2024 Maths Games Junior - Years 5 & 6
Resource Kit 1
Teaching Problem Solving

Problem Solving Strategies

This resource kit follows on from the Preparation Kit and its emphasis on:

Guess, Check and Refine

Draw a Diagram

The problems are sourced from previous Junior (Division J) Maths Olympiads and Maths Games papers.

They introduce two new problem solving strategies:

1. Find a Pattern

One of the most frequently used problem solving strategies is that of recognising and extending a pattern.

Students can often simplify a difficult problem by identifying a pattern in it, and then applying that pattern to the problem situation.

2. Build a Table

A table displays information so that it is easily located and understood, and missing information becomes obvious.

If students are not given the data for a problem, and must generate it themselves, a table is an excellent way to record what they have done so they don't have to repeat their efforts.

A table can also be invaluable for detecting significant patterns.

Resource Kit 1 focuses on:

Find a Pattern

Build a Table

Set Yellow

Example problems for which full worked solutions are included.

Set Green

Problems that are designed to be similar to Set Yellow, but with fewer difficult elements.

Set Orange

Problems that are similar in mathematical structure to the corresponding Yellow problems.

Further questions and solution methods can be found in the APSMO resource book "Building Confidence in Maths Problem Solving", available from www.apsmo.edu.au.

How to use these problems

At the start of the lesson, present the problem and ask the students to think about it. Encourage students to try to solve it in any way they like. When the students have had enough time to consider their solutions, ask them to describe or present their methods, taking particular note of different ways of arriving at the same solution.

Each question includes at least one solution method that the majority of students should be able to follow. By participating in lessons that demonstrate achievable problem solving techniques, students may gain increased confidence in their own ability to address unfamiliar problems.

Finally, the consideration of different solution methods is fundamental to the students' development as effective and sophisticated problem solvers. Even when students have solved a problem to their own satisfaction, it is important to expose them to other methods and encourage them to judge whether or not the other methods are more efficient.

Preparation Kit

Guess, Check and Refine

This involves making a reasonable guess of the answer, and checking it against the conditions of the problem. An incorrect guess may provide more information that may lead to the answer.

Draw a Diagram

A diagram may reveal information that may not be obvious just by reading the problem.

It is also useful for keeping track of where the student is up to in a multi-step problem.

Resource Kit 1

Find a Pattern

A frequently used problem solving strategy is that of recognising and extending a pattern.

Students can often simplify a difficult problem by identifying a pattern in the problem situation.

Build a Table

A table displays information so that it is easily located and understood.

A table is an excellent way to record data so the student doesn't have to repeat their efforts.

Resource Kit 2

Work Backwards

If a problem describes a procedure and then specifies the final result, this method usually makes the problem much easier to solve.

Make an Organised List

Listing every possibility in an organised way is an important tool.

How students organise the data often reveals additional information.

Resource Kit 3

Solve a Simpler Related Problem

Many hard problems are actually simpler problems that have been extended to larger numbers.

Patterns can sometimes be identified by trying the problem with smaller numbers.

Eliminate All But One Possibility

Deciding what a quantity is not, can narrow the field to a very small number of possibilities.

These can then be tested against the conditions of the original problem.

Resource Kit 4

Convert to a More Convenient Form

There are times when changing some of the conditions of a problem makes a solution clearer or more convenient.

Divide a Complex Shape

Sometimes it is possible to divide an unusual shape into two or more common shapes that are easier to work with.

Set Yellow

1.1) There are 38 children on a bus.

There are 4 more girls on the bus than boys.

How many boys are there on the bus?

1.2) Michelle's Number Recycling Machine obeys exactly two rules:

1. If an inserted number has exactly 1 digit, double the number.

2. If an inserted number has exactly 2 digits, compute the sum of the digits.

The first number Michelle inserts is 1.

Then every answer she gets is inserted back into the machine until fifty numbers are inserted.

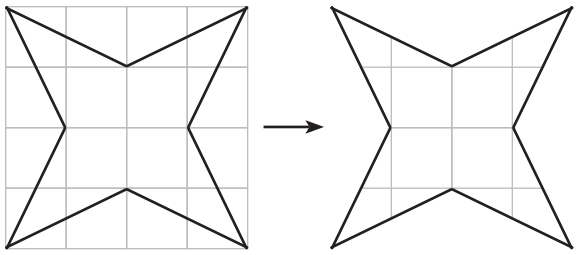
What is the fiftieth number to be inserted?

1.3) If it's 2:00 p.m. right now, what time will it be 50 hours from now?

Include a.m. or p.m. in your answer.

1.4) A four-pointed star is drawn on square grid paper and then cut out, as shown.

In how many ways can it be folded in half so that both halves overlap exactly?



Set Yellow

1.5) Consecutive numbers form a sequence, where each number is 1 greater than the previous number.
For example, 7, 8, 9 are three consecutive counting numbers.
Find the smallest number which can be expressed as:

- the sum of two consecutive counting numbers, and also as
- the sum of three consecutive counting numbers.

