Reasoning in the classroom

Jewels

Support materials for teachers

Year 3

Llywodraeth Cymru
Welsh Government

Year 3 Reasoning in the classroom – Jewels

These Year 3 activities start with an item that was included in the 2014 National Numeracy Tests (Reasoning). They continue with two linked activities, in which learners use their numerical and spatial understanding to solve problems.

Activity 1

Jewels

Learners find the cost of jewels, then solve other related problems.

Includes:

- Teachers' script
- PowerPoint presentation
- Jewels questions
- Markscheme

Activity 2

Hundreds, tens, units

They play a game in which five learners represent the digits (hundreds, tens and units) of a number. They then investigate a given number to find the two numbers closest to it that have digits that sum to five.

Includes:

- Explain and question – instructions for teachers
- Resource sheet – Detectives and their evidence

Activity 3

The king's rings

Learners investigate different colour combinations to create rings fit for a king.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Rings
- Resource sheet – More rings
- Resource sheet – Our rings

Reasoning skills required

Identify	Communicate	Review
Learners choose what to do and how to do it.	They talk and write about their work, giving reasons for their decisions and choices.	They check their results.

Procedural skills

- **Addition, subtraction**
- **Multiplication (or repeated addition)**
- **Place value**
- **Shape names**

Numerical language

- **Equal number**
- **Hundreds, tens, units**
- **Digits**
- **Sum and difference**
- **Number lines**
- **Adjacent (optional)**
- **Rules**
- **Pentagon/hexagon**

Activity 1

Jewels

Activity 1 – Jewels

Outline

In this Year 3 activity, learners use their reasoning skills to work out the cost of jewels and how many can be bought with different sums of money. They then produce a reasoned argument as to whether a fixed number of jewels will fit inside six boxes.

You will need

Teachers' script

PowerPoint presentation

Jewels questions
Three pages for each learner, can be printed double-sided

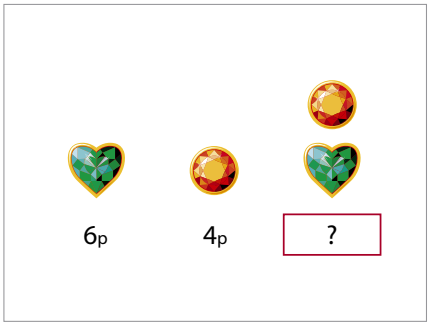
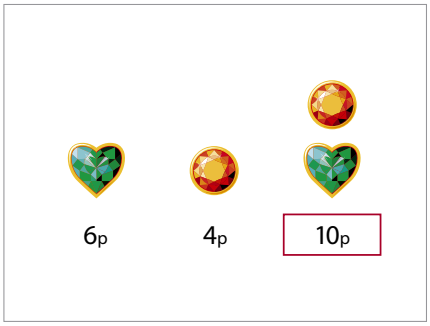
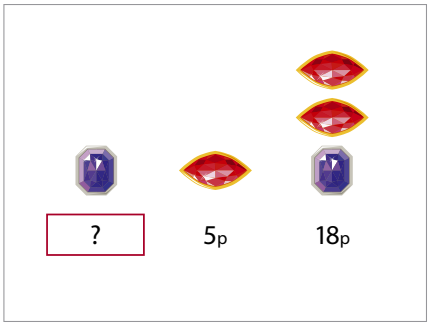
Markscheme

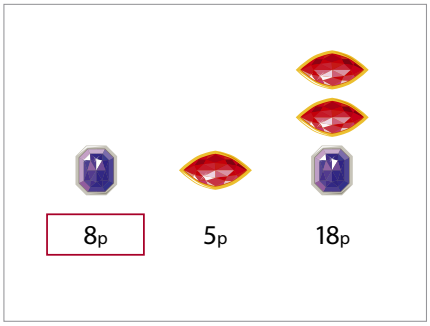
TS

Presentation to be shown to learners before they work on Jewels

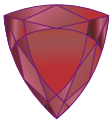
The text in the right-hand boxes (but not italics) should be read to learners. You can use your own words, or provide additional explanation of contexts, if necessary. However, if you are using this as an assessment item, no help must be given with the numeracy that is to be assessed.

