cinema. How many different ways can they line up?

Problem 2

Number 1 2 3

Level 1

How many different double-scoop ice-cream cones can be made using the flavours vanilla, chocolate and strawberry? (Hint: vanilla on top and chocolate on the bottom is the same as chocolate on top and vanilla on the bottom.)

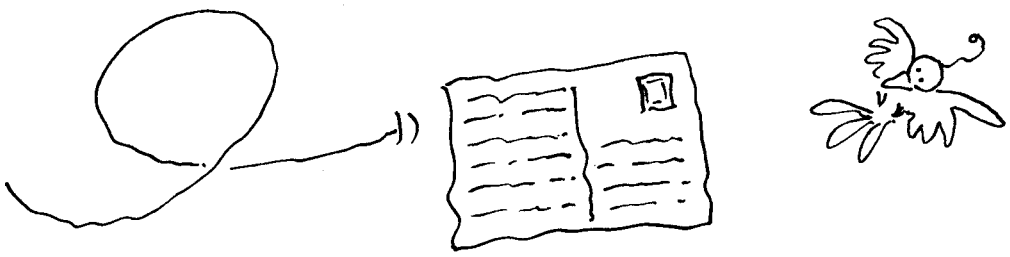


Problem 3

Number 1 2 3

Level 1

If four families send each other cards, how many are sent altogether?

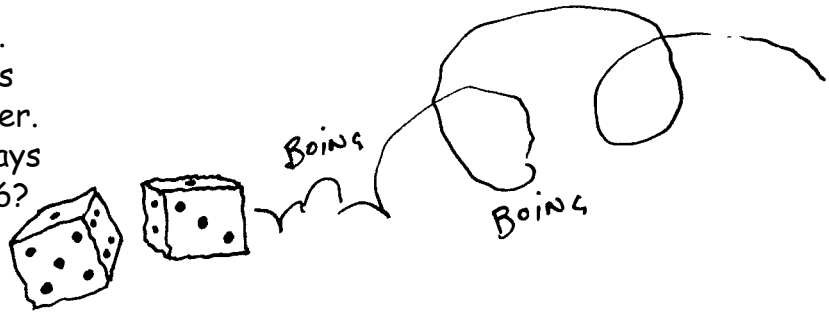


Problem 4

Number 1 2 3

Level 1

A pair of dice is rolled. The two rolled numbers are then added together. How many different ways can you roll a total of 6?



Problem 5

Number 1 2 3

Level 1

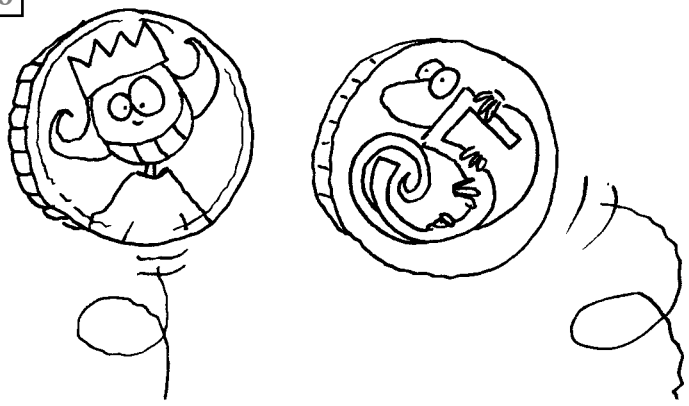
Mrs Henderson has just given birth to a baby girl. Mrs Henderson wants to name the baby Jane, Lucy, Kirsty or Ashley. Mr Henderson wants the baby's middle name to be either Rachel, Pam, Maggie or Susie. How many different name possibilities are there?

Problem 6

Number 1 2 3

Level 1

If you toss two coins in the air, what are all the possible outcomes when they land?