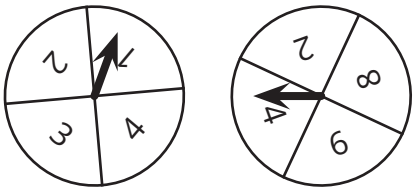
1.6) In a board game, a number is made by adding the number spun on Spinner A to the number spun on Spinner B.

Spinner A has the numbers 1, 2, 3 and 4 on it.

Spinner B has the numbers 2, 4, 6 and 8 on it.

In how many different ways can you spin a total that is odd?

(We will consider 1+6 and 3+4 to be two different ways.)



Spinner A Spinner B

1.7) A scientist has labelled a row of plants with numbers from 1 to 40.
He gives extra water to every second plant, starting with plant number 2.
He gives extra fertiliser to every third plant, starting with plant number 3.
He shades every fourth plant, starting with plant number 4.
What is the number of the first plant to receive all three treatments?

1.8) State three consecutive numbers, each less than 100, such that:

- the smallest is divisible by 6,
- the next is divisible by 5, and
- the largest is divisible by 4.

(Note: Consecutive numbers are whole numbers that follow in order. An example is 4, 5, 6, 7, 8.)

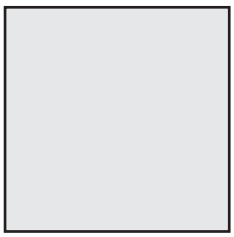
Set Green

1.1) There are 8 children on a bus.
There are 4 more girls on the bus than boys.
How many boys are there on the bus?

1.2) Harry's Number Recycling Machine obeys exactly two rules:
If the inserted number has just 1 digit, double the number and print out the result.
Otherwise, if the inserted number has 2 digits, remove the tens digit and print out the result.
The first number Harry inserts is 2.
Then every answer he gets is inserted back into the machine until twenty numbers are inserted.
What is the twentieth number to be inserted?

1.3) If it's 2:00 p.m. right now, what time will it be 48 hours from now?
Include a.m. or p.m. in your answer.

1.4) In how many ways can a square be folded in half so that both halves overlap exactly?



Set Green

1.5) Consecutive numbers form a sequence, where each number is 1 greater than the previous number.

For example, 7, 8, 9 are three consecutive counting numbers.

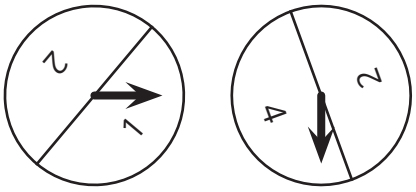
Find the smallest number greater than 10 which can be expressed as the sum of three consecutive counting numbers.

1.6) In a board game, a number is made by adding the number spun on Spinner A to the number spun on Spinner B.

Spinner A has the numbers 1 and 2 on it.

Spinner B has the numbers 2 and 4 on it.

In how many different ways can you spin a total that is odd?



Spinner A Spinner B

1.7) A scientist has labelled a row of plants with numbers from 1 to 40.

He gives extra water to every third plant, starting with plant number 3.

He shades every fifth plant, starting with plant number 2.

What is the number of the first plant to receive both treatments?

1.8) State three consecutive numbers, each less than 20, such that:

- the smallest is divisible by 4,
- the next is divisible by 3, and
- the largest is divisible by 2.

(Note: Consecutive numbers are whole numbers that follow in order. An example is 4, 5, 6, 7, 8.)

Set Orange

1.1) A red counter is worth 25 cents and a blue counter is worth 5 cents.
Emma has 4 more red counters than blue counters.
The total value of her counters is $3.10.
How may blue counters does Emma have?

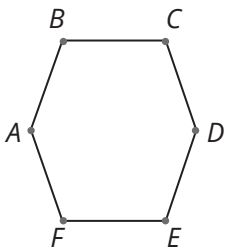
1.2) Harry is playing with Michelle's Number Recycling Machine, which obeys exactly two rules:

1. If an inserted number has exactly 1 digit, double the number.
2. If an inserted number has exactly 2 digits, compute the sum of the digits.

The first number Harry inserts is 3.
Then every answer he gets is inserted back into the machine until a hundred numbers are inserted.
What is the one-hundredth number to be inserted?

1.3) Rachel left home for school at 7:45 one morning.
She returned home at 4:05 that afternoon.
How many hours and minutes was she gone?
(The number of minutes in your answer must be less than 60.)

1.4) The figure shown is a hexagon with six sides of the same length.
Not all of the interior angles are the same size.
Angles *A* and *D* are the same size.
Angles *B*, *C*, *E*, and *F* are the same size.
How many lines of symmetry does the figure have?



Set Orange

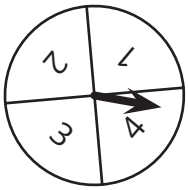
1.5) The sum of three consecutive counting numbers is 15 more than the greatest of them.

What is the greatest of the three numbers?

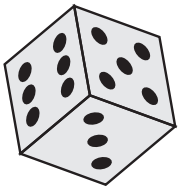
1.6) Laura spins Spinner A and rolls a standard die, and then adds the results together.

In how many ways can she get a total that is odd?

(We will consider spinning 1 on the spinner and rolling 4 on the die to be different from rolling 1 on the die and spinning 4 on the spinner.)