Slide 1		*(Keep this slide on the screen until you are ready to start the presentation.)*
Slide 2		Do you know what this is? Yes, it's a crown, worn by a king or queen. What are these called? *(point to the jewels)* Yes, they are called jewels. Why do you think that kings and queens have jewels on their crowns? *(Likely responses include colour, that jewels sparkle, and also that they show how rich the king or queen is.)* Most people can't afford to buy real jewels – they are much too expensive. But you can buy . . .
Slide 3		. . . pretend jewels. These are much cheaper but they still look beautiful.

Slide 4		These two children love dressing up. And they love jewels! They save all their pocket money to buy pretend jewels which they stick onto crowns. Deciding which jewels to buy is difficult as they like them all. And they have to use their numeracy to help them work out the costs.
Slide 5		How much is this green jewel? *(point)* And how much is this orange jewel? *(point)* So how much does it cost to buy both the green jewel and the orange jewel? Let's check . . .
Slide 6		That's right, 10p, because 6 + 4 = 10
Slide 7		This one is harder. Talk with the person next to you. Can you work out how much one purple jewel costs? *(Encourage discussion, then support learners, using the whiteboard if necessary, to understand that the purple jewel costs 8p because 5 + 5 + 8 = 18)* Let's check . . .

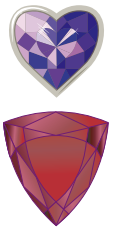
Slide 8		Well done! Now you are going to answer some questions about the jewels that they buy. Remember to show your working so that someone else can understand what you are doing and why. *(If you are using this item for assessment purposes, you may wish to limit the time available, e.g. 15 minutes.)*

1

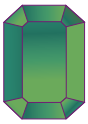


7p

3p

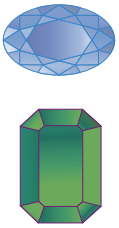


p



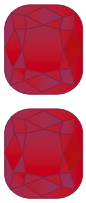
9p

p



14p

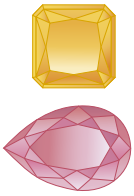
4p



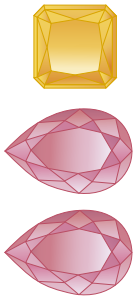
8p

p

p



7p



10p

3m

2

 2p each

 3p each

 5p each

 has 30p.

She buys **four**  and **four** 

How many  can she buy?

2m

 has 40p.

He wants an **equal number** of  ,  and 

How many of each jewel can he buy?

of each jewel

2m

3 The children have six boxes.

10 **small** jewels fit in each box

or

5 **big** jewels fit in each box.

has 23 **small** jewels and 10 **big** jewels.

has 17 **small** jewels and 9 **big** jewels.

Will **all** their jewels fit in the six boxes?

Show how you work it out.

3m

Activity 1 – Jewels – Markscheme

Q	Marks	Answer
1	3m	All four correct, i.e. **10**p **5**p **12**p **4**p
	Or 2m	Any **three** correct
	Or 1m	Any **two** correct

2i	2m	**2**
	Or 1m	Shows clearly that 2 jewels are required, but then gives an incorrect answer Or Shows **20** ◄ **Cost of 4 red and 4 green jewels** Or Shows **10** ◄ **Change from 30p**

2ii	2m	**4** of each jewel
	Or 1m	Shows clearly that 4 of each jewel are required, but then gives an incorrect answer Or Shows an attempt to find how many 10's there are in 40

Activity 1 – Jewels – Markscheme (continued)

