

## (D) Real Numbers (1/2) [Solution]

D1.

(a) 

(b) 

(c) 

D2. (a) piņasut                      (b) qulit atausiq                      (c) iñuiññaq malğuk

D3. (a) 1                                  (b) 5                                  (c) 19

D4. a. 2022-1-27                      b. 4000

The writing is the date – in this version January 27, 2022 (date of the Open Round). The Kaktovik Iñupiaq numerals read 2022-1-27, with  $2022 = (5 \cdot 400 + 1 \cdot 20 + 2)$ ; the Iñupiaq says “January twenty-seven, two thousand twenty-two”.

The suffix -agliaq (meaning \*400), shown in the date, is applied to base qulit to form quliagliaq, 4000.

The word for “January” has nothing numeric in it; it refers to the appearance of the brightness of the new/returning sun. (This is not intended/possible to be deduced.)

The Kaktovik Iñupiaq numerals are formed with (relatively) vertical lines indicating ones, and (relatively) horizontal lines indicating fives, up to nineteen. After that, a base-20 positional notation begins (using zero as needed):

				
0	1	2	3	4
				
5	6	7	8	9
				
10	11	12	13	14
				
15	16	17	18	19



## (D) Real Numbers (2/2) [Solution]

The Iñupiaq is similarly base-20 with a sub-base of 5:

1: atausiq	6: itchaksrat	11: qulit atausiq	16: akimiaq atausiq
2: malġuk	7: tallimat malġuk	12: qulit malġuk	17: akimiaq malġuk
3: piņasut	8: tallimat piņasut	13: qulit piņasut	18: akimiaq piņasut
4: sisamat	9: quliņġugutaiġaq	14: akimiagutaiġaq	19: iñuiññaġutaiġaq
5: tallimat	10: qulit	15: akimiaq	20: iñuiññaq

The sub-base and base words are formed from body part/position words: tallimat means hand/arm, qulit means top (upper body digits), akimiaq means (roughly) “it goes across”, and iñuiññaq means “complete/entire person”, with the iñu- root (person) shared with Iñupiaq (mentioned in the footnote). (This root is cognate with those in “Inuit”, in which the -it is cognate with the -t in Iñupiat (i.e., a plural marker), inukshuk/inuksuk, and many others.)

Numbers words 20-38 are formed with the iñuiññaq base, followed by the remainder; 40 is malġukipiaq and 39 is malġukipiaġutaiġaq; higher multiples of 20 are formed like malġukipiaq with -ipiaq. Multiples of 400 use the suffix -agġiaq, as in tallimaagġiaq (2000). Very large numbers can be formed by appending multiple suffixes.

In Arabic numerals, the equations on the blackboard are:

$$4 - 3 = 1$$

$$2 \times (a) = 8$$

$$4 + 8 = 12$$

$$(b) - 1 = 14$$

$$20 - 4 = 16$$

$$56 \div 7 = 8$$

$$5 \times (c) = 30$$

Sources:

Consultation from Edna Ahgeak MacLean, Kirk Miller, and Myles Creed.

[https://en.wikipedia.org/wiki/Iñupiaq\\_language#Numerals](https://en.wikipedia.org/wiki/Iñupiaq_language#Numerals)

[https://en.wikipedia.org/wiki/Kaktovik\\_numerals](https://en.wikipedia.org/wiki/Kaktovik_numerals)

<http://www.ankn.uaf.edu/sop/SOPv2i1.pdf>

[https://library.alaska.gov/hist/hist\\_docs/docs/anlm/200078.pdf](https://library.alaska.gov/hist/hist_docs/docs/anlm/200078.pdf)

<https://www.uaf.edu/anlc/languages/inupiaq.php>

