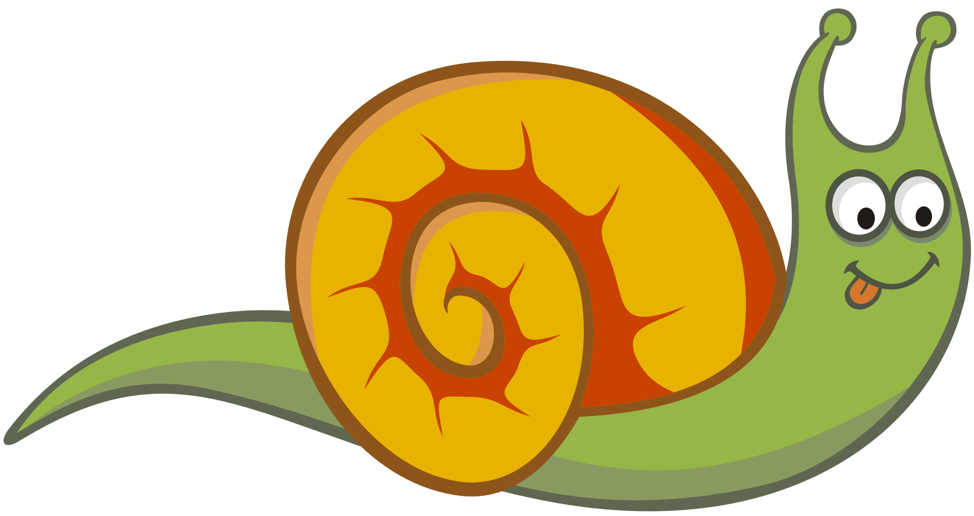
Reasoning in the classroom

Sammy the snail

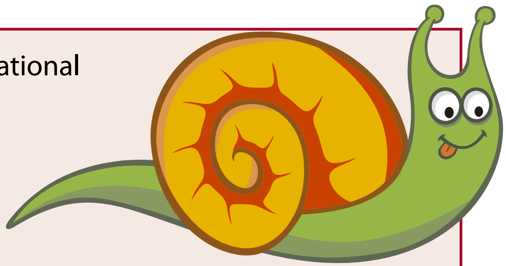


Support materials for teachers

Year 4

Llywodraeth Cymru
Welsh Government

Year 4 Reasoning in the classroom – Sammy the snail



These Year 4 activities start with an item that was included in the 2014 National Numeracy Tests (Reasoning). A further linked activity is also provided.

Activity 1

Sammy the snail
Learners use their understanding of time to work out how long it takes a snail to climb stairs.

Includes:
- Sammy the snail question
- Markscheme

Activity 2

Fibonacci steps
They explore number patterns within the context of running up steps.

Includes:
- Explain and question – instructions for teachers
- Whiteboard – Steps 1
- Whiteboard – Steps 2
- Teachers' sheet – Solutions

Reasoning skills required

Identify	Communicate	Review
Learners choose their own strategies when solving simple problems.	They explain their reasoning.	They draw conclusions and check their working.

Procedural skills

- **Time (hours and minutes)**
- **Multiplication (or repeated addition)**
- **Patterns**

Numerical language

- **Steep**
- **Pattern**
- **Number sequence**
- **Result**

Activity 1

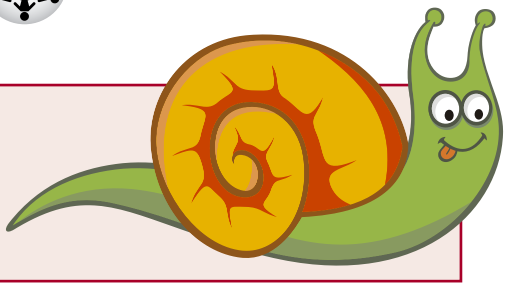
Sammy the snail

Activity 1 – Sammy the snail

or

Outline

In this Year 4 activity, learners use their reasoning skills to work out what time it is when a snail reaches the top of the stairs.



