Blake's Topic Bank

UNIT P7
Problem Solving
Middle Primary

Problem Solving
Guessing and Checking

by **Sharon Shapiro**

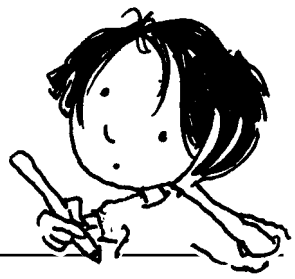
This unit contains:

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

Problem Solving
Guessing and Checking

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 Guessing and Checking

Guessing and checking is a highly useful strategy for problem solving which is often underestimated. It is a technique that requires students to begin with an educated guess (as opposed to a wild guess). The student's initial guess should take into account the important aspects of the specific problem. The student then checks their guess against the conditions of the problem, and if it is not a correct solution, revises it according to whether it is too small or too large. The process is repeated until a solution is found.

It is very important for students using this strategy to first note all of the important facts in the problem. This ensures that their guess is an informed guess, not simply a blind one.

Teachers will need to guide students if their starting points are totally unrealistic. The beginning point for students is learning how to make a reasonable guess to begin with. However, students will still learn from making faulty guesses.

The best way to deal with the information gathered when using the guess and check method is to draw up a table. This ensures that all guesses, and their results, are recorded systematically.

The guessing and checking strategy can be used by teachers to encourage those students who are not confident in their problem-solving ability. It can also be useful when students have had limited experience with problem solving, or when they encounter problems that seem to bear little relationship to problems they have solved previously.

The following steps are important when guessing and checking to solve a problem.

Taking note of the important facts

As mentioned, students should begin by taking careful note of the important aspects of the problem, and of what is the exact problem they are trying to solve.

For example, consider this problem:

Alana is five years older than Saul. Alana's age plus Saul's age totals 25. What are their ages?

Students should first note the important information given to them in the setting out of the problem. In this problem, the important information is that:
Alana is five years older than Saul.
Alana's age plus Saul's age totals 25.
What they are trying to find out by solving the problem is the ages of Alana and Saul.

Finding a starting point

The student should now make an initial guess, and consider whether it is reasonable. In the sample problem, for example, it would not be reasonable to guess either Alana's or Saul's age as greater than 25, since that is the total for the entire problem.

Say the student decides as an initial guess that Alana is 12 and Saul is 7.

The best way to keep a systematic record of guesses and results is in a table.

Drawing up a table

When drawing up the table, students will need to refer to the important factors of the specific problem. For the sample problem, the table should be drawn up with columns for Alana's age, Saul's age, and for the total created by Alana's age plus Saul's age.

Guess	Alana's age	Saul's age	Total

Testing the guess

Students should now test their guess.

If Alana is 12 and Saul is 7, the combined total of their ages is 19. Since the required total is 25, this guess is too low. The student must revise their guess to give a larger total.

Guess	Alana's age	Saul's age	Total
1	12	7	(19) Too Low

Say the student now guesses that Alana is 18 and Saul is 13.

The total is now too high, so the guess needs to be revised to give a smaller total.

Guess	Alana's age	Saul's age	Total
1	12	7	19
2	18	13	(31) Too High

If the student now guesses that Alana is 15 and Saul is 10, they will find they have a solution to the problem.

Guess	Alana's age	Saul's age	Total
1	12	7	19
2	18	13	31
3	15	10	(25) Correct

Because the results have been recorded in the table, students can see exactly what guesses they have made, and how close to solving the problem it got them.

Teaching Examples Guessing and Checking

Example 1

Jenny collected 45 stickers over a five-day period. Each day she was given three more stickers than the day before. How many was she given each day?

Understanding the problem

What do we know?

The total number of stickers is 45.
The stickers were collected over a five-day period.
Each day there were three more than the day before.

What do we need to find out?

Questioning: How many does she receive each day?

Communicating a solution

Give students a hint if they need a starting point. For example, it might be useful to start with five stickers. Keeping a running total will make it clear when the total of 45 stickers has been reached or exceeded.