Spinner A



1.7) Olivia feeds her fish every second day. She feeds her turtle every seventh day.

On the 24th of July, Olivia fed both her fish and her turtle.

What will be the next date when she feeds both of them?

1.8) An even number between 100 and 125 is divisible by 3 and also by 5.

What is that number?

Maths Games – Example Problem 1.1

Example Problem 1.1 - Green

There are 8 children on a bus.
There are 4 more girls on the bus than boys.
How many boys are there on the bus?

Example Problem 1.1 - Yellow

There are 38 children on a bus.
There are 4 more girls on the bus than boys.
How many boys are there on the bus?

Example Problem 1.1 - Orange

A red counter is worth 25 cents and a blue counter is worth 5 cents.
Emma has 4 more red counters than blue counters.
The total value of her counters is $3.10.
How may blue counters does Emma have?

Maths Games Example Solution 1.1 - Yellow

There are 38 children on a bus. There are 4 more girls on the bus than boys.

How many boys are there on the bus?

Strategy 1: Find a Pattern

Let's start by making **38 ÷ 2 = 19** of the children boys, and the other 19 children girls.

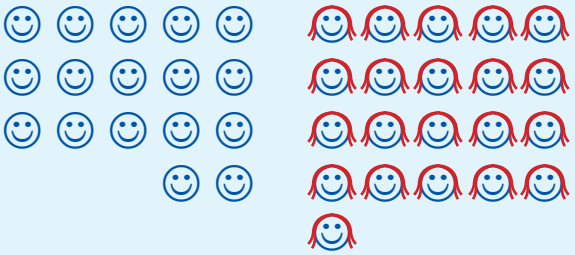
If so, then there would be **19 – 19 = 0** more girls than boys on the bus.

There are supposed to be more girls than boys. Let's have one more girl, which means we will have to have one less boy.

Then there would be **20 – 18 = 2** more girls than boys on the bus.

Swapping one boy for a girl increased the difference by **2**.

Let's see if swapping another boy for a girl would increase the difference by **2** more.



This time, there would be **21 – 17 = 4** more girls than boys on the bus.

That matches the question.

There must be **17** boys on the bus.

Strategy 2: Build a Table, and Find a Pattern

Let's put children on the bus, so that there's always **4** more girls than boys.

We'll start with just 4 girls.

To maintain the difference, each time we'll add one boy, and one girl.

No. of girls	4	5	6	7	...
No. of boys	0	1	2	3	...
Total children	4	6	8	10	...

Every time we add one more boy and one more girl, the total number of children increases by **2**.

To reach a total of **38** students on the bus, we would need to add **38 – 10 = 28** more children, in boy-girl pairs.

This increases both the number of boys and the number of girls by **28 ÷ 2 = 14.**

No. of girls	4	5	6	7	...	7 + 14 = 21
No. of boys	0	1	2	3	...	3 + 14 = 17
Total children	4	6	8	10	...	38

With 21 girls and 17 boys, there are four more girls than boys, and a total of **38** children.

That matches the question, so there must be **17** boys on the bus.

Strategy 3: Reason Logically

Suppose we took 4 girls off the bus. Then there would be the same number of boys and girls on the bus.

After taking 4 girls off, there would be **38 – 4 = 34** children on the bus.

There must be **34 ÷ 2 = 17** boys on the bus.

Answers

1.1 - Green: 2

1.1 - Orange: 7

1.1 - Yellow: 17

Maths Games – Example Problem 1.2

Example Problem 1.2 - Green

Harry's Number Recycling Machine obeys exactly two rules:

If the inserted number has just 1 digit, double the number and print out the result.
Otherwise, if the inserted number has 2 digits, remove the tens digit and print out the result.

The first number Harry inserts is 2.

Then every answer he gets is inserted back into the machine until twenty numbers are inserted.

What is the twentieth number to be inserted?

Example Problem 1.2 - Yellow

Michelle's Number Recycling Machine obeys exactly two rules:

1. If an inserted number has exactly 1 digit, double the number.
2. If an inserted number has exactly 2 digits, compute the sum of the digits.

The first number Michelle inserts is 1.

Then every answer she gets is inserted back into the machine until fifty numbers are inserted.

What is the fiftieth number to be inserted?

Example Problem 1.2 - Orange

Harry is playing with Michelle's Number Recycling Machine, which obeys exactly two rules:

1. If an inserted number has exactly 1 digit, double the number.
2. If an inserted number has exactly 2 digits, compute the sum of the digits.

The first number Harry inserts is 3.

Then every answer he gets is inserted back into the machine until a hundred numbers are inserted.

What is the one-hundredth number to be inserted?

Maths Games Example Solution 1.2 - Yellow

Michelle's Number Recycling Machine obeys exactly two rules:

1. *If an inserted number has exactly 1 digit, double the number.*
2. *If an inserted number has exactly 2 digits, compute the sum of the digits.*

The first number Michelle inserts is 1. Then every answer she gets is inserted back into the machine until fifty numbers are inserted.

What is the fiftieth number to be inserted?

Strategy: Find a Pattern, and Build a Table

Let's see what happens as Michelle inserts numbers.

The first number she inserts is 1.