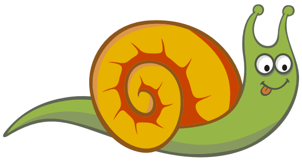
You will need

Sammy the snail question
One page for each learner

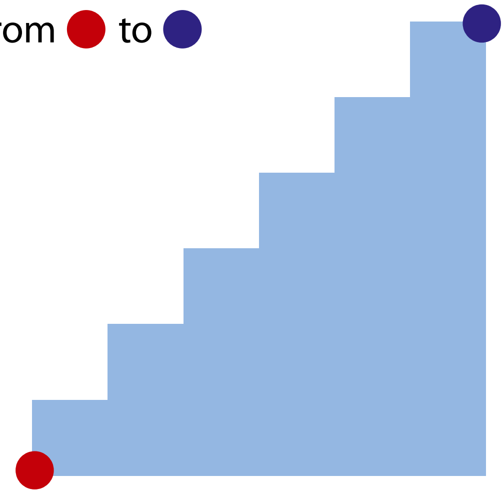
Markscheme

This is Sammy the snail.

He is very slow.



He climbs the stairs from ● to ●



He takes **30 minutes** to climb **up** each step. ↑

He takes **15 minutes** to move **along** each step. →

He starts climbing at **6am**.

What time is it when he gets to ● ?

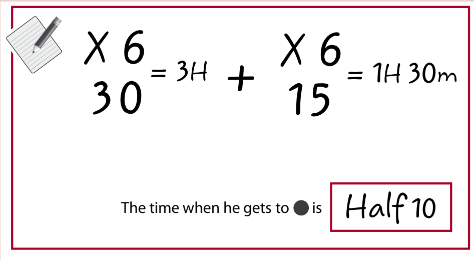
The time when he gets to ● is

4m

Activity 1 – Sammy the snail – Markscheme

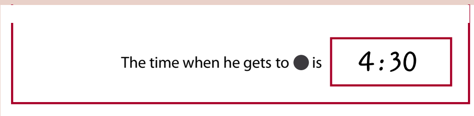
Marks	Answer	
4m	**10:30am** (accept 10:30)	
Or 3m	Shows or implies **$4\frac{1}{2}$** (accept **3** and **$1\frac{1}{2}$**)	**Total time in hours**
	Or	
	Answer **9:45** or **11:15**	**Correct time for 5 or 7 steps, rather than 6**
Or 2m	Shows **270** or **6 × 45**	**Total time in minutes**
	Or	
	Answer **9:00** or **7:30**	**Has considered only ↑ or →**
	Or	
	Shows the intent to list times from 6am in **45-minute intervals**, even if there are multiple errors	**45 minutes per step**
Or 1m	Shows or implies **3** or **$1\frac{1}{2}$**	**Time in hours, ↑ or →**
	Or	
	Shows the intent to list times from 6am in alternate **30- then 15-minute intervals**, even if there are multiple errors	
	Or	
	Shows the intent to **add at least three 45's** (or three 30's and three 15's), even if there are multiple errors	

Activity 1 – Sammy the snail – Exemplars



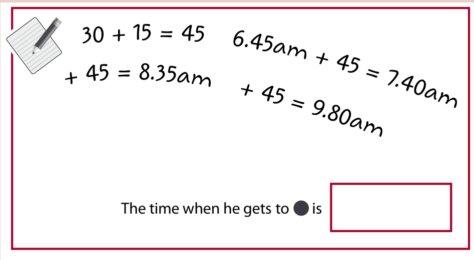
Correct answer; **4 marks**

- Half 10 is an acceptable alternative for 10:30



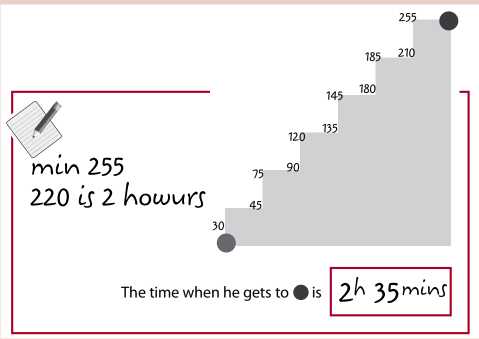
$4\frac{1}{2}$ implied; **3 marks**

- This learner has confused a specific time with a time interval. However, $4\frac{1}{2}$ is clearly implied.