PROBLEM SOLVING TASK CARDS - Creating an Organised List

Problem 7

Space

Level 2

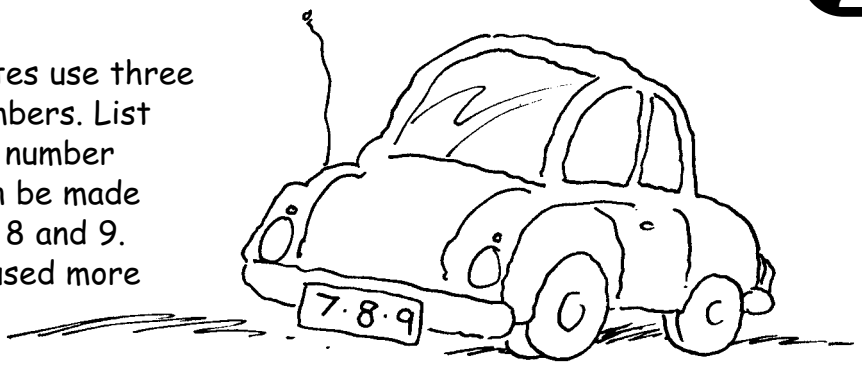
I have four metal sculptures to display on the mantelpiece above the fireplace. The first one is a cellist, the second a violinist, the third a flautist and the fourth a saxophonist. How many different ways can I organise the musicians?

Problem 8

Number 1 2 3

Level 2

Some car number plates use three letters and three numbers. List all the three numeral number combinations that can be made using the numerals 7, 8 and 9. Each number can be used more than once.



Problem 9

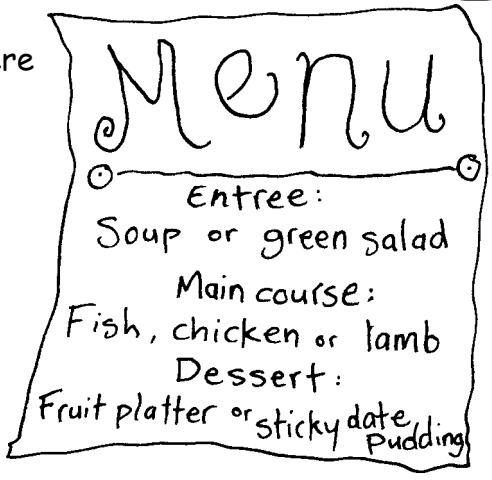
Number 1 2 3

Level 2

A group of diners go to a restaurant where there is a flat rate of $45 for lunch. One menu item for each course can be selected.

Entree: Soup or green salad
Main course: Fish, chicken or lamb
Dessert: Fruit platter or sticky date pudding

Show all the different dinner possibilities.

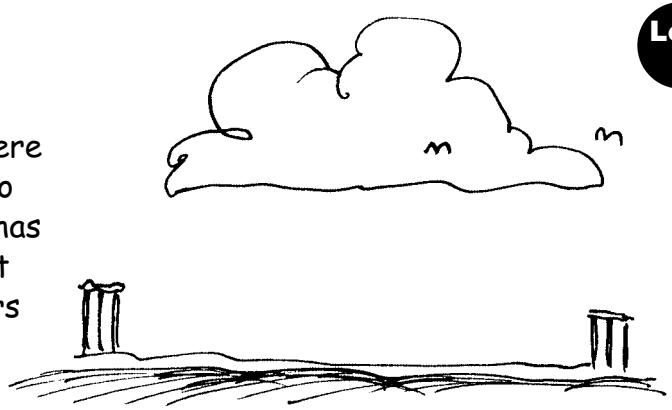


Problem 10

Number 1 2 3

Level 2

In a playground cricket game there are six students who are going to bowl to the batting team which has nine players. How many different combinations are there of players who can bat and bowl together?



Problem 11

Number 1 2 3

Level 2

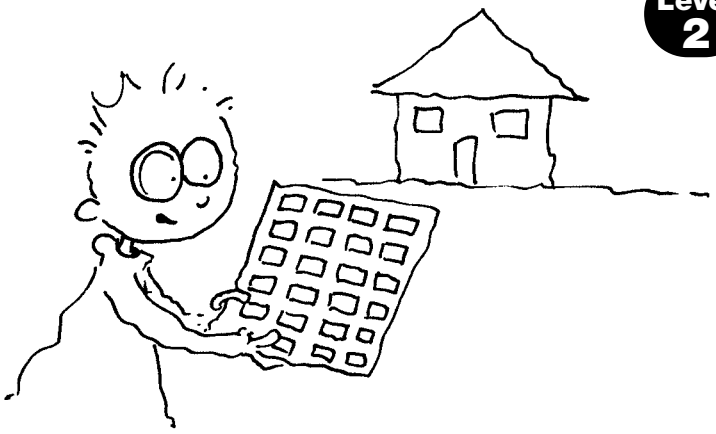
Adrian attends swimming training each morning at 6 am. He has to swim all four strokes (backstroke, breaststroke, freestyle and butterfly). To keep focused, he swims the strokes in a different order each day. How many different combinations are there?