Draw up a table with three rows and five columns.

Day	1	2	3	4	5
Number of stickers	5	8	11	14	17
Total	5	13	24	38	55

Guess 1 is too high. Start with a lower number of stickers for guess 2.

Guess 2

Day	1	2	3	4	5
Number of stickers	2	5	8	11	14
Total	2	7	15	26	40

After five days the total is too low, so start with a higher number for the guess 3.

Guess 3

Day	1	2	3	4	5
Number of stickers	3	6	9	12	15
Total	3	9	18	30	45

Guess 3 is accurate. Jenny is given 3 stickers on the first day, 6 on the second day, 9 on the third day, 12 on the fourth day, and 15 on the fifth day.

Reflecting and Generalising

Discuss related problem with students. Could the problem have been solved any other way? Can this method be used with similar problems?

Extension

The amount of stickers received could double each day, or stickers could be collected for a longer period of time. The total number of stickers collected could also be varied.

Teaching Examples Guessing and Checking

Example 2

A family set out on a five-day trek. Each day they travelled 50 km less than they had the day before. The total distance they travelled was exactly 1500 km. How far did they travel each day?

Understanding the problem

What do we know?

The family travelled for five days.
Each day they travelled 50 km less than the day before.
The total distance they travelled was 1500 kilometres.

What do we need to find out?

Questioning: How far did the family travel each day?

Communicating a solution

Begin by making a guess at the distance travelled on the first day. If students need help with a starting point, you could suggest they try 500 km.

Draw up a table with three columns and five rows.

Guess 1:

Day	Distance (km)	Total (km)
1	500	500
2	450	950
3	400	1350
4	350	1700
5		

The total distance travelled by the third day has not reached 1500 km, but by Day 4, it is greater than 1500 km.

For guess 2, try starting with a lower number, say 350 km:

Day	Distance (km)	Total (km)
1	350	350
2	300	650
3	250	900
4	200	1100
5	150	1250

Starting with a guess of 350 km travelled on the first day, the family has not travelled far enough by the fifth day.

For guess 3, try a number in between the two that have already been tried, for example 400 km.

Day	Distance (km)	Total (km)
1	400	400
2	350	750
3	300	1050
4	250	1300
5	200	1500

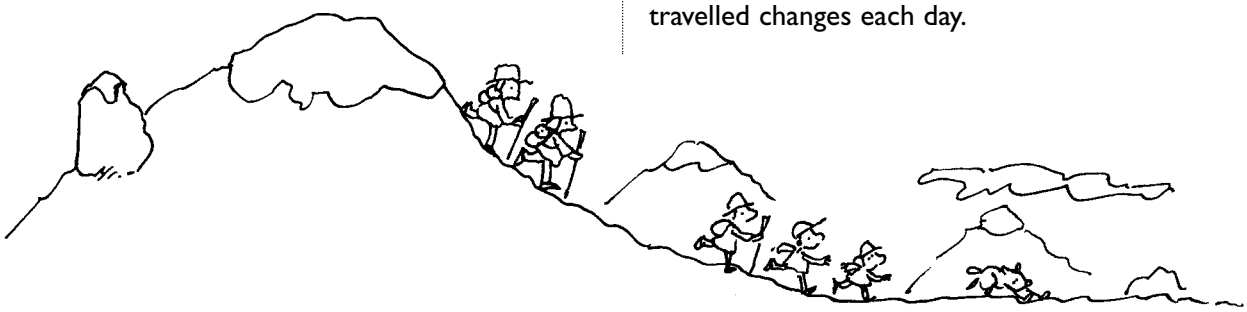
This guess gives a correct solution. On the first day, the family travelled 400 km; on the second day, 350 km; on the third day, 300 km; on the fourth day, 250 km; and 200 km on the fifth day.

Reflecting and Generalising

Through the process of guessing and checking, a solution was reached. This strategy can be used for other problems that do not begin with a fixed starting point, but feature increases or decreases of a fixed amount.