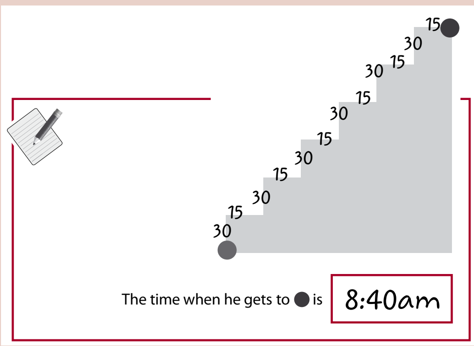
Lists times from 6am in 45-minute intervals; **2 marks**

- This learner has an effective method but each step is incorrect. The sight of 9.80am confirms conceptual difficulties in understanding time.



Add 30's and 15's; **1 mark**

- The staircase shows the result of adding 30's and 15's. This method would lead to the value 270 but there are slips after 135
- Why this learner thinks that 220 minutes is 2 hours would form a useful discussion point after the test.



Insufficient working; **0 marks**

- Although this learner shows understanding of the context, there is no evidence that they have added the 30's and 15's. Sadly, no marks can be given.

Activity 2

Fibonacci steps

Activity 2 – Fibonacci steps

Outline

In this Year 4 activity, learners explore number patterns within the context of running up steps. It introduces learners to a pattern of numbers called the Fibonacci sequence.

The activity is fairly demanding and some learners will benefit from a greater amount of teacher input than usual.

You will need

WB **Whiteboard – Steps 1**

WB **Whiteboard – Steps 2**

T **Teachers' sheet – Solutions**

Activity 2 – Fibonacci steps

Explain

Remind learners of Sammy the snail's journey up the stairs in **Activity 1 – Sammy the snail**. Ask why we have stairs *(a simple question that may well produce some interesting responses)*. Show **Steps 1** on the whiteboard, and ask if they think it would be easy to run up these steps, which are steep. Ask them to imagine they are in a cross-country running race – and these steps are part of the race. They want to win, so to be quicker, some of the time they leap two steps at once. The rest of the time, they take just one step at a time. If they mix the two types of action, stepping onto the next step, or leaping over it to the next one, in how many different ways can they get to the top? Show **Steps 2** on the whiteboard *(part of the steps in* **Steps 1***)* and then tell them they are going to find out.

Together, work through the number of ways to climb one step, two steps and three steps, writing in the different ways *(provided in the teachers' sheet,* **Solutions***)* and using the terminology 'step' and 'leap' or 'S' and 'L'. Use diagrams as appropriate. Then ask learners, in their groups, to find the number of ways for four steps.

Bring the class together to discuss the outcomes, then ask them to find the number of ways for five steps. Again bring them together to check results. Show the number of different ways together in a table of results and ask if learners can see a pattern that would help them to work out the next number. *(Support if needed.)* How should they check? *(Try with six steps.)*

