Reasoning in the classroom

Ages

Support materials for teachers

Year 6

Llywodraeth Cymru
Welsh Government

Year 6 Reasoning in the classroom – Ages

These Year 6 activities link to the theme of age. The first activity was included in the 2015 National Numeracy Tests (Reasoning). This is followed by one further activity.

Activity 1

Ages

Learners use information about the ages of two people to work out the age of a third person.

Includes:

- Ages question
- Markscheme

Activity 2

Age puzzles

Learners explore the relationship between the ages of the two people, including through interpreting graphs.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Pete and Joe
- Resource sheet – Pete and Joe graph
- Resource sheet – Pete and Joe graph questions
- Resource sheet – Maryam and Elin graph puzzle
- Teachers' sheet – Solutions

Reasoning skills required

Identify	Communicate	Review
Learners choose their methods and create their own age puzzle(s).	They interpret puzzles and graphs and discuss their meaning.	They use trial and improvement, or other methods, to find solutions, checking as they go.

Procedural skills

- **Four rules of number**
- **Fractions**
- **Comparative bar charts**
- **Algebra (optional)**

Numerical language

- **Total**
- **Twice/double/half**
- **Graph**
- **Key**
- **Difference**
- **Scale**

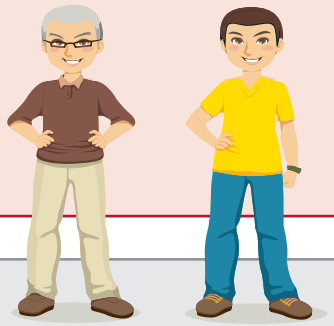
Activity 1

Ages

Activity 1 – Ages

Outline

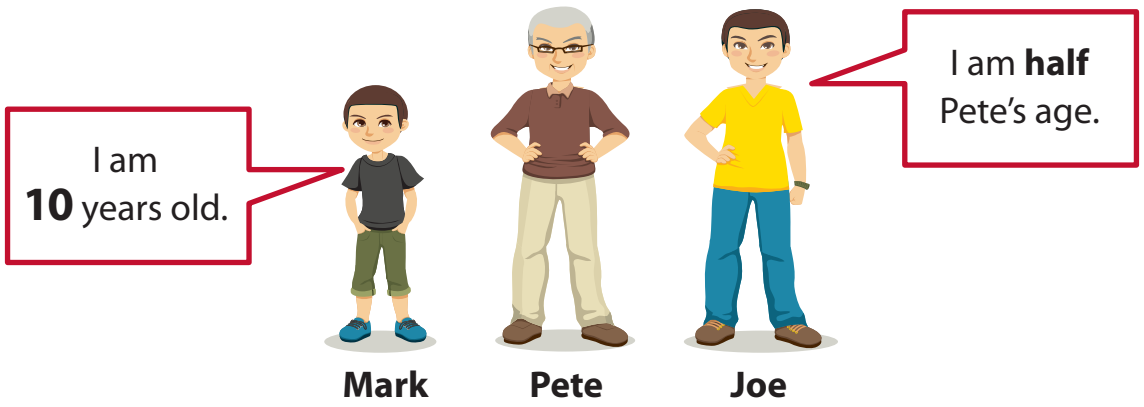
Ages is a pre-algebraic activity that requires learners to use information about the ages of two people to work out the age of a third person.