1 has exactly 1 digit, so the machine doubles the number.

1 → 2 × 1 = 2 → 2

The answer she gets is 2. She inserts 2 back into the machine.

2 has exactly 1 digit, so the machine doubles the number.

2 → 2 × 2 = 4 → 4

The answer she gets is 4. She inserts 4 back into the machine.

4 has exactly 1 digit, so the machine doubles the number.

4 → 2 × 4 = 8 → 8

The answer she gets is 8. She inserts 8 back into the machine.

8 has exactly 1 digit, so the machine doubles the number.

8 → 2 × 8 = 16 → 16

The answer she gets is 16. She inserts 16 back into the machine.

16 has 2 digits, so the machine computes the sum of the digits.

16 → 1 + 6 = 7 → 7

The answer she gets is 7. She inserts 7 back into the machine.

7 has exactly 1 digit, so the machine doubles the number.

7 → 2 × 7 = 14 → 14

The answer she gets is 14. She inserts 14 back into the machine.

14 has 2 digits, so the machine computes the sum of the digits.

14 → 1 + 4 = 5 → 5

The answer she gets is 5. She inserts 5 back into the machine.

5 has exactly 1 digit, so the machine doubles the number.

5 → 2 × 5 = 10 → 10

The answer she gets is 10. She inserts 10 back into the machine.

10 has 2 digits, so the machine computes the sum of the digits.

10 → 1 + 0 = 1 → 1

We've seen 1 before. And the machine always does the same thing when Michelle inserts 1.

So the numbers she inserts will go like this:

1, 2, 4, 8, 16, 7, 14, 5, 10,

1, 2, 4, 8, 16, 7, 14, 5, 10,

1, ...

By arranging the pattern in a table, we can see that every **9th** number is a 10.

This means that the **9th**, **18th**, **27th**, **36th**, and **45th** numbers are all 10.

Continuing the pattern, the following numbers are 1, 2, 4, 8, 16.

So the fiftieth number to be inserted is **16.**

1st	2nd	3rd	4th	5th	6th	7th	8th	9th
1,	2,	4,	8,	16,	7,	14,	5,	10,
10th	11th	12th	13th	14th	15th	16th	17th	18th
1,	2,	4,	8,	16,	7,	14,	5,	10,
19th	...							27th
1,	...							10,
								36th
								10,
								45th
								10,
46th	47th	48th	49th	50th				
1,	2,	4,	8,	16				

Answers

1.2 - Green: 4

1.2 - Orange: 3

1.2 - Yellow: 16

Maths Games – Example Problem 1.3

Example Problem 1.3 - Green

If it's 2:00 p.m. right now, what time will it be 48 hours from now?
Include a.m. or p.m. in your answer.

Example Problem 1.3 - Yellow

If it's 2:00 p.m. right now, what time will it be 50 hours from now?
Include a.m. or p.m. in your answer.

Example Problem 1.3 - Orange

Rachel left home for school at 7:45 one morning.
She returned home at 4:05 that afternoon.
How many hours and minutes was she gone?
(The number of minutes in your answer must be less than 60.)

Maths Games Example Solution 1.3 - Yellow

If it's 2:00 p.m. right now, what time will it be 50 hours from now?

Include a.m. or p.m. in your answer.

Strategy 1: Find a Pattern

To add 50 hours, we can add 10 hours five times.

	Hours from now	Time
2:00 p.m. + 10 hours = 12 midnight.	10	12:00 a.m.
12:00 a.m. + 10 hours = 10:00 a.m.	20	10:00 a.m.
10:00 a.m. + 10 hours = 20:00, or 8:00 p.m.	30	8:00 p.m.

Can you see a pattern?

To add 10 hours, it is like:

- Going back 2 hours, and then
- Adding 12 hours, which means switching a.m./p.m.

Using this two-step procedure to work what time it is in 50 hours' time:

Time now	2 hours ago	12 hours later	Hours from now
2:00 p.m.	12:00 p.m.	12:00 a.m.	10
12:00 a.m.	10:00 p.m.	10:00 a.m.	20
10:00 a.m.	8:00 a.m.	8:00 p.m.	30
8:00 p.m.	6:00 p.m.	6:00 a.m.	40
6:00 a.m.	4:00 a.m.	4:00 p.m.	50

It will be **4:00 p.m.** in 50 hours' time.

Strategy 2: Solve a Simpler Related Problem

50 hours is not a convenient amount to add. What is an easy number of hours to add?

How about 24 hours? This might be more convenient, because there are 24 hours in a whole day.

If it's 2:00 p.m. now, in 24 hours it will be 2:00 p.m. again.

24 hours after that, it will be 2:00 p.m. again.

2 more hours makes 24 + 24 + 2 = 50 hours in total.

50 hours from now, it will be **4:00 p.m.**

Strategy 3: Convert to a More Convenient Form

We might be able to work this out more easily using 24 hour time.

12 hour time	24 hour time
12:00 p.m.	12:00
1:00 p.m.	13:00
2:00 p.m.	14:00
3:00 p.m.	15:00
4:00 p.m.	16:00

... and so on.

2:00 p.m. is 14:00 in 24 hour time.