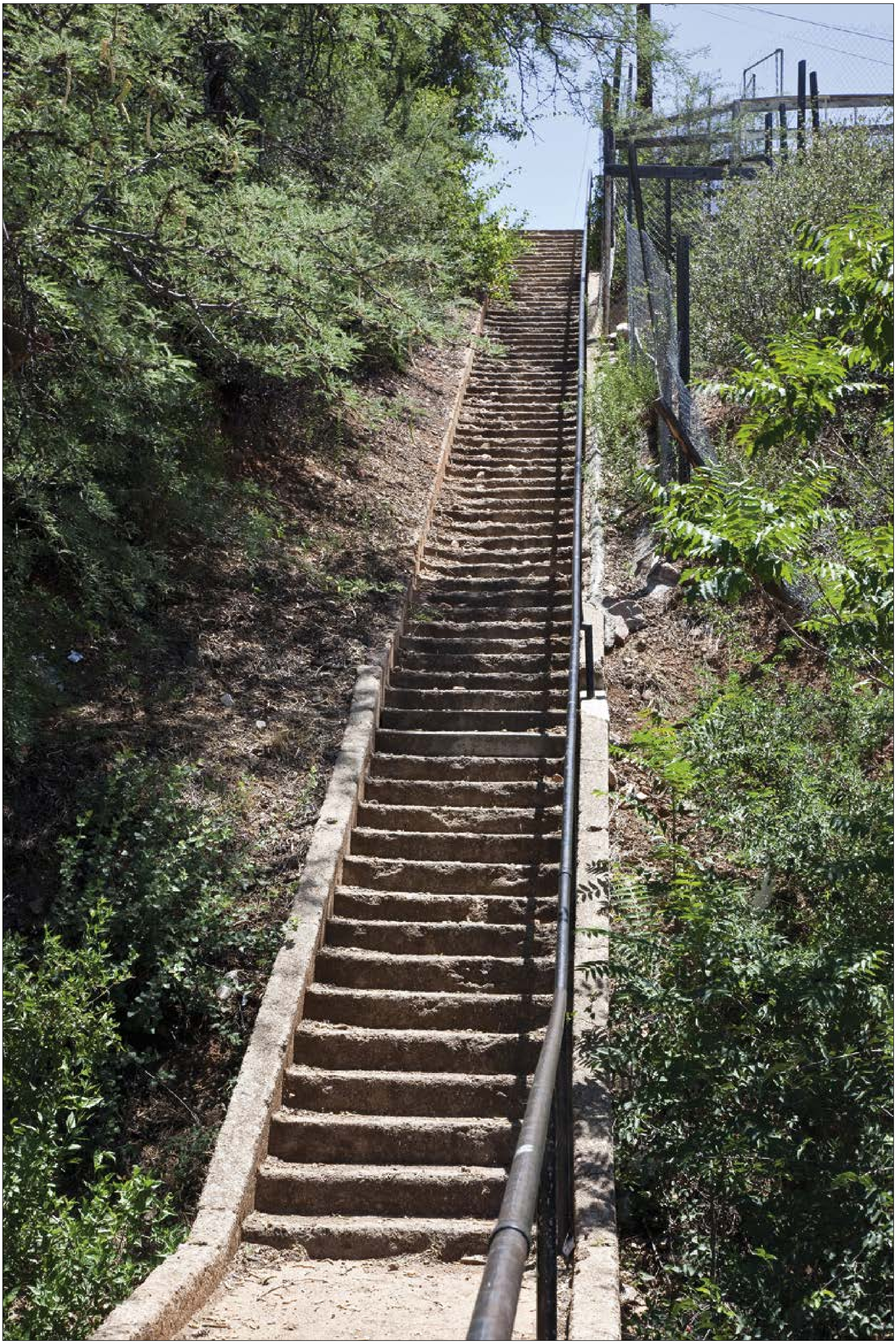
Now ask them to use the pattern to work out how many ways there are to climb all 10 steps. What about 11 steps? Or 12? Conclude, if appropriate, by discussing that this is the Fibonacci sequence *(see* **Solutions***)*.

Question

- Why are the steps in the picture steep? *(The slope is steep.)* Are the stairs in your house/school as steep? Why not? Why would most people find running up these steps difficult? What might you feel if you ran all the way up these steps?
- How are you going to go through all the different ways, so you make sure you find them all? *(Being systematic is important – and drawing different ways will help.)* And how are you going to record your work?
- *(When they have correctly worked out the numbers for five steps)* Look at the numbers you have in this column *(the number of different ways)*. Can you see a pattern? Write the numbers in a line. What can you see now? Look at these numbers *(the 2, 3 and 5)*. Is there anything special about them? What? (*The 2 and 3 add together to make 5.)* Is that a clue?
- *(When they have the pattern)* How could you work out the number of different ways if there were 11 steps? Or 12?