You will need

Ages question
Half page for each learner

Markscheme

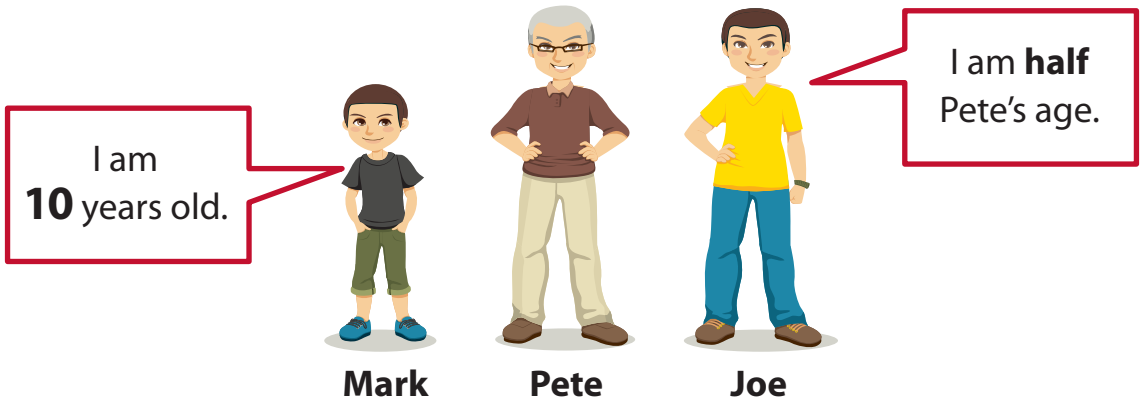


The **total** of their ages is **100**

How old is **Pete**?

years old

2m



The **total** of their ages is **100**

How old is **Pete**?

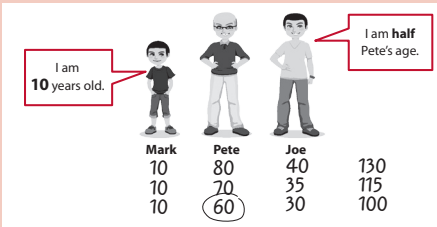
years old

2m

Activity 1 – Ages – Markscheme and exemplars

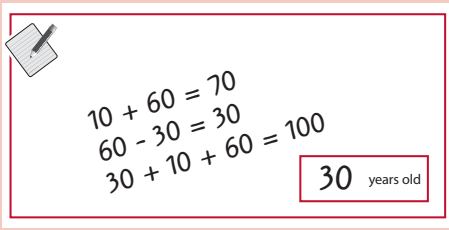
Marks	Answer
2m	**60** years old
Or 1m	Shows **30**

◀ **Joe's age**



Correct; **2 marks**

- This learner is using trial and improvement. Although the answer box is blank, 60 is ringed and is clearly linked to Pete so is acceptable.



Shows 30; **1 mark**

Common error

The correct ages for Pete and Joe are shown, but the wrong value has been selected as the answer. Note that 30 in the answer box with no working would also score 1 mark.

Activity 2

Age puzzles

Activity 2 – Age puzzles

Outline

This Year 6 activity continues the theme of related ages introduced in **Activity 1 – Ages**. Learners consider whether Pete could ever be twice Joe's age again in the future, and whether it was ever true in the past. Learners use comparative bar charts to support their reasoning.

They work to solve a puzzle in which some, but not all, information is given on a graph, and create similar puzzles for others to solve.

You will need

Whiteboard – Pete and Joe

Resource sheet – Pete and Joe graph
One page for each pair/small group

Resource sheet – Pete and Joe graph questions
Half page for each pair/small group

Resource sheet – Maryam and Elin graph puzzle
Half page for each pair/small group

Teachers' sheet – Solutions

Activity 2 – Age puzzles

Explain

Remind learners of **Activity 1 – Ages** in which Joe was half the age of Pete *(aged 30 and 60 respectively)*. Show **Pete and Joe** and ask learners to work in their pairs/small groups to discuss.

After a suitable time, bring learners back together and agree that it is not possible that at any other time Pete was/is twice Joe's age again, then ask for reasons why. *(Learners are likely to recognise that before Joe was 30, Pete was always more than twice his age but after Joe is 30, Pete will always be less than twice Joe's age – but expressing this succinctly is challenging. The graph work that follows is designed to deepen understanding.)*

Give each pair/small group a copy of **Pete and Joe graph** and **Pete and Joe graph questions**. After groups have worked together, discuss as a class. *(Answers can be found on the teachers' sheet* **Solutions***.)*

Now give each pair/small group a copy of **Maryam and Elin graph puzzle**. Can they work out how old Elin and Maryam are now? *(See* **Solutions***.)* Finally, learners can be asked to create their own ages graph and puzzle for others to solve – see questions below for suggested approaches.

Question

Pete and Joe

- What changes? *(Their ages)* What stays the same? *(The difference between their ages)*
- In 10 years' time, how old will Joe be? *(40)* For Pete to be twice his age, how old would he need to be *(80)*. Is that possible? Why not? *(Because the difference in their ages will always be 30 years. So when Joe is 40 Pete will be 40 + 30 = 70 years.)*

Pete and Joe graph *(also see* **Solutions***)*

- Which do you find easier to understand – information about their ages in words, or information about their ages on the graph? Why?