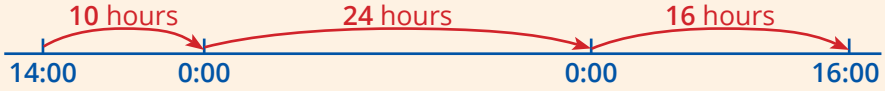
With 24 hours in a day, there are 24 – 14 = 10 hours from 14:00 until the end of Day 1.

24 hours later, it will be the end of Day 2.

This is 10 + 24 = 34 hours after 14:00 on Day 1.

There are 50 – 34 = 16 hours left to go.

16 hours after 0:00 is 16:00.



50 hours after 14:00 the time will be 16:00, **or 4:00 p.m.**

Answers

1.3 - Green: 2:00 p.m.

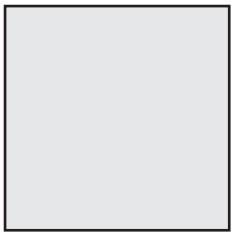
1.3 - Yellow: 4:00 p.m.

1.3 - Orange: 8 hours 20 mins

Maths Games – Example Problem 1.4

Example Problem 1.4 - Green

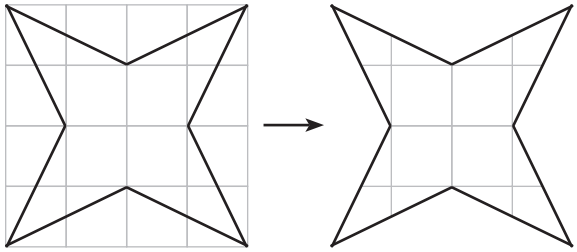
In how many ways can a square be folded in half so that both halves overlap exactly?



Example Problem 1.4 - Yellow

A four-pointed star is drawn on square grid paper and then cut out, as shown.

In how many ways can it be folded in half so that both halves overlap exactly?



Example Problem 1.4 - Orange

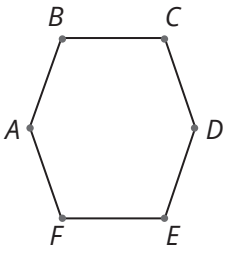
The figure shown is a hexagon with six sides of the same length.

Not all of the interior angles are the same size.

Angles *A* and *D* are the same size.

Angles *B*, *C*, *E*, and *F* are the same size.

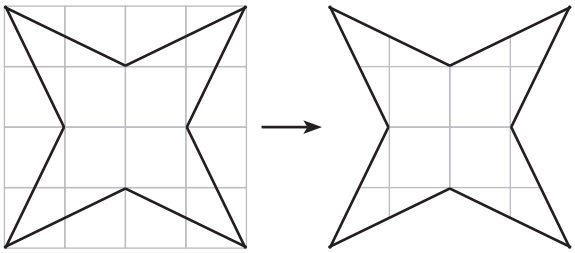
How many lines of symmetry does the figure have?



Maths Games Example Solution 1.4 - Yellow

A four-pointed star is drawn on square grid paper and then cut out, as shown.

In how many ways can it be folded in half so that both halves overlap exactly?



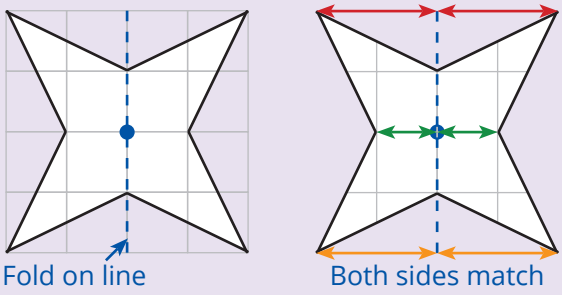
Strategy: Use Concrete Materials or Draw a Diagram, and Find a Pattern

Let's start by finding one way that we can fold the star in half, so that both halves overlap exactly.

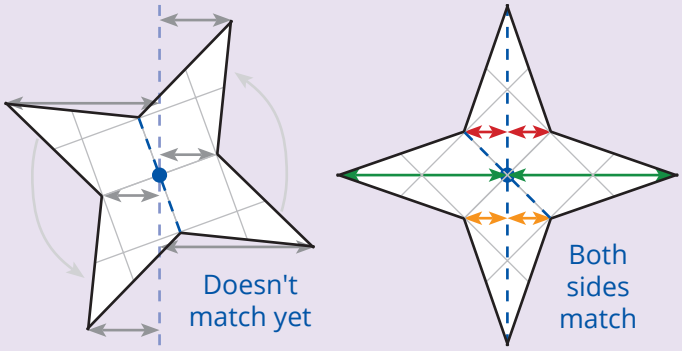
This may be more effectively done by folding a paper star.

We shall here attempt to use diagrams to demonstrate the symmetry of the shape.

All of the vertices on the left of the central grid line can be matched with a vertex on the right, so that both vertices are the same distance from this centre line.