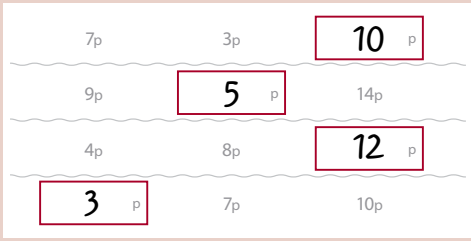
Q	Marks	Answer
3	3m	Refers to both small and big jewels to show why 8 boxes are needed, e.g. • 19 large jewels need 4 boxes, 40 little ones need 4, so 8 boxes not 6 Or Refers to both small and big jewels to show which jewels are left over, i.e. shows one of the following rows: 40 small into 4 boxes | 10 big into 2 boxes | 9 big jewels left over 30 small into 3 boxes | 15 big into 3 boxes | 10 small and 4 big left over 20 small into 2 boxes | 19 big into 4 boxes | 20 small jewels left over
	Or 2m	States that **8 boxes** are needed, but does not give clear reasons why Or Shows a correct number(s) of jewels left over, but does not give clear reasons why Or Justifies why 9 boxes are needed, by showing or implying that she needs 5 boxes and he needs 4 boxes Or Shows that **40 small** jewels need **4 boxes**, or that **19 big jewels** need **4 boxes**
	Or 1m	Shows **40** and **19** Or Shows or implies an attempt to fill at least two boxes with 10 or 5 jewels

◀ **Most common correct response**

◀ **Her jewels and his jewels kept separately**

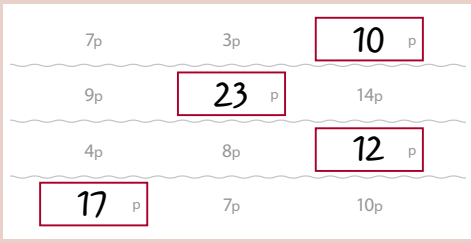
Activity 1 – Jewels – Exemplars

Question 1



Three correct; **2 marks**

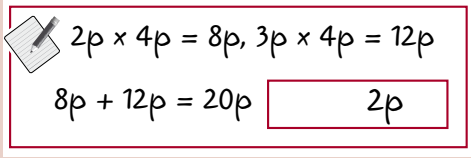
Common error: The answer 3p for the final part is a common error, from assuming that the first two numbers always sum to the last.



Two correct; **1 mark**

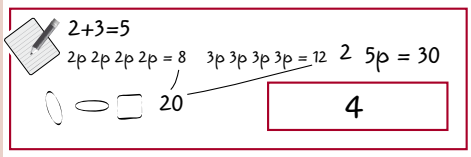
Common error: This learner has added all the pairs of values, even when this is not an appropriate strategy.

Question 2i



Correct; **2 marks**

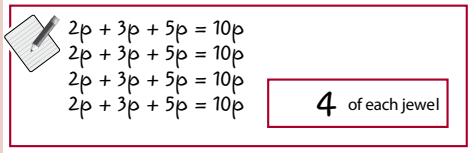
- 'p' in the answer box can be ignored. However, this learner would benefit from discussion after the test about its inclusion in the answer and working.



Shows 20; **1 mark**

- The first step towards the solution (the cost of the red and green jewels) is shown, but the number of blue jewels is incorrect.

Question 2ii



Correct; **2 marks**

- Although the working is repetitious, it is correct.

Shows 4 of each; **1 mark**

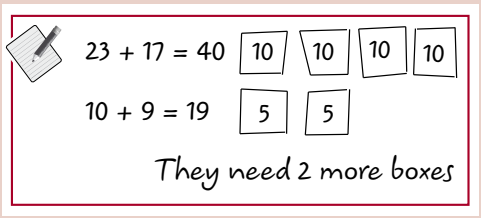
- This learner shows clear understanding, but gives the total number of jewels as the answer.

Incomplete; **0 marks**

Common error: The first step, finding the cost of one of each jewel, is correct but is then not used.

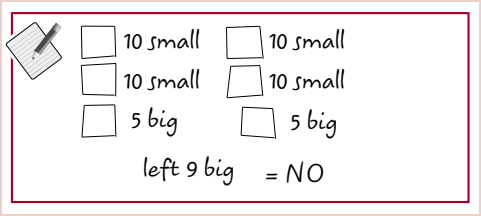
Activity 1 – Jewels – Exemplars (continued)

Question 3



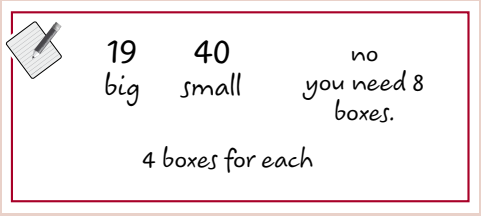
Correct; **3 marks**

- This learner shows clear numerical communication, using numbers and diagrams effectively.



