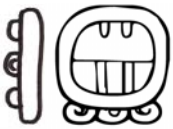
(K) Tzolk'in

K1. Draw the Mayan names of the days labeled *a* and *b* on the calendar (see next page).

a. 

b. 

K2. Write *c* and *d* on the calendar for the following days (see next page).

c. 

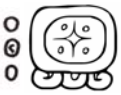
d. 

K3. How often does the following day occur?

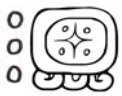
e. 

Every 260 days.

August

						
						
				***c***		
						

September

	b					
						
			***d***			
					*a*	

K4. Explain your answers.

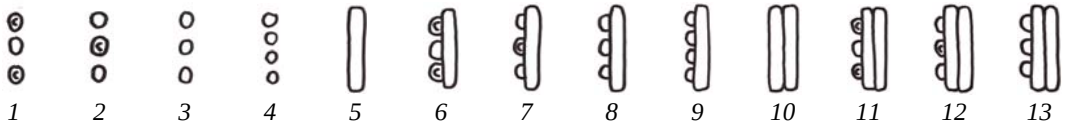
We first observe that each day name includes two glyphs, which repeat in cycles of different length. In particular, the right-hand side glyphs, which look like little pictures, repeat every twenty days. For example, the  glyph repearts three times: August 18, September 7, and September 27; as a side note, it means Venus. Thus, the picture glyphs should repeat either every 20 days, or in some shorter cycle, which is a divisor of 20; however, if we consider all smaller divisors of 20, we find out that they cause "collisions" between glyphs, which means that the length of the cycle is exactly 20. As another side note, there is no way to identify the beginning of this cycle, and Mayans do not have a general consensus about its "start" day.

On the other hand, the glyphs on the left appear to cycle every 13 days:

We find three missing glyphs in Problems K2 and K3, and we can use the observed pattern to put them in their proper places. We can also deduce the positions of days in Problems K2c and K3d, which increases the certainty of placing the dot-and-bar glyphs.

We can determine the "start" for this sequence by observing the pattern of these glyphs; specficially, the arrow above shows the discontinuity in the pattern, which is likely to be the start of the cycle, thus leading to the following order:

We next observe that (1) the third glyph consists of three empty circles, and (2) the eighth glyph has three cirlces, the ninth has four circles, and the tenth has an extra bar instead of the circles. In fact, these symbols are numbers, and we can deduce their representation; specifically, a number is a sum of its elements, where an empty circle is 1 and a bar is 5. We can thus deduce that the fourth glyph consists of four empty circles:



We can now determine most day names.

In particular, September 28 (Problem K1a) is as shown on the left, since it is immediately after a "3" day, and it is 40 days after August 19, which should have the same picture glyph.

The only places for glyphs in Problems K2c and K2d are on August 23 and September 19, which gives the positions of 19 out of the 20 picture glyphs, and leaves only one missing picture glyph.

The day in Problem K1b falls on one of the missing-glyph days. We next note that the missing picture glyph appear in Problem K3, and thus it should be as shown on the left.

In conclusion, we observe that the lengths of the two cycles, 20 and 13, are relatively prime, which means that the length of the combined cycle is $20 \cdot 13 = 260$ days, and thus the Tzolk'in year is 260-day long. Note that it serves only as the ritual calendar, and not as the agricultural calendar.

Notes

Some contestants have noticed that the picture glyphs 9 and 11 days after "Venus" are identical. This use of two identical glyphs is a typo; the two glyps are similar, and the problem editor has accidentally used the same symbol. Fortunately, it does not lead to any critical contraditction, and it does not make the problem unsolvable. We apologize for this typo, but we also wish to notice that linguists sometimes encounter similar problems in their research, since the authors of ancient records also made mistakes.