Extension

To extend this kind of problem, several factors can be varied, for example the total distance travelled; the length of the trip; the way the distance travelled changes each day.



Example 3

Arrange the counting numbers from 1–6 to form a triangle, so that the sum of the numbers on each side of the triangle add up to 10.

Understanding the problem

What do we know?

The counting numbers 1-6 are to be used.
The numbers on each side of the triangle must add up to 10.

What do we need to find out?

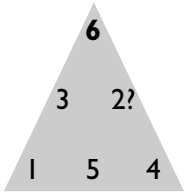
Questioning: Where are we going to place the numbers?

Communicating a solution

Students could start by choosing one of the numbers from one to six, and placing it at the top of the triangle. They can then experiment with adding the other numbers, to see if they can make the sides of the triangle add up to 10.

Guess 1:

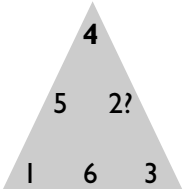
Start with the number six at the top of the triangle. This is just one example of how the triangle can be completed:



Students will find that it is not possible to solve this problem beginning with the number six at the top

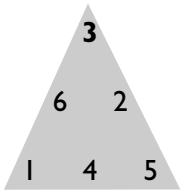
Guess 2:

This time, start with the number four at the top. This is an example of how the triangle can be completed:



Students will find that, using the number 4 at the top of the triangle, it is not possible to construct a triangle so that the sides add up to 10.

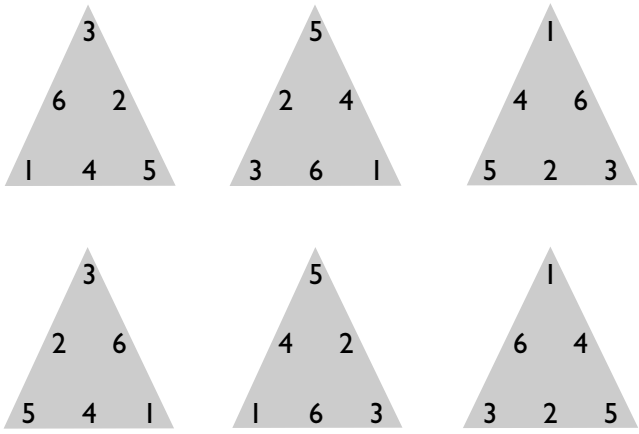
Guess 3:



This time, try placing the number 3 at the top of the triangle. Again, this is just one example of how the triangle can then be constructed.

This triangle is a correct solution to the problem. All the sides of the triangle add up to 10.

The possible solutions are:



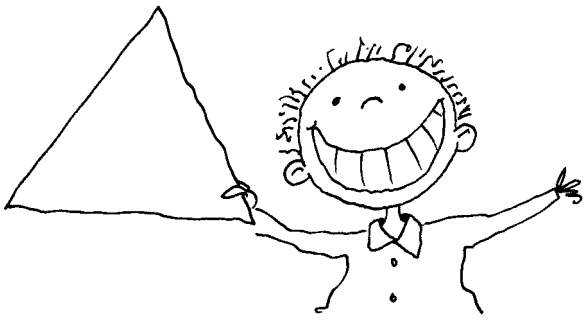
In each case, 1, 3 and 5 must be the corner numbers.

Reflecting and Generalising

This approach can be used with different sets of counting numbers, and a different required total for the sides.

Extension

As an extension, students could use the counting numbers from 4–9, with the sum of the numbers on each side coming to 18.



BLM Guessing and Checking

★ 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?

★ Planning and communicating a solution

Is your guess reasonable? If not, should your starting point be raised or lowered? Are you working systematically and eliminating all the incorrect criteria?

★ Reflecting and generalising

How accurate is your answer? How can you apply this strategy to other problems? Could a more effective method have been used?

★ Extension

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

PROBLEM SOLVING TASK CARDS - Guessing and Checking

Problem 1 Number 1 2 3

Level 1

Forty students are going to a camp. There are twelve more boys than girls going. How many girls are there?