Problem 12

Number 1 2 3

Level 2

Mr Wright is repainting his house. He is looking at colour charts and has to choose from blue, green or silver for his roof, and red, brown, gold, purple or cream for the walls. How many different paint combinations can he choose?



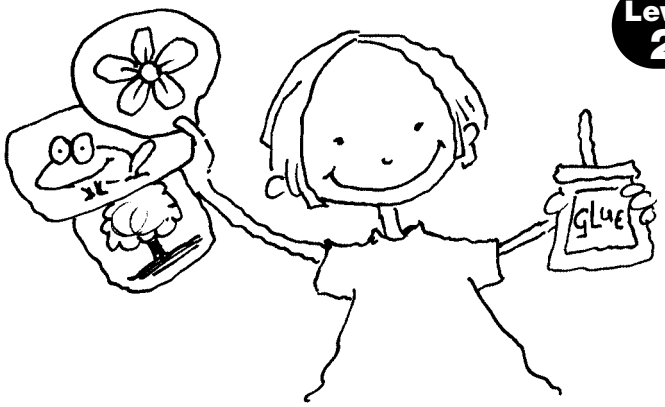
PROBLEM SOLVING TASK CARDS - Creating an Organised List

Problem 13

Number 1 2 3

Level 2

Marco has to decorate his three-page project with a picture on each page. He has three pictures to choose from. How many different ways can he use the pictures?

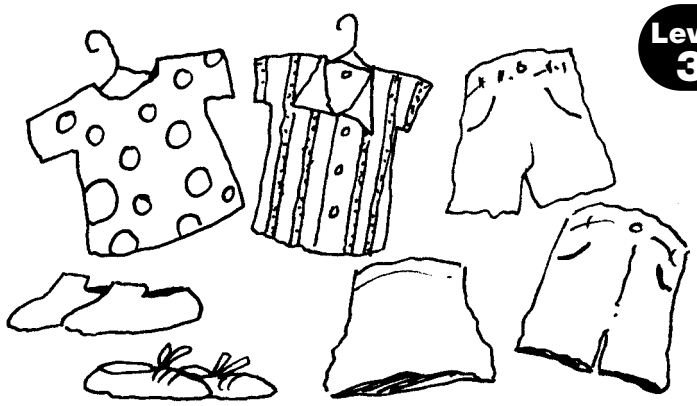


Problem 14

Number 1 2 3

Level 3

Gabriella has a spotted shirt and a striped shirt. She has green shorts, red shorts and a blue skirt. She can wear black or navy shoes. How many outfits can she make?



Problem 15

Number 1 2 3

Level 3

Jamie has to decide which one of his five friends to invite to come over to play. He can invite Steven, Fred, Paul, Jack or Cassie. They can play in the bedroom, playroom or outside. They can play a computer game, build with lego, make a jigsaw puzzle or play with a rubber ball. How many combinations are there?

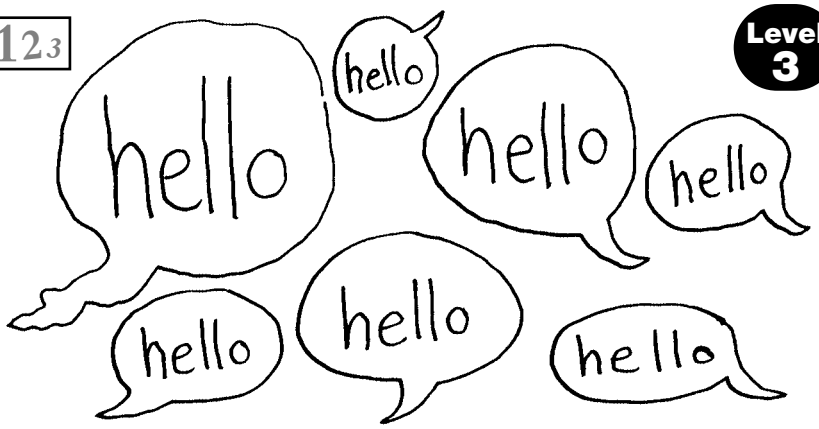
PROBLEM SOLVING TASK CARDS - Creating an Organised List

Problem 16

Number 1 2 3

Level 3

There were 35 people at a party. How many hello's were said if nobody said hello to anyone who had already said hello to them?