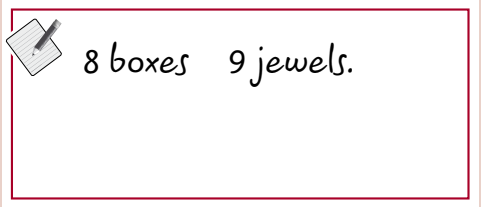
Correct; **3 marks**

- This response justifies 'left 9 big' by showing which jewels can fit in each box.



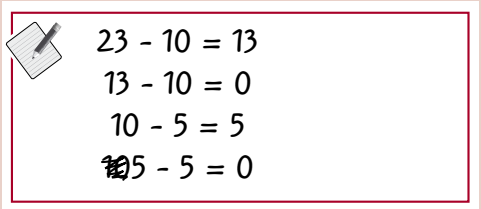
Correct; **3 marks**

- Although this numerical communication is not as effective as the ones above, it does refer to both big and small jewels to justify why 8 boxes are needed.

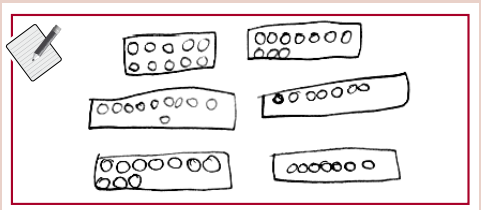


8 boxes; **2 marks**

- This learner almost certainly understands the problem but their numerical communication is weak: why 8 boxes are needed is not justified and the relevance of '9 jewels' is not explained.



Jewels into boxes implied; **1 mark**



Jewels into boxes implied; **1 mark**

Activity 2

Hundreds, tens, units

Activity 2 – Hundreds, tens, units

Outline

This activity continues the general theme of combinations from **Activity 1 – Jewels**. It is a physical activity, played by learners in groups of five. They use their understanding of place value (hundreds, tens and units) to represent numbers in which the digits sum to five. Then they use number lines to find the closest number that can be represented in this way.

You will need

Chalk (or paper if carrying out the activity indoors)

Resource sheet – Detectives and their evidence

Activity 2 – Hundreds, tens, units

Explain

Split learners into groups of five *(if the number of learners is not a multiple of five, make groups larger than five and ask them to take part in turns)*. Allocate each group an area in the playground where you have written 'h', 't', 'u' to represent hundreds, tens and units. *(If this activity is to take place indoors, write on paper/card, which can then be placed on the floor.)*

Explain to learners that they are going to play a game. You will call out a number and they will 'become' the hundreds, ten or units, standing behind 'h', 't' and 'u' as appropriate. Call the number 500 and help them to understand that as there are five hundreds, no tens and no units, all five of the group should stand in a column behind the 'h'. Then call 401. Now where should they stand? *(One person should move from the hundreds column to the units column.)*

Play again, using these numbers: 23, 320, 230, 203, 410, 302. Continue with numbers that can be made exactly *(i.e. the digits sum to 5)* for as long as necessary, but once learners are confident call out 45. After a few moments, agree that 45 cannot be made with five people, and say that you would like them to make the number that is closest to 45. After discussion, agree that they can make 41 or 50 – but which is closer? Tell learners that, just like detectives, they need to show you evidence!

If appropriate, return to the classroom and use a number line. Help learners recognise that as 41 is 4 away from 45 and 50 is 5 away from 45, the number closer to 45 is 41.

Now ask learners to work in pairs/small groups on the resource sheet **Detectives and their evidence**. When they have finished bring them back to the playground/hall, go through each number in turn, and ask them to 'make' the number they have identified as closest. Discuss their responses. They then can create similar questions of their own for other groups to solve.

(Solutions: 32 and 41 are closest to 36; 32 is closer. 401 and 410 are closest to 408; 410 is closer. 122 and 131 are closest to 126; 122 is closer. 320 and 410 are closest to 362; 320 is closer.)