Problem 2 Number 1 2 3

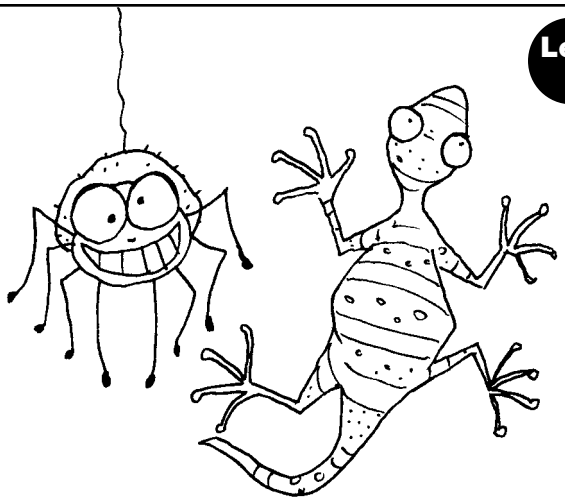
Level 1

At the local swimming pool it costs $1.00 to hire a towel and 60c to hire a deckchair. Rebecca hired some of each and spent $5.80 altogether. How many towels and how many deckchairs did she hire?

Problem 3 Number 1 2 3

Level 1

On a visit to the zoo, a group of children decided to count the heads and legs of the spiders and lizards in one of the enclosures. They found that there were 10 heads and 60 legs altogether. How many spiders and lizards were there?

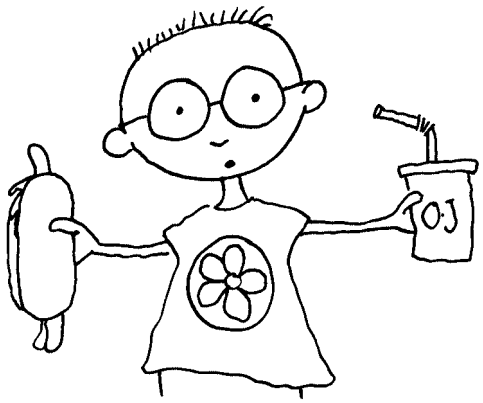


PROBLEM SOLVING TASK CARDS - Guessing and Checking

Problem 4 Number 1 2 3

Level 1

Yasmine bought a hot dog and an orange drink for $2.85. The hot dog cost twice as much as the orange drink. What was the cost of each one?



Problem 5 Number 1 2 3

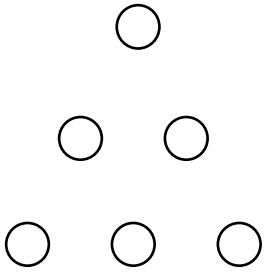
Level 1

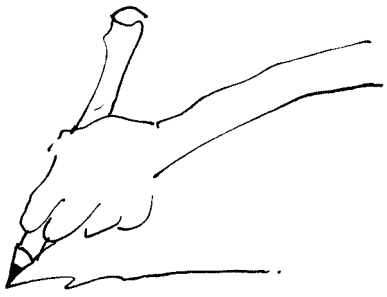
Jordan is buying concert tickets for eight friends. He has $50. A reserve seats cost $7 each, and B reserve seats are $5. If he buys some of each kind, and spends exactly $50, how many tickets does he buy?

Problem 6 Number 1 2 3

Level 1

Complete the following triangle using the numbers 1–6. Each side must add up to 12.



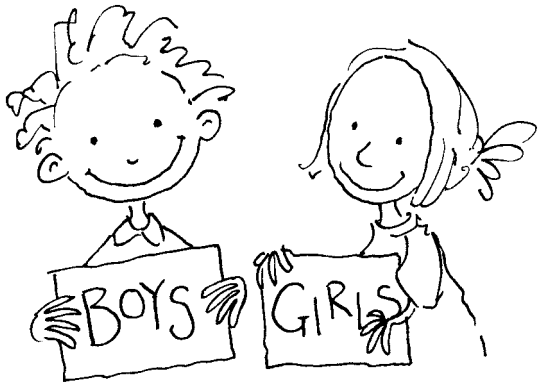


PROBLEM SOLVING TASK CARDS - Guessing and Checking

Problem 7 Number 1 2 3

Level 2

There are 757 students enrolled at a school. There are 37 more girls than boys. How many boys are there?