Maryam and Elin graph puzzle

- What do you know? What do you not know? What are you going to do first? *(Trial with different numbers to see if the numbers can be found through trial and improvement.)*
- What puzzles are you creating for others to solve? Have you checked that they have enough information to find the answer? Is there any information you could remove that would leave them still able to solve your puzzle? *(Learners may wish to consider number patterns, e.g. as in the table below.)*

B is three times A's age	*When will B be twice A's age?*
A now 6, B now 18	*In 6 years' time – A 12, B 24*
A now 7, B now 21	*In 7 years' time – A 14, B 28*
A now 8, B now 24	*In 8 years' time – A 16, B 32*

WB

I am 60.

I am twice Joe's age.

Pete

Joe

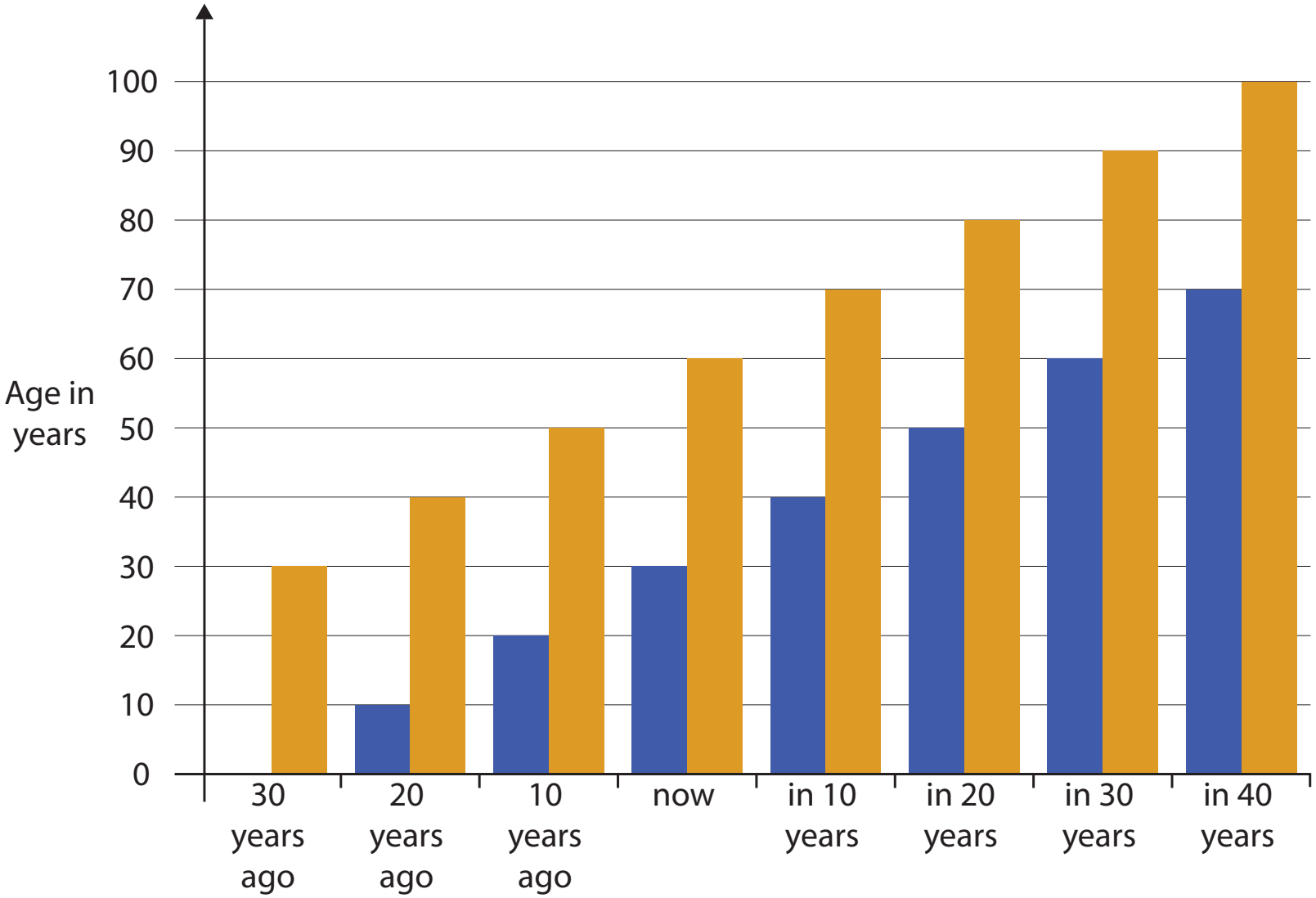
I am 30.

