Primary Division 2017-2018 Round 3 Solutions

P3.1. Adam is now 9 years older than Brianna and 13 years ago he was twice as old as she was then. How old are Adam and Brianna now?

Solution 1

We are told that Adam is 9 years older than Brianna.
So their age difference is 9 years which means that when Brianna was 9 years old, Adam was 18 years old.
That was 13 years ago so their ages now are $9 + 13 = 22$ and $18 + 13 = 31$.

Guidelines

1 mark for realising the age difference is always 9 years.
1 mark for realising that the age difference must be Brianna's age 13 years ago.
1 mark for stating Adam's age 13 years ago has to be 18.
1 mark for their present ages.

Solution 2

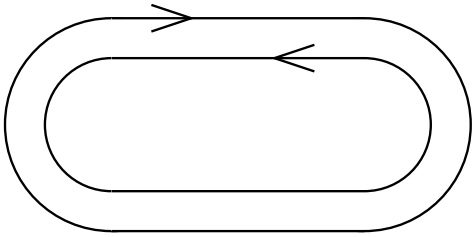
Let Adam's age be y years.

13 years ago:

$$y - 13 = 2(y - 9 - 13)$$
$$y - 13 = 2y - 44$$
$$y = 31$$

So now, Adam is 31 and Brianna is 22 years old.

P3.2.



Trains on the Glasgow Subway depart every 4 minutes, and a complete circuit takes 24 minutes. Ewan sets off at 8.30 am on a train round in one direction at the same time as another train leaves in the opposite direction. How many trains will he pass on a complete circuit back to his starting station? (Do not count trains at the start or end station.)

Solution 1

At the start of his journey Ewan will see the 8.06 in the station, having just completed its journey in the other direction.

At the end of his journey at 8.54 he will see the 8.54 in the station, just about to leave in the other direction.

At some point around the circuit he will pass all the trains leaving between these, i.e. those leaving at 8.10, ... 8.50.

So he sees 11 trains.

Guidelines

1 mark for start time of first train Ewan sees

1 mark for start time of last train Ewan sees

1 mark for list of start times of intervening trains

1 mark for he sees 11 trains

Solution 2

Assume that the trains travel at constant speed around the circuit.

Then at 8.30 there will be a train 4 minutes away, which Ewan will pass after 2 minutes, as they travel towards each other. As they pass there will be another train approaching 4 minutes away, which Ewan will pass after another 2 minutes. So Ewan will pass trains every 2 minutes i.e. at 8.32, 8.34, ... 8.52 until he meets another train in the station at 8.54.

So he passes 11 trains on his journey.

{*In fact the trains will not travel at constant speed - there will be station stops around the circuit. But still Ewan will have to pass all the trains as if they were travelling at constant speed, so the answer is still 11.*}

P3.3. Some people think it is unlucky if the 13th day of a month falls on a Friday. Show that in every calendar year which is not a leap year, there will always be at least one such unlucky Friday but that there can be no more than three.

Solution

Taking 2018 as an example non-leap year, the table shows the days that the 13th falls on

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sa	Tu	Tu	F	Su	W	F	M	Th	Sa	Tu	Th

Each day of the week occurs in this list at least once. So whichever day of the week 13th Jan falls on in a non-leap year there will always be at least one Friday 13th in the year.

Similarly no day of the week appears more than 3 times in this list. So whichever day of the week 13th Jan falls on in a non-leap year there can be no more than 3 Friday 13ths in the year.