Problem 8 Number 1 2 3

Level 2

Find at least three different ways to score 101 by adding four of the following numbers: 50, 30, 27, 25, 20, 19, 16, 15 and 7.

Problem 9 Number 1 2 3

Level 2

Lisa keeps parakeets and mice as pets. She has eleven pets altogether, and they have 36 legs between them. How many mice does she have?

PROBLEM SOLVING TASK CARDS - Guessing and Checking

Problem 10 Number 1 2 3

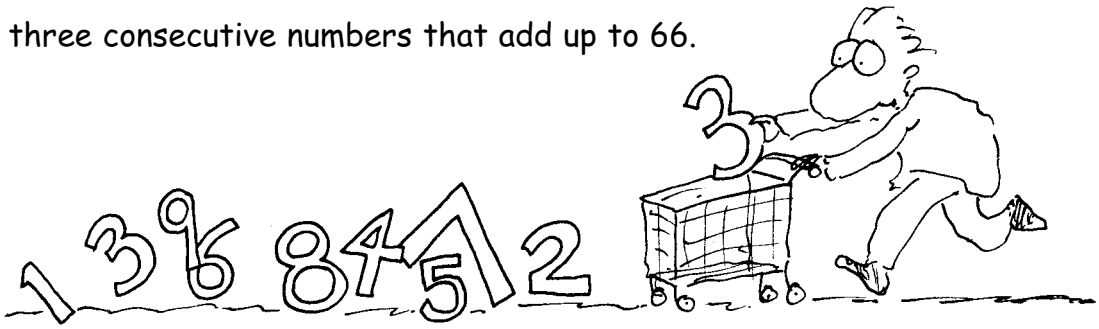
Level 2

Ally has 56 books in her bookcase. They are either adventure stories or biographies. She has 14 more adventure story books than biographies. How many of each type of book does she have?

Problem 11 Number 1 2 3

Level 2

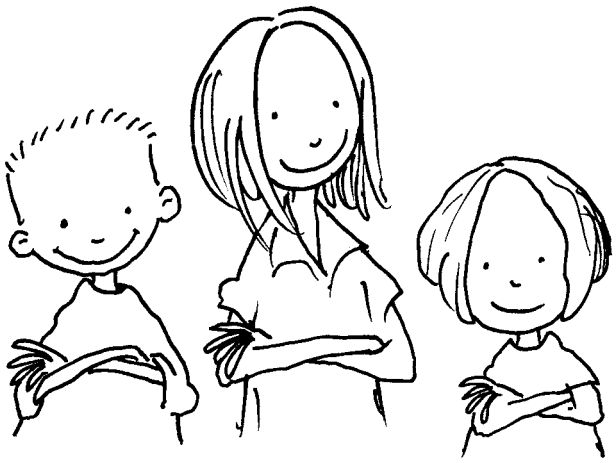
Find three consecutive numbers that add up to 66.



Problem 12 Number 1 2 3

Level 2

Carolyn is twice as old as Jackie. Ben is five years older than Jackie. The sum of the ages of the three children is 41. What are their ages?



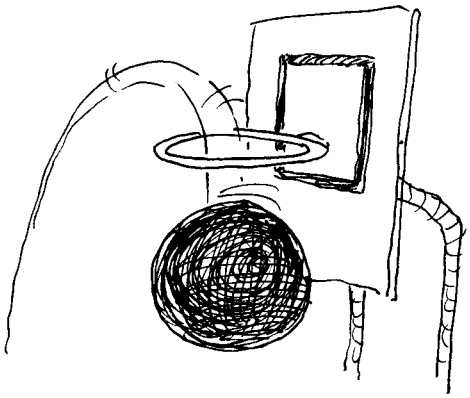
PROBLEM SOLVING TASK CARDS - Guessing and Checking

Problem 13

Number 1 2 3

Level 2

In a basketball game, Jeff, Henry and George scored 20 goals between them. Jeff scored the lowest, and George scored the highest. Jeff's score doubled was between Henry's and George's. How many goals did Jeff score?