Question

- What is the biggest number that your group of five people can show? *(500)* What about the smallest? *(5)*
- What does 'digit' mean? Can you tell me a number in which the digits sum to four?
- When I call a number, how can you tell whether your group of five can make it exactly? *(The sum of the digits must be five.)*
- How are you working out which two numbers with digits that sum to five are closest to . . . ?
- What does 'difference' mean, e.g. what is the difference between 30 and 50? *(20)* How does a number line help you find the difference between two numbers? Do you need to count up in ones? *(No, you could count up in tens, or fives, or . . .)*

Remember! You have 5 people who can be h (100's), t (10's) or u (1's).

The two numbers closest to 36

are _____ and _____

_____ is closer.

Our evidence:

The two numbers closest to 408

are _____ and _____

_____ is closer.

Our evidence:

The two numbers closest to 126

are _____ and _____

_____ is closer.

Our evidence:

The two numbers closest to 362

are _____ and _____

_____ is closer.

Our evidence:

Activity 3

The king’s rings

Activity 3 – The king's rings

or

Outline

In this Year 3 activity, learners find the minimum number of colours needed to create beautiful rings to present to the 'king'.

You will need

WB **Whiteboard – Rings**

R **Resource sheet – More rings**

R **Resource sheet – Our rings**

Colouring pencils

Activity 3 – The king's rings

Explain

Show **Rings** on the whiteboard and explain that it shows a very important king. The king loves jewels, especially rings. He wants them to be as beautiful as possible but he has rules:

1. each ring must have as few colours as possible
2. the shapes that share a common edge *(that are adjacent)* must be different colours.

Ask how many colours the king needs to colour the first *(left-hand)* ring. Choose a colour for the top left shape, e.g. red, and colour it. Help learners understand that as the top right shape shares an edge, it can't be red. Choose a different colour, e.g. yellow, and colour it, then use the rules to continue colouring the other sections, i.e.  Also colour the second ring, e.g. 

Tell learners that they are going to see whether, given the king's rules, all rings can be coloured in using just two colours. Give each pair a copy of the resource sheet **More rings** and ask them to investigate. *(From left to right, 2, 3 and 4 colours are needed.)*

Next, give each pair a copy of the resource sheet **Our rings** and ask them to design rings for the king. If appropriate, learners can also create rings using different shapes. The 'ring finders' *(the class)* will vote for the most beautiful/interesting ring to present to the 'king' *(this could be the headteacher)*.

When they have finished, ask them to write their names on the back of their designs. Place all the designs together so everyone can see them, without knowing which sheet belongs to which pair. Give each pair a sticker *(or similar)* and tell them to vote *(using the sticker)* for the ring that will go to the king. The ring needs to be beautiful and interesting, but it must, of course, follow the king's rules – so they need to check! And they must not vote for their own ring. Encourage them to talk about the reasons for their choice.