I am half Pete's age.

Will Pete ever be exactly twice Joe's age again?

Has he ever been exactly twice Joe's age before?

The Pete and Joe graph



The Pete and Joe graph questions

1. What is missing from the graph? Write it on!
2. What is the difference in height within pairs of bars?
   Why is it always the same?
3. How old was Pete when Joe was born?
4. How long ago was Pete's age exactly four times Joe's age?
5. How does the graph help to show that Pete's age has never been twice Joe's age before, and never will be again? (Does it matter that the graph doesn't show every year, only every 10 years?)

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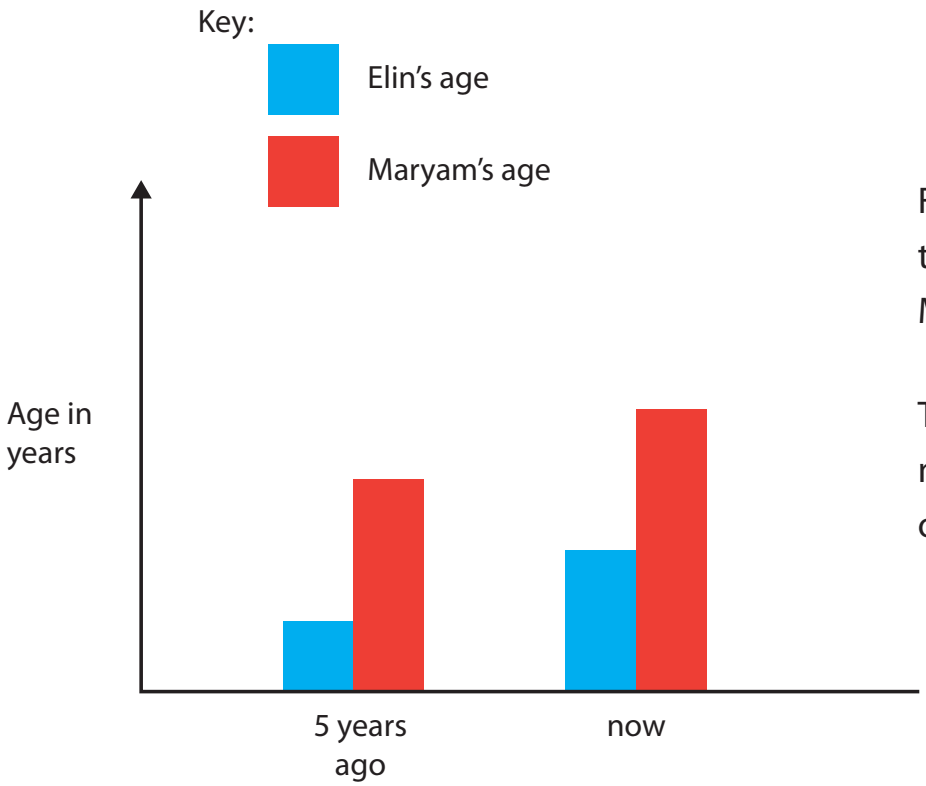
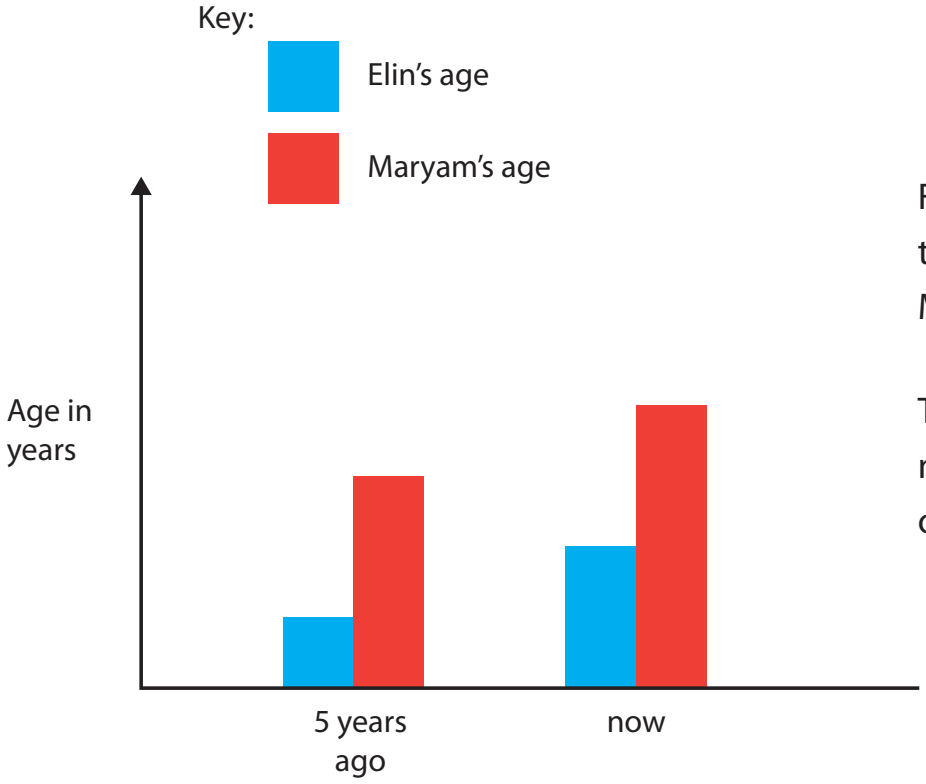
The Maryam and Elin graph puzzle