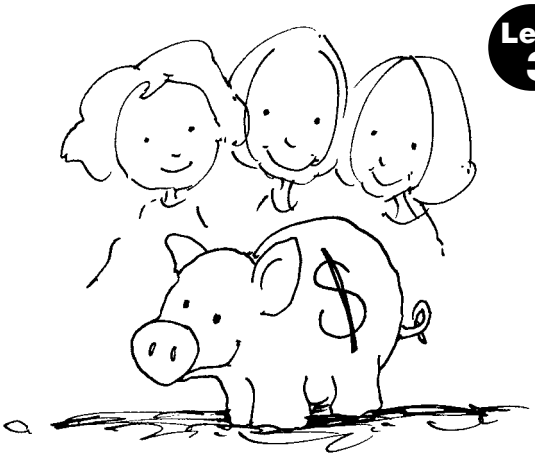


Problem 14

Number 1 2 3

Level 3

Three sisters put their money together to buy an anniversary present for their parents. Between them, Michelle, Lauren and Holly have saved $20. Michelle saved $3 more than Lauren, and Lauren saved $4 more than Holly. How much did each of the sisters save?



Problem 15

Measurement

Level 3

A carpenter is busy making three-legged stools and four-legged chairs for a furniture fair. She managed to produce 30 items of furniture. When she counted, there were 104 legs altogether (not counting hers). How many chairs and stools were there?

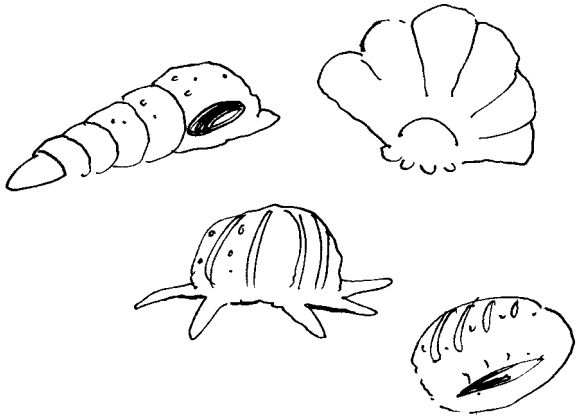
PROBLEM SOLVING TASK CARDS - Guessing and Checking

Problem 16

Number 1 2 3

Level 3

Riad collected 50 seashells over a period of five days. Each day he collected three more than he had the day before. How many shells did Riad collect each day?

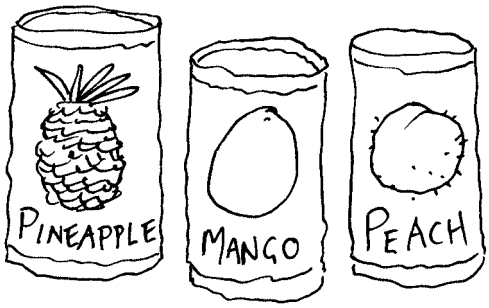


Problem 17

Number 1 2 3

Level 3

On a shelf at the supermarket there are 95 tins of three types of fruit— mangoes, peaches and pineapple. There are eight more tins of mangoes than of peaches, but three more tins of peaches than there are tins of pineapple. How many tins of mangoes, peaches and pineapple are there?