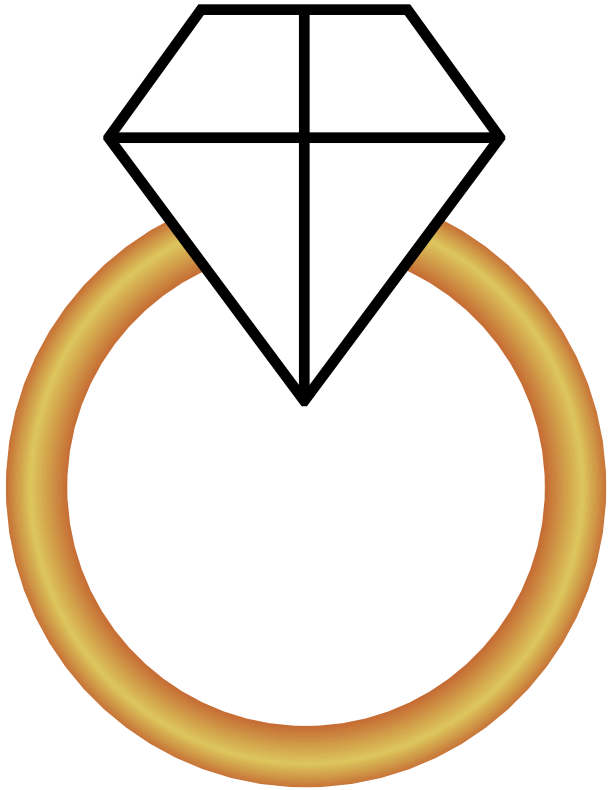
Question

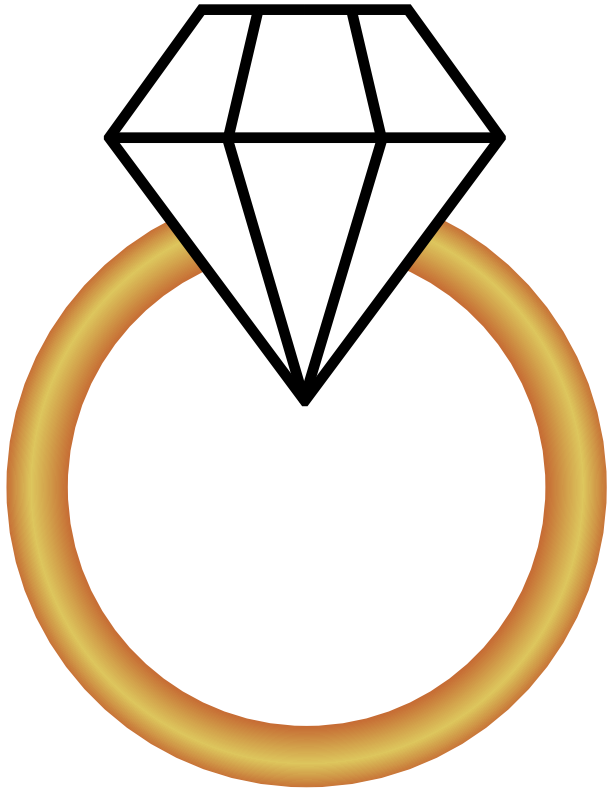
- How are you sure that you can't colour this ring using two colours? *(Being able to explain their thinking is an important part of numerical reasoning.)*
- Can you think of different ways to make a ring with two colours/three colours/four colours? Have you checked that the king's rules have been obeyed?
- What name do we give to a shape with five sides? *(Pentagon)* What about a shape with six sides? *(Hexagon)* How can you remember which is which? *(Both hexagon and six include the letter x.)*
- Do you both agree which ring is best? If not, how will you come to a decision?

Extension

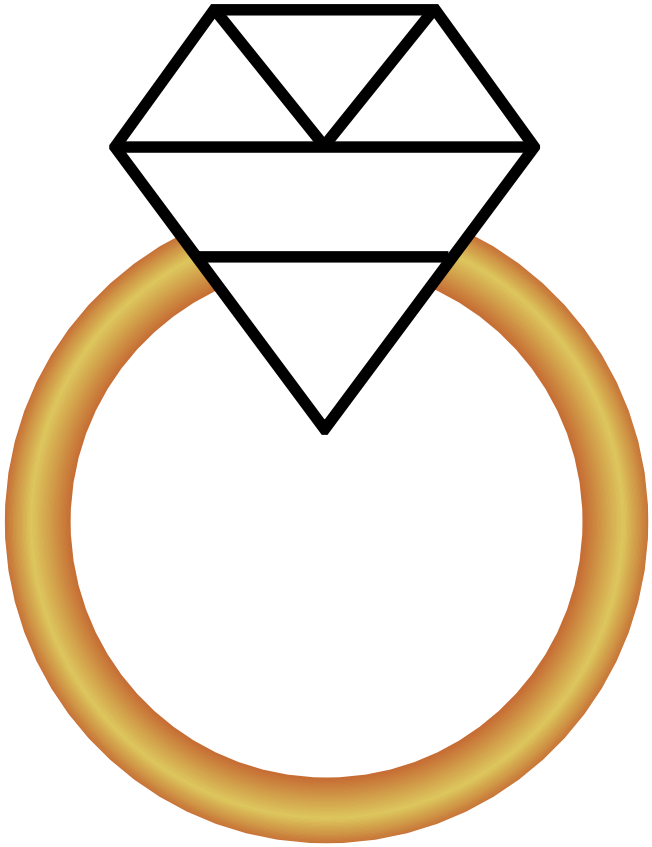
- Can they design a ring that needs more than four colours? *(They can't – four colours will always be enough. For an interesting explanation, designed for adults, see 'The Four Colour Theorem' on http://nrich.maths.org/6291)*

