

[illegible]

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Dedicated to Isoraḱatheð.

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0.1 | Introduction

1 | Phonology and orthography

1.1 | Phoneme inventory

Table 1.1: The consonants of Lek-Tsaro.

	Bilabial	Alveolar	Palatal	Velar	Glottal
Nasal	m	n	ɲ	ŋ	
Plosive	p b	t d	c ɟ	k g	ʔ
Fricative	f	s	ʃ	x	
(coarticulated)	θx	fx		ff	
Affricate		ts	tʃ		
Lateral fricative		ɬ			
Approximant		ɹ	j	w	
Lateral approximant		l			
Trill		r			

Table 1.2: The vowels of Lek-Tsaro.

Spread	Half-rounded	Rounded
i	ɣ	y
u	ɤ	u
ɛ		œ
ʌ		ɔ
ä		

In addition to consonants and vowels, Lek-Tsaro has rod signals, represented by numbers. Rod A is blue and held by one's dominant hand and B is red and held by one's non-dominant hand.

1. Rod A is raised to one's chest, while B is pointed down.
2. Rods A and B are crossed in the front.
3. Rod B is raised upwards in front of the nondominant arm, while rod A is lowered.
4. Rod A is pointed sideways near one's nondominant arm, while rod B is lowered.
5. Rods A and B are extended to the sides.

6. Rods A and B are extended, facing forward.
7. Rod A is raised forward, while B is pointed to the side.
8. Rod B is raised forward, while A is pointed to the side.

Lowering both rods is interpreted as an absence of a rod signal.

If the use of rods are unavailable, the numerals of the positions may be pronounced.

1.2 | Hacmisation

Lek-Tsaro uses the hacm script with superscript letters to indicate phonemes not found in Arka. The transcriptions can be found in Tables 1.3 and 1.4.

Table 1.3: The consonants of Lek-Tsaro.

	Bilabial	Alveolar	Palatal	Velar	Glottal
Nasal	ɒ	n	n ^ɥ	n ^ɣ	
Plosive	d b	f ɳ	f ^ɥ ɳ ^ɥ	ɰ ɸ	.
Fricative	a	j	l	h	
(coarticulated)	j ^h	a ^h		a ^l	
Affricate		tʃ	ʃ		
Lateral fricative		s			
Approximant		ɹ	ɥ	o	
Lateral approximant		l			
Trill		r			

Table 1.4: The vowels of Lek-Tsaro.

Spread	Half-rounded	Rounded
ɕ	ɕ ^ə	ɕ ^ɔ
ə ^ɕ	ə	ə ^ɔ
e		e ^ɔ
ɔ ^e		ɔ
ɪ		

Rod signs are represented by the hacm digits <1 2 3 4 5 6 7> attached to the end of the verbs they encompass. Proper words are preceded by a backslash <\>.

Vowels that are inferrable from context are sometimes omitted. For example, /æfan/ (to speak) is written <µean>, but /æfin/ (to spread), which is less common, is written <µeacn>, with the second vowel. Most of this grammar will leave all vowels written.

1.3 | Phonotactics

An onset consists of one of the following:

- any single consonant other than /l/ (the exceptions are <le> [lek] and related words),

- any obstruent followed by an approximant other than /l/,
- or any plosive followed by /r/,
- or any nasal followed by /j/ or /w/.

A nucleus consists of one vowel.
A coda consists of one of the following:

- nothing,
- a nasal,
- a voiceless plosive (excluding /ʔ/),
- /ɹ/, /s/ or /l/

1.4 | Stress

Stress falls on the last syllable with a coda, or otherwise the second-to-last syllable.
See table 1.5 for examples.

Table 1.5: Examples of stress locations.

Orthography	Location of stress (# from last)
ɒʒɪ	2
nɪ.cn	1
.əʔfəlb	2
ɪjnedc ^a	3

1.5 | Vowel harmony

For the purposes of vowel harmony, vowels are divided into front and back vowels.
/a/ is neutral. A root with neither front nor back vowels acts as if it has front vowels.
If by some odd chance a word has both front and back vowels, it is treated as either by random chance.

1.6 | Allophony

The following changes are made:

$$s \rightarrow \text{ʃ} \quad (\blacklozenge\{w, j, u, y\}) \quad \text{NB this is a whistled sibilant.}$$
$$C_1\{n, \eta\}C_2\{k, g\} \rightarrow \text{NC}_2[+uv] \quad [2 \mid \#\sigma]$$
$$C_1[+av] \rightarrow C_1[+rt] \quad \left[\sum_{n \in \chi} n^2 \in \mathbb{P} \right]$$

Some examples:


























- $\langle \text{joc}\text{f} \rangle$ turning from turquoise to blue /swit/ [ʃwit]
- $\langle \text{j}^{\text{h}}\text{cnle} \rangle$ does not go /θxinkε/ [θxinqε] because the number of syllables is even
- $\langle \text{n}\text{l}.\text{cn}\text{l}\text{f} \rangle$ but was waiting /naʔin{16}/ [ŋaʔin{16}] because $1^2 + 6^2 = 37$ is prime

1.7 | The script of Lek-Tsaro

Lek-Tsaro also uses its own script, inspired by one of Uruwi's old childhood cyphers.