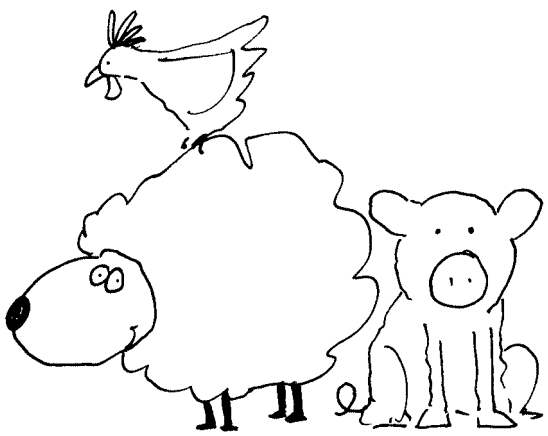


Problem 18

Number 1 2 3

Level 3

Mrs Harrison sold 48 animals at the market. Her pigs sold for $20 each, her hens for $5 each and her sheep for $10 each. She collected $505 from the sale. How many of each type of animal did she sell?



Answers to Task Cards

Problem 1

Sample guess and check solution:

	Girls	Boys	Total	
Guess 1:	6	18	24	too low
Guess 2:	12	24	36	still too low
Guess 3:	14	26	40	correct

There are 14 girls going to the camp.

Problem 2

Sample guess and check solution:

Guess	Towels ($1)	Deckchairs (60c)	Total	
1:	2 ($2.00)	2 ($1.20)	$3.20	too low
2:	3 ($3.00)	4 ($2.40)	$5.40	still too low
3:	4 ($4.00)	3 ($1.80)	$5.80	correct

Rebecca hired four towels and three deckchairs.

Problem 3

Since the total number of heads is 10, the total number of animals must be 10.

Sample guess and check solution:

Guess	Spiders (8 legs)	Lizards (4 legs)	Total heads	Total legs	
1:	1 (8 legs)	9 (36 legs)	10	44	too low
2:	3 (24 legs)	7 (28 legs)	10	52	still too low
3:	5 (40 legs)	5 (20 legs)	10	60	correct

Five spiders and five lizards gives a total of 10 heads and 60 legs.

Problem 4

	Orange juice	Hot dog	Total	
Guess 1:	$1.00	$2.00	$3.00	too high
Guess 2:	80c	$1.60	$2.40	too low
Guess 3:	95c	$1.90	$2.85	correct

The orange juice cost 95c and the hot dog cost $1.90.

Problem 5

Sample guess and check solution:

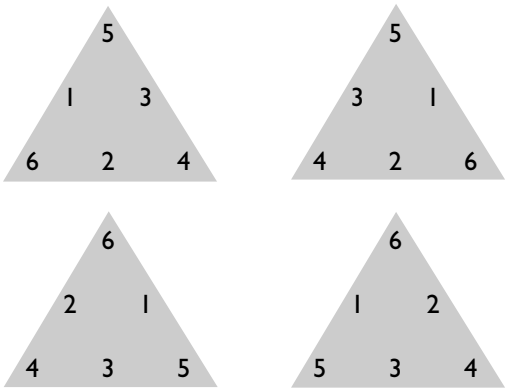
Remember there must be 8 tickets in total.

	$7 tickets	$5 tickets	Total	
Guess 1:	3 ($21)	5($25)	$46	too low
Guess 2:	6 ($42)	2($10)	$52	too high
Guess 3:	5 ($35)	3($15)	$50	correct

Jordan buys five tickets for $7, and three tickets for $5.

Problem 6

Possible solutions are:



(In each case, 4, 5 and 6 are the corner numbers.)

Problem 7

Sample guess and check solution:

	Boys	Girls	Total	
Guess 1:	100	137	237	too low
Guess 2:	300	337	637	still too low
Guess 3:	400	437	837	too high
Guess 4:	350	387	737	too low
Guess 3:	360	397	757	correct

There are 360 boys altogether.

Problem 8

1. 50 + 20 + 16 + 15 = 101
2. 50 + 25 + 19 + 7 = 101
3. 30 + 27 + 25 + 19 = 101

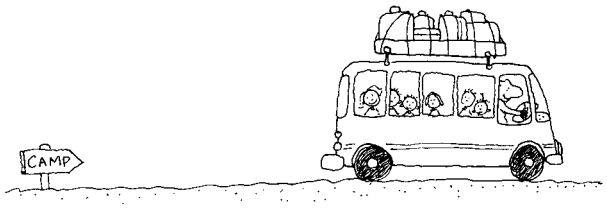
Problem 9

Sample guess and check solution:

Remember there must be 11 animals in total.