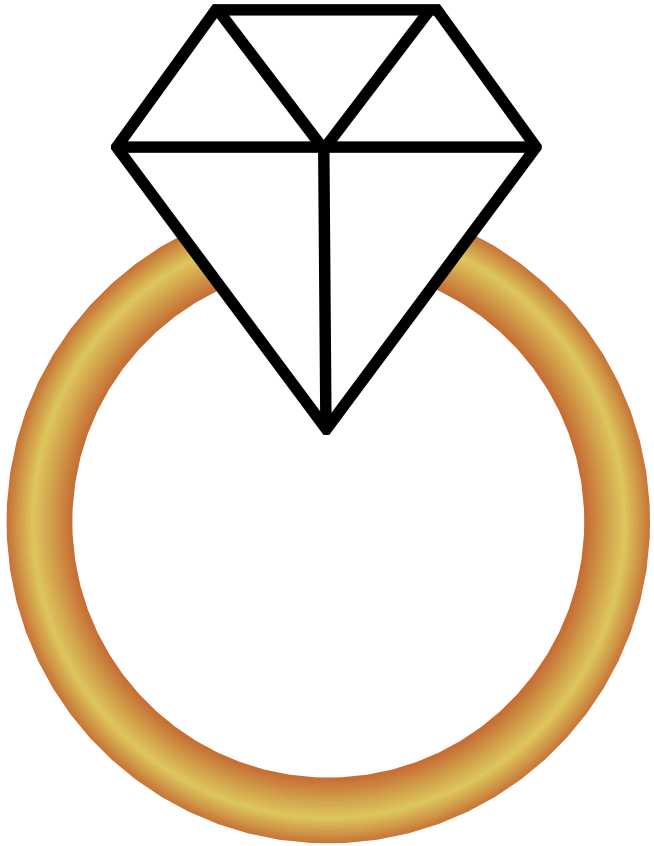
How many colours?