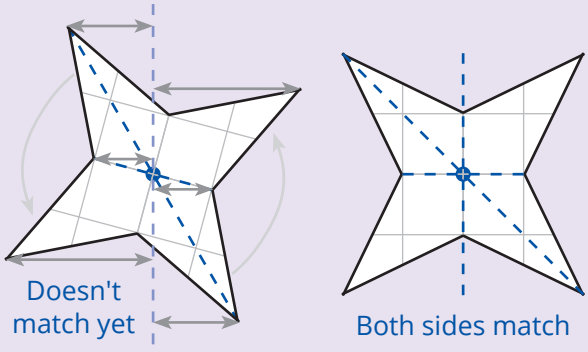
We can now rotate the star about its centre point until we can see this matching happening once again.



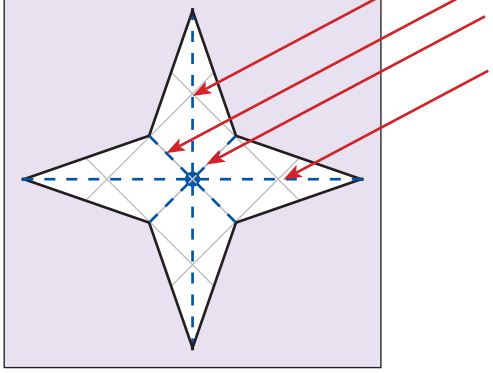
We can see a pattern occurring as we rotate about the centre point.

After another eighth-turn, the star will look similar to the original orientation.

Since it's the same, we know that it will also fold in half exactly along the grid line.



A further one-eighth rotation sees the star oriented in another familiar configuration.



We have created **4** fold lines.

If we rotate the star any further, we'll start duplicating fold lines that have already been created.

So there are **4** ways to fold the star so that both halves match exactly.

Answers

1.4 - Green: 4

1.4 - Orange: 2

1.4 - Yellow: 4

Maths Games – Example Problem 1.5

Example Problem 1.5 - Green

Consecutive numbers form a sequence, where each number is 1 greater than the previous number.

For example, 7, 8, 9 are three consecutive counting numbers.

Find the smallest number greater than 10 which can be expressed as the sum of three consecutive counting numbers.

Example Problem 1.5 - Yellow

Consecutive numbers form a sequence, where each number is 1 greater than the previous number.

For example, 7, 8, 9 are three consecutive counting numbers.

Find the smallest number which can be expressed as:

- the sum of two consecutive counting numbers, and also as
- the sum of three consecutive counting numbers.

Example Problem 1.5 - Orange

The sum of three consecutive counting numbers is 15 more than the greatest of them.

What is the greatest of the three numbers?

Maths Games Example Solution 1.5 - Yellow

Consecutive numbers form a sequence, where each number is 1 greater than the previous number.

For example, 7, 8, 9 are three consecutive counting numbers.

Find the smallest number which can be expressed as:

- the sum of two consecutive counting numbers, and also as
- the sum of three consecutive counting numbers.

Strategy 1: Build a Table, and Find a Pattern

We could begin by listing numbers that are the sum of two consecutive counting numbers.

First counting number	Next counting number	Sum of 2 numbers
1	2	3
2	3	5
3	4	7
4	5	9

It looks like all odd numbers greater than **1**, can be expressed as the sum of two consecutive counting numbers.

Why might this pattern occur?

Next, we could list numbers that are the sum of three consecutive counting numbers.

1st number	2nd number	3rd number	Sum of 3 numbers
1	2	3	6
2	3	4	9
3	4	5	12
4	5	6	15

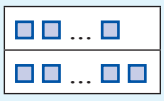
It looks like all multiples of **3** that are greater than **3**, can be expressed as the sum of three consecutive counting numbers.

Why might this pattern occur?

From our tables, we can see that **9** is the smallest number that can be expressed as both the sum of two consecutive counting numbers, and also as the sum of three consecutive counting numbers.

Strategy 2: Reason Logically

We can represent **2** consecutive counting numbers like this:

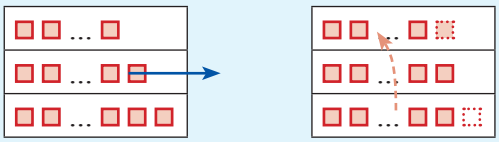


The second number is **1** more than the first number.

To find their sum, we could just double the first number, and add **1**.

This means that the sum of these **2** numbers must be **odd**.

We can represent **3** consecutive counting numbers like this:



The first number is **1** less than the second number.

The third number is **1** more than the second number.

To find the sum of the **3** numbers, we could just multiply the second number by **3**.

Therefore the sum of these **3** numbers must be a multiple of **3**.

We know that our number must be both **odd**, and a multiple of **3**.

The **odd** multiples of **3** are **3**, **9**, **15**, **21**, and so on.

- Let's test **3** against the conditions of the problem. **3** = **1** + **2**, but when we try to express **3** as the sum of **3** consecutive numbers we end up with **3** = **0** + **1** + **2**; and **0** is not a counting number.
- Let's test **9** against the conditions of the problem. **9** = **4** + **5**, and also **9** = **2** + **3** + **4**.

Therefore **9** is the smallest number that satisfies the conditions of the problem.