	Parakeets (2 legs)	Mice (4 legs)	Total legs	
Guess 1:	6 (12 legs)	5 (20 legs)	32	too low
Guess 2:	5 (10 legs)	6 (24 legs)	34	still too low
Guess 3:	4 (8 legs)	7 (28 legs)	36	correct

Lisa has seven mice.



Problem 10

Sample guess and check solution:

	Biographies	Adventure	Total books	
Guess 1:	15	29	44	too low
Guess 2:	17	31	48	too low
Guess 3:	20	34	54	too low
Guess 4:	21	35	56	correct

Ally has 35 adventure books and 21 biography books.

Problem 11

Sample guess and check solution:

Guess 1:	10 + 11 + 12 = 33	too low
Guess 2:	20 + 21 + 22 = 63	still too low
Guess 3:	25 + 26 + 27 = 78	too high
Guess 4:	21 + 22 + 23 = 66	correct

The three consecutive numbers are 21, 22 and 23.

Problem 12

Sample guess and check solution:

Start by guessing Jackie's age.

	Jackie	Carolyn	Ben	Total	
Guess 1:	5	10	10	25	too low
Guess 2:	11	22	16	49	too high
Guess 3:	10	20	15	45	still too high
Guess 4:	9	18	14	41	correct

Jackie is 9, Carolyn is 18, and Ben is 14.

Problem 13

Sample guess and check solution:

	Jeff	Henry	George	Total goals	
Guess 1:	2	3	5	10	too low
Guess 2:	3	5	7	15	too low
Guess 3:	4	7	9	20	correct

Jeff scored 4, Henry scored 7, and George scored 9 goals.

(An alternative solution is that Jeff scored 4 goals, Henry 6 goals, and George 10 goals.)

Problem 14

Sample guess and check solution:

	Michelle	Lauren	Holly	Total	
Guess 1:	$15	$12	$8	$35	too high
Guess 2:	$8	$5	$1	$14	too low
Guess 3:	$10	$7	$3	$20	correct

Michelle had saved $10, Lauren had saved $7, and Holly had saved $3.

Problem 15

Sample guess and check solution:

There are 30 items of furniture altogether.

	Stools (3 legs)	Chair (4 legs)	Total legs	
Guess 1:	26 (78 legs)	4 (16 legs)	94	too low
Guess 2:	20 (60 legs)	10 (40 legs)	100	still too low
Guess 3:	15 (45 legs)	15 (60 legs)	105	too high
Guess 4:	16 (48 legs)	14 (56 legs)	104	correct

There were 16 stools and 14 chairs.

Problem 16

Sample guess and check solution:

	Day 1	Day 2	Day 3	Day 4	Day 5	Total shells	
Guess 1:	5	8	11	14	17	55	too high
Guess 2:	2	5	8	11	14	40	too low
Guess 3:	4	7	10	13	16	50	correct

He collected 4 shells on day one, 7 shells on day two, 10 shells on day three, 13 shells on day four and 16 shells on the fifth day.

Problem 17

Sample guess and check solution:

Start by guessing the number of tins of mangoes.

	Mangoes	Peaches	Pineapple	Total tins	
Guess 1:	26	18	15	59	too low
Guess 2:	40	32	29	101	too high
Guess 3:	38	30	27	95	correct

There are 38 tins of mangoes, 30 tins of peaches and 27 tins of pineapple.

Problem 18

Sample guess and check solution:

The number of animals must add up to 48.

Guess	Pigs ($20)	Hens ($5)	Sheep ($10)	Total	
1:	15 ($300)	15 ($75)	18 ($180)	$555	too high
2:	9 ($180)	30 ($150)	9 ($90)	$420	too low
3:	12 ($240)	19 ($95)	17 ($170)	$505	correct

Mrs Harrison sold 12 pigs, 19 hens and 17 sheep.