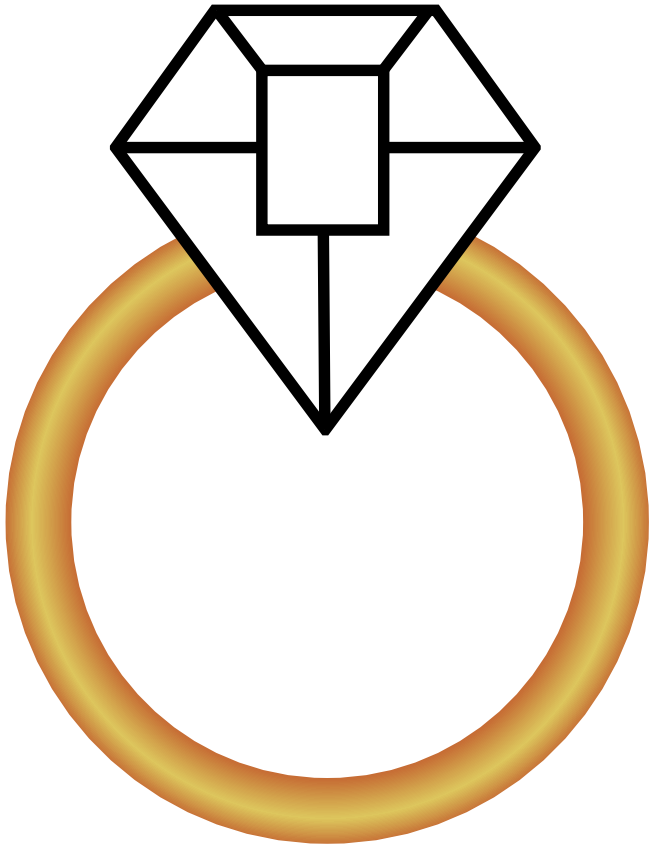




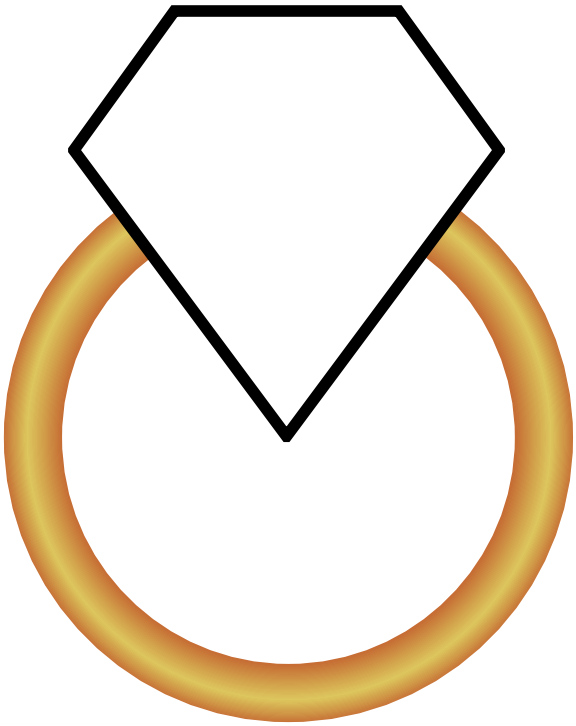
How many colours?



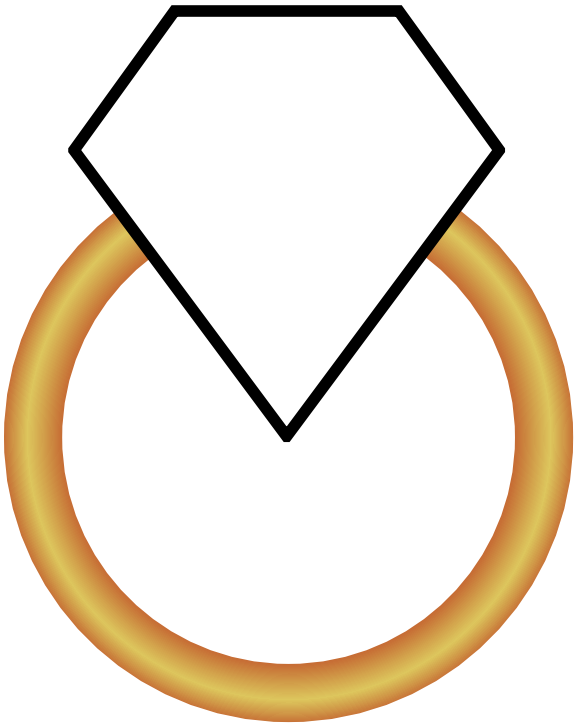




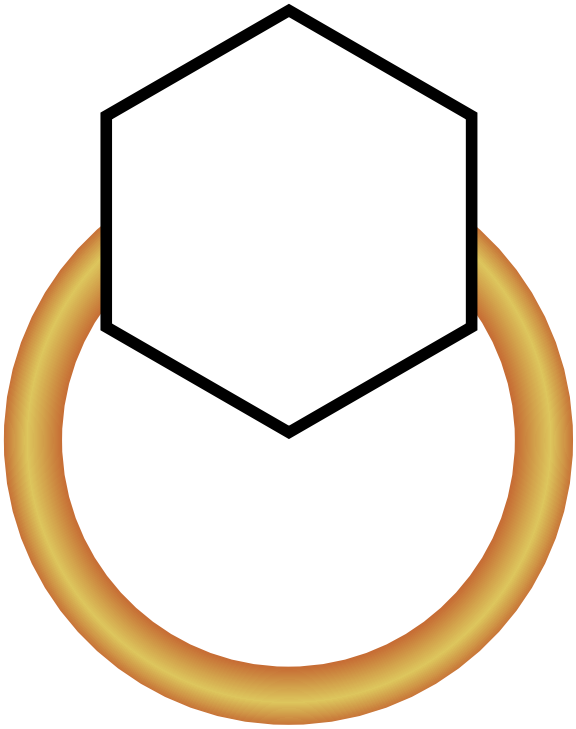
Our ring needs 2 colours.



Our ring needs 3 colours.



Our ring needs _____ colours.



Our ring needs _____ colours.