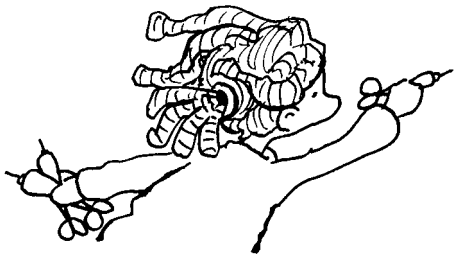


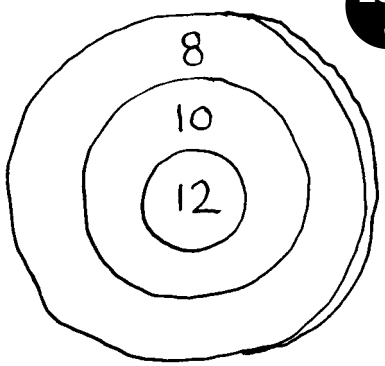
Problem 17

Number 1 2 3

Level 3

If three darts are thrown at this dartboard, and all of them hit the board, what are the possible totals?



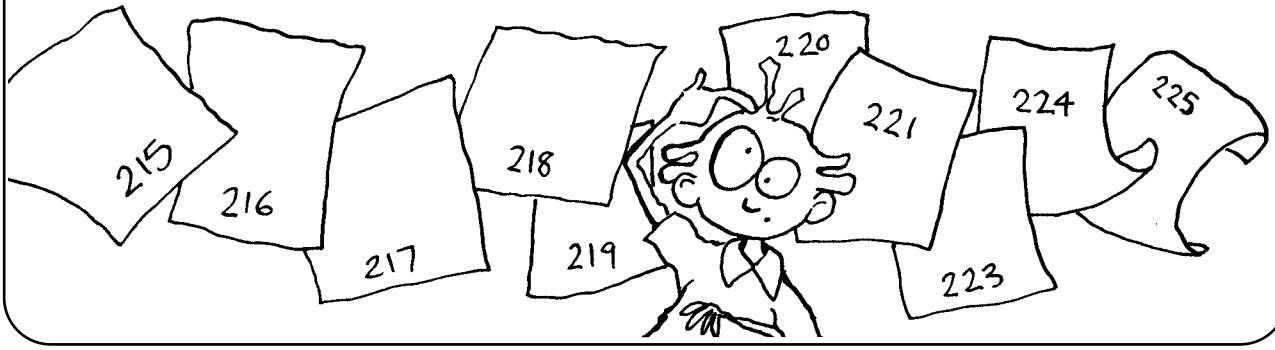


Problem 18

Number 1 2 3

Level 3

How many numerals are written when numbering a book of 225 pages?



Answers to Task Cards

Problem 1

David	Brett	Jemma	Carmel
David	Brett	Carmel	Jemma
David	Jemma	Brett	Carmel
David	Jemma	Carmel	Brett
David	Carmel	Brett	Jemma
David	Carmel	Jemma	Brett

Beginning with any particular child, there will be six combinations. Therefore there are 6 x 4 = 24 combinations in total.

Problem 2

vanilla	chocolate
vanilla	strawberry
vanilla	vanilla
chocolate	chocolate
chocolate	strawberry
strawberry	strawberry

There are six different possible combinations.

Problem 3

Families	A	B	C	D
	AB	BA	CA	DA
	AC	BC	CB	DB
	AD	BD	CD	DC

There are 12 cards altogether.

Problem 4

Listing only the combinations that add up to six:

1 and 5
2 and 4
3 and 3
4 and 2
5 and 1

There are five ways altogether to throw a combination that adds up to six.

Problem 5

Jane	Rachel	Kirsty	Rachel
Jane	Pam	Kirsty	Pam
Jane	Maggie	Kirsty	Maggie
Jane	Susie	Kirsty	Susie
Lucy	Rachel	Ashley	Rachel
Lucy	Pam	Ashley	Pam
Lucy	Maggie	Ashley	Maggie
Lucy	Susie	Ashley	Susie

There are 16 possible different name combinations.