Five years ago Maryam was three times Elin's age. Now Maryam is twice Elin's age.

The scale showing years is missing! Can you work out how old Maryam and Elin are now?

The Maryam and Elin graph puzzle



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The scale showing years is missing! Can you work out how old Maryam and Elin are now?

Pete and Joe graph

1. The key is missing – this is deliberate in order to focus attention on the underlying meaning of the graph: the orange bars represent Pete's age and the blue bars represent Joe's age.

2. The difference is always 30 years as the age difference never changes – Pete will always be 30 years older than Joe however long they live. (The graph assumes that they live to a ripe old age!)

3. As Pete is always 30 years older than Joe, he was 30 when Joe was born. This is also shown on the graph.

4. 20 years ago.

5. Although it is not a formal proof, the graph clearly shows the changing multiplicative relationship between the heights of Pete and Joe. We can see that in the future, the height of Joe's bar is always more than half the height of Pete's bar, and in the past the height of Joe's bar was always less than half. If the remaining years were to be inserted this would still be true.

Some learners may be able to follow this algebraic proof.

	Joe	Pete
Age now	30	60
Age in Y years' time	30 + Y	60 + Y

But if Pete is twice Joe's age in Y years' time Joe's age will be $2 \times (30 + Y) =$ **60 + 2Y**.
So now we have **60 + 2Y = 60 + Y** which means that Y must be 0.
The only time the relationship can be true is now.
Alternatively, learners might reason that if Pete is to be twice as old as Joe, then the number of years added to 60 must be **double** the number of years added to 30. Since we are adding the same number of years to each this is clearly impossible.

The Maryam and Elin graph puzzle

The most likely method to be used is trial and improvement – this is a useful technique when more formal methods are not available. Learners should be encouraged to record their trials and decisions logically, e.g.

Elin's age 5 years ago	Maryam's age 5 years ago	Elin's age now	Maryam's age now	
Try 20	60	25	65	×
Try 10	30	15	35	×
Try 5	15	10	20	✓

Elin is 10 years old. Maryam is 20 years old.

Some learners may be able to follow this agebraic proof.
If Elin's age five years ago was Y, Maryam's age five years ago was 3Y.
Elin's age now is Y + 5, and Maryam's age now is 3Y + 5.
But we know that Maryam's age now is twice that of Elin's, so

$$\begin{aligned} 2 \times (Y + 5) &= 3Y + 5 \\ 2Y + 10 &= 3Y + 5 \\ 10 &= Y + 5 \\ Y &= 5 \end{aligned}$$

Five years ago Elin was 5 years old so now she must be 10 and Maryam must be 20.