Answers

1.5 - Green: 12

1.5 - Orange: 9

1.5 - Yellow: 9

Maths Games – Example Problem 1.6

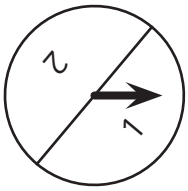
Example Problem 1.6 - Green

In a board game, a number is made by adding the number spun on Spinner A to the number spun on Spinner B.

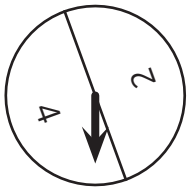
Spinner A has the numbers 1 and 2 on it.

Spinner B has the numbers 2 and 4 on it.

In how many ways can you spin a total that is odd?



Spinner A



Spinner B

Example Problem 1.6 - Yellow

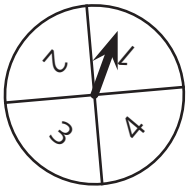
In a board game, a number is made by adding the number spun on Spinner A to the number spun on Spinner B.

Spinner A has the numbers 1, 2, 3 and 4 on it.

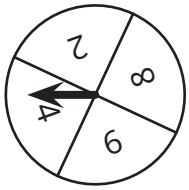
Spinner B has the numbers 2, 4, 6 and 8 on it.

In how many ways can you spin a total that is odd?

(We will consider 1+6 and 3+4 to be two different ways.)



Spinner A



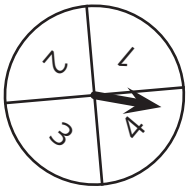
Spinner B

Example Problem 1.6 - Orange

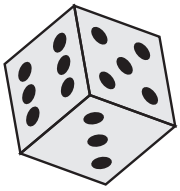
Laura spins Spinner A and rolls a standard die, and then adds the results together.

In how many ways can she get a total that is odd?

(We will consider spinning 1 on the spinner and rolling 4 on the die to be different from rolling 1 on the die and spinning 4 on the spinner.)



Spinner A



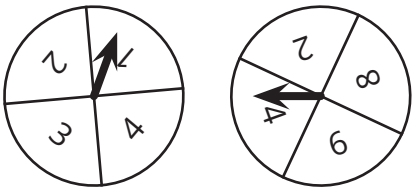
Maths Games Example Solution 1.6 - Yellow

In a board game, a number is made by adding the number spun on Spinner A to the number spun on Spinner B.

Spinner A has the numbers 1, 2, 3 and 4 on it.

Spinner B has the numbers 2, 4, 6 and 8 on it.

In how many ways can you spin a total that is odd?



Spinner A Spinner B

Strategy 1: Build a Table

Let's begin by listing the four possible results for Spinner A.

Spinner A	
1	
2	
3	
4	

For each of these results, we could have one of four different results on Spinner B.

Spinner A	Spinner B: 2	4	6	8
1				
2				
3				
4				

Let's calculate the possible sums, to fill in the table.

Spinner A	+	Spinner B: 2	4	6	8
	1	3	5	7	9
	2	4	6	8	10
	3	5	7	9	11
	4	6	8	10	12

We can now mark all of the totals that are odd.

Spinner A	+	Spinner B: 2	4	6	8
	1	(3)	(5)	(7)	(9)
	2	4	6	8	10
	3	(5)	(7)	(9)	(11)
	4	6	8	10	12

There are **8** ways to spin a total that is odd.

Strategy 2: Draw a Diagram, and Find a Pattern

An even number is divisible by **2**.

This means that it can be represented by a rectangular array that is **2** units wide.

2	4	6	8
○○	○○ ○○	○○ ○○ ○○	○○ ○○ ○○ ○○

An odd number cannot be represented by an array that is **2** units wide.

The extra **1** is unpaired.

1	3	5	7
○	○○ ○	○○ ○○ ○	○○ ○○ ○○ ○

From the diagrams, we can see that:

Even + Even = Even	Even + Odd = Odd	Odd + Odd = Even
○○ ○○ ○○ ○○	○○ ○○ ○○ ○	○○ ○○ ○○ ○○

All **4** of the numbers on Spinner B are even.

So, since the addition of an even number does not change the parity of a number, the parity of the sum of the two spinners is just going to be the parity of the number from Spinner A.

There are **2** odd numbers on Spinner A.

So there are **2 × 4 = 8** ways to spin an odd total.

Answers

1.6 - Green: 2

1.6 - Orange: 12

1.6 - Yellow: 8

Maths Games – Example Problem 1.7

Example Problem 1.7 - Green

A scientist has labelled a row of plants with numbers from 1 to 40.
He gives extra water to every third plant, starting with plant number 3.
He shades every fifth plant, starting with plant number 2.
What is the number of the first plant to receive both treatments?

Example Problem 1.7 - Yellow

A scientist has labelled a row of plants with numbers from 1 to 40.
He gives extra water to every second plant, starting with plant number 2.
He gives extra fertiliser to every third plant, starting with plant number 3.
He shades every fourth plant, starting with plant number 4.
What is the number of the first plant to receive all three treatments?

Example Problem 1.7 - Orange

Olivia feeds her fish every second day. She feeds her turtle every seventh day.
On the 24th of July, Olivia fed both her fish and her turtle.
What will be the next date when she feeds both of them?

Maths Games Example Solution 1.7 - Yellow

A scientist has labelled a row of plants with numbers from 1 to 40.