Problem 6

H H
H T
T T
H T

There are 4 different possibilities.

Problem 7

C V F S	V C S F	S C F V	F C S V
C V S F	V C F S	S C V F	F C V S
C S F V	V F C S	S F C V	F S C V
C S V F	V F S C	S F V C	F S V C
C F V S	V S F C	S V F C	F V S C
C F S V	V S C F	S V C F	F V C S

There are 24 different positions.

Problem 8

777	787	797
778	788	798
779	789	799

There are nine combinations when 7 is used as the first digit. Therefore there are 9 x 3 = 27 combinations in total.

Problem 9

soup	fish	fruit platter
soup	fish	sticky date
soup	chicken	fruit platter
soup	chicken	sticky date
soup	lamb	fruit platter
soup	lamb	sticky date
green salad	fish	fruit platter
green salad	fish	sticky date
green salad	chicken	fruit platter
green salad	chicken	sticky date
green salad	lamb	fruit platter
green salad	lamb	sticky date

There are 12 possible dinners altogether.

Problem 10

6 bowlers

Each bowler bowls to 9 batters. Therefore there are 9 x 6 = 54 combinations altogether.

Bowler	Batter
1	1
1	2
1	3
1	4
1	5
1	6
1	7
1	8
1	9

Problem 11

Ba	Bu	F	Br
Ba	Bu	Br	F
Ba	F	Br	Bu
Ba	F	Bu	Br
Ba	Br	Bu	F
Ba	Br	F	Bu

There are 6 combinations with any stroke swum first. There are 6 x 4 = 24 combinations altogether.

Problem 12

blue	red	green	red
blue	brown	green	brown
blue	gold	green	gold
blue	purple	green	purple
blue	cream	green	cream

silver	red
silver	brown
silver	gold
silver	purple
silver	cream

He can choose from 15 different paint combinations.

Problem 13

Page 1	Page 2	Page 3
Pic 1	Pic 2	Pic 3
Pic 1	Pic 3	Pic 2
Pic 2	Pic 1	Pic 3
Pic 2	Pic 3	Pic 1
Pic 3	Pic 1	Pic 2
Pic 3	Pic 2	Pic 1

There are 6 possible ways Marco can use the three pictures.

Problem 14

spotted shirt	green shorts	black shoes
spotted shirt	green shorts	navy shoes
spotted shirt	red shorts	black shoes
spotted shirt	red shorts	navy shoes
spotted shirt	blue skirt	black shoes
spotted shirt	blue skirt	navy shoes

Each shirt can be used to create six possible outfits. Therefore there are 6 x 2 = 12 possible outfits altogether.

Problem 15

Steven	bedroom	computer
Steven	bedroom	lego
Steven	bedroom	jigsaw
Steven	bedroom	ball
Steven	playroom	computer
Steven	playroom	lego
Steven	playroom	jigsaw
Steven	playroom	ball
Steven	outside	computer
Steven	outside	lego
Steven	outside	jigsaw
Steven	outside	ball

For each friend there are 12 combinations. Since there are five friends to choose from, there are 12 x 5 = 60 combinations in total.

Problem 16

1st person says 34 hello's (once to each of the other people).

2nd person says 33 hello's (as the first person has already said hello to them).

3rd person says 32 hello's etc

34 + 33 + 32 + 31 + 30 + 29 + 28 + 27 + 26 + 25 + 24 + 23 + 22 + 21 + 20 + 19 + 18 + 17 + 16 + 15 + 14 + 13 + 12 +11 +10 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 595.

There are 595 hello's said.

Problem 17

12 + 12 + 12 = 36
12 + 12 + 10 = 34
12 + 12 + 8 = 32
12 + 10 + 10 = 32
12 + 10 + 8 = 30
12 + 8 + 8 = 28

10 + 10 + 10 = 30
10 + 10 + 8 = 28
10 + 8 + 8 = 26

8 + 8 + 8 = 24

The possible totals are 24, 26, 28, 30, 32, 34 and 36.

Problem 18

Pages	1–9	have 1 numeral.	1 x 9 = 9
	10–99	have 2 numerals.	2 x 90 = 180
	100–225	have 3 numerals.	3 x 126 = 378

There is a total of 567 numerals.