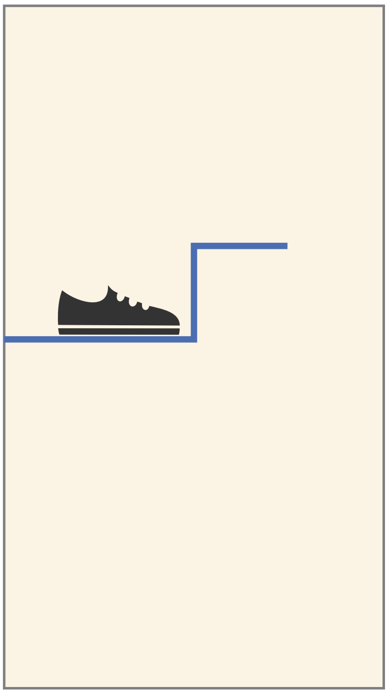
Extension

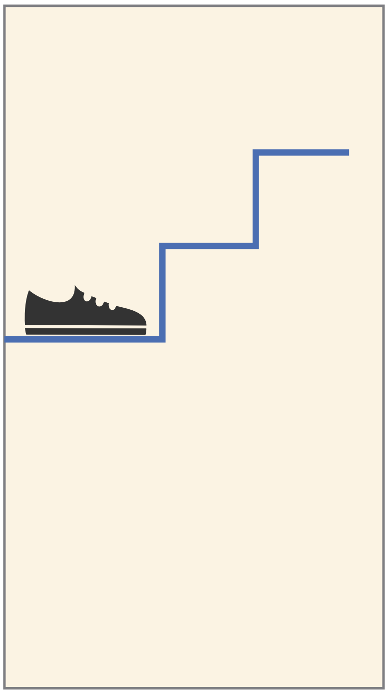
- Can you use a spreadsheet to continue the pattern? *(Learners can get very excited about the numbers in the sequence – there are 10 946 different ways to climb 20 steps!)*

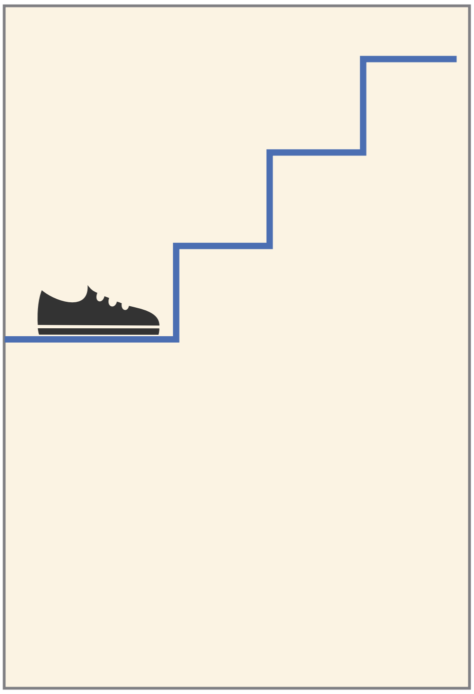


10 steps
We can go one step at a time.
Or we can go two steps at a time.

How many ways can we get to the top?







Steps	Number of ways	Different ways (words)	Different ways (letters)
1	1	Step	S
2	2	Step, step Leap	SS L
3	3	Step, step, step Step, leap Leap, step	SSS SL LS
4	5	Step, step, step, step Step, step, leap Step, leap, step Leap, step, step Leap, leap	SSSS SSL SLS LSS LL
5	8	Step, step, step, step, step Step, step, step, leap Step, step, leap, step Step, leap, step, step Leap, step, step, step Step, leap, leap Leap, step, leap Leap, leap, step	SSSSS SSSL SSLS SLSS LSSS SLL LSL LLS
6	13		
7	21		
8	34		
9	55		
10	89		

The solutions produce the Fibonacci sequence, where each number is the sum of the previous two.

For an interesting, accessible history of Fibonacci and how as a young man in the thirteenth century he found the number sequence that has made him famous to this day, see www.nrich.maths.org/2470