He gives extra water to every second plant, starting with plant number 2. He gives extra fertiliser to every third plant, starting with plant number 3. He shades every fourth plant, starting with plant number 4.

What is the number of the first plant to receive all three treatments ?

Strategy 1: Build a Table, and Find a Pattern

Let's build a table to represent all of the plants.

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	36	37	38	39	40

Every **2nd** plant gets extra water.

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	(36)	37	(38)	39	(40)

Every 3rd plant gets extra fertiliser.

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	(36)	37	38	(39)	40

Every 4th plant gets shaded.

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	(36)	37	38	39	(40)

What patterns can you see in the table, when you circle every 2nd, 3rd, or 4th plant?

If we circle every 2nd, 3rd, or 4th plant on the same table, we find that plant numbers **12**, **24** and **36** get circled each time.

The first plant to receive all three treatments is plant number **12**.

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	(36)	37	(38)	(39)	(40)

Strategy 2: Build a Table

If we build a table with 2 plants in each row, then it is easy to mark every 2nd plant for extra watering.

1	2
3	4
5	6
7	8
9	10
11	12
13	14
15	16
17	18

... etc

If we build a table with 3 plants in each row, then it is easy to mark every 3rd plant for extra fertiliser.

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

... etc

If we build a table with 4 plants in each row, then it is easy to mark every 4th plant for shading.

Every plant in this group also received the extra water that was given to every 2nd plant.

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	36

... etc

The first plant to appear in all three lists is number **12**.

Answers

1.7 - Green: 12

1.7 - Orange: August 7

1.7 - Yellow: 12

Maths Games – Example Problem 1.8

Example Problem 1.8 - Green

State three consecutive numbers, each less than 20, such that:

- the smallest is divisible by 4,
- the next is divisible by 3, and
- the largest is divisible by 2.

(Note: Consecutive numbers are whole numbers that follow in order. An example is 4, 5, 6, 7, 8.)

Example Problem 1.8 - Yellow

State three consecutive numbers, each less than 100, such that:

- the smallest is divisible by 6,
- the next is divisible by 5, and
- the largest is divisible by 4.

(Note: Consecutive numbers are whole numbers that follow in order. An example is 4, 5, 6, 7, 8.)

Example Problem 1.8 - Orange

An even number between 100 and 125 is divisible by 3 and also by 5.

What is that number?

Maths Games Example Solution 1.8 - Yellow

State three consecutive numbers, each less than 100, such that the smallest is divisible by 6, the next is divisible by 5 and the largest is divisible by 4.

(Note: Consecutive numbers are whole numbers that follow in order. An example is 4, 5, 6, 7, 8.)

Strategy 1: Find a Pattern

To find groups of numbers where the smallest number is divisible by 6, we can begin by listing multiples of 6.

6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
7	13	19	25	31	37	43	49	55	61	67	73	79	85	91	97
8	14	20	26	32	38	44	50	56	62	68	74	80	86	92	98

We know that the numbers in the group are consecutive.

The number in the second position is supposed to be divisible by 5.

6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
7	13	19	25	31	37	43	49	55	61	67	73	79	85	91	97
8	14	20	26	32	38	44	50	56	62	68	74	80	86	92	98

Multiples of 5 are easy to spot, as they have **5** or **0** in the ones place.

The number in the third position is supposed to be divisible by 4.

6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96
7	13	19	25	31	37	43	49	55	61	67	73	79	85	91	97
8	14	20	26	32	38	44	50	56	62	68	74	80	86	92	98

By highlighting multiples of 4 we know from the 4 times table, we can find and continue a pattern.

It looks like the numbers (54, 55, 56) will work. We know that 54 is divisible by 6, and 55 is divisible by 5.

From our pattern, we predict that 56 will be divisible by 4. To check if this is true, we can count up by 4s from a known multiple of 4, such as 40: 40, 44, 48, 52, 56.

Therefore 56 is divisible by 4, and so **(54, 55, 56)** will match the conditions in the question.

Strategy 2: Build a Table

The smallest number is divisible by 6, so we can begin by highlighting multiples of 6.

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	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

We can now highlight groups of 3 consecutive numbers that start with a multiple of 6.

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	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

We can eliminate any combinations where the second number is not a multiple of 5.

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	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

There are only three possible combinations now: (24, 25, 26), (54, 55, 56) and (84, 85, 86).

Of these, only **(54, 55, 56)** satisfies the condition that the largest number is divisible by 4.

Answers

1.8 - Green: (8, 9, 10)

1.8 - Orange: 120

1.8 - Yellow: (54, 55, 56)

Answers

Set Green	
1.1	2
1.2	4
1.3	2:00 p.m.
1.4	4
1.5	12
1.6	2
1.7	12
1.8	(8, 9, 10)

Set Yellow	
1.1	17
1.2	16
1.3	4:00 p.m.
1.4	4
1.5	9
1.6	8
1.7	12
1.8	(54, 55, 56)

Set Orange	
1.1	7
1.2	3
1.3	8 hours 20 minutes
1.4	2
1.5	9
1.6	12
1.7	August 7
1.8	120