The consonants within a word are divided into pairs (plus one single consonant at the end if applicable). Thus, $\langle \text{d}\text{ə}\text{n}^{\text{p}}\text{i}\text{d}\text{ɔ}^{\text{e}}-\text{m}\text{i} \rangle$ would have $\langle \text{d}\text{n}^{\text{p}} \text{d}\text{m} \rangle$. These pairs then get a glyph that combines the glyphs for their constituent consonants.

Table 1.6: Single consonants in the script.

 d	 f	 l	 j	 a
 n	 ɒ	 h	 j ^h	 ɥ
 r	 l/s	 l	 o	 φ
 n ^p	 ɔ	 b	 a ^l	 a ^h
 ɔ ^ɥ	 ɥ	 μ	 n ^ɥ	 .

The full table of consonant pairs can be found at tables 1.7 and 1.8. There are some general rules:

- Double consonants get their single-consonant glyphs with a ring below.
- d-coloured glyphs bear the characteristic middle bar of $\langle \text{z} \rangle \langle \text{d} \rangle$: $\text{z d} + \text{l l} \rightarrow \text{z l dl}$.
- l-coloured glyphs rest under the characteristic arrow of $\langle \text{z} \rangle \langle \text{l} \rangle$: $\text{z l} + \text{f f} \rightarrow \text{z f lf}$.
- f-coloured glyphs rest under the characteristic hilt of $\langle \text{f} \rangle \langle \text{r} \rangle$: $\text{f r} + \text{r r} \rightarrow \text{f r rr}$.
- j-coloured glyphs bear the characteristic bar-and-circle of $\langle \text{j} \rangle \langle \text{b} \rangle$: $\text{j b} + \text{b b} \rightarrow \text{j b bb}$.
- a-coloured glyphs bear the characteristic double-swash of $\langle \text{a} \rangle \langle \text{n}^{\text{p}} \rangle$: $\text{a n}^{\text{p}} + \text{n}^{\text{p}} \text{n}^{\text{p}} \rightarrow \text{a n}^{\text{p}} \text{n}^{\text{p}}$.
- ɒ-coloured glyphs bear the characteristic brook of $\langle \text{ɒ} \rangle \langle \text{d} \rangle$: $\text{ɒ d} + \text{d d} \rightarrow \text{ɒ d dd}$.
- j^h-coloured glyphs bear the characteristic arc of $\langle \text{j}^{\text{h}} \rangle \langle \text{ɒ} \rangle$: $\text{j}^{\text{h}} \text{ɒ} + \text{ɒ ɒ} \rightarrow \text{j}^{\text{h}} \text{ɒ j}^{\text{h}} \text{ɒ}$.
- ɥ-coloured glyphs rest under the characteristic triangle of $\langle \text{ɥ} \rangle \langle \text{ɥ} \rangle$: $\text{ɥ ɥ} + \text{ɥ ɥ} \rightarrow \text{ɥ ɥ ɥ ɥ}$.
- r-coloured glyphs rest under the characteristic overring of $\langle \text{r} \rangle \langle \text{r} \rangle$: $\text{r r} + \text{r r} \rightarrow \text{r r rr rr}$.

Table 1.7: Consonant pairs in the script.

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
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0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
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0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
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0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
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0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
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0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
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0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I																	

- l-coloured glyphs rest to the left of the characteristic vertical line of $\langle \text{I} \rangle \langle \text{I} \rangle$: $\text{I} \text{I} + \text{I} \rightarrow \text{I} \text{I} \text{I}$.
- o-coloured glyphs are superimposed with a copy rotated either π or, in the case of a few glyphs, $\pi/2$: $\text{O} + \text{I} \rightarrow \text{OI}$; $\text{O} + \text{h} \rightarrow \text{oh}$.
- n-coloured glyphs are superimposed with $\langle \text{X} \rangle \langle \text{n} \rangle$: $\text{X} \text{n} + \text{I} \rightarrow \text{XnI}$. In some cases, the cross might be rotated $\pi/4$: $\text{X} \text{n} + \text{n} \rightarrow \text{Xn}$.
- b-coloured glyphs rest inside the characteristic room of $\langle \text{E} \rangle \langle \text{b} \rangle$: $\text{E} \text{b} + \text{I} \rightarrow \text{E bI}$.
- a^l-coloured glyphs rest under the characteristic flare of $\langle \text{Z} \rangle \langle \text{a}^l \rangle$: $\text{Z} \text{a}^l + \text{I} \rightarrow \text{Z a}^l \text{I}$.
- n^u-coloured glyphs rest under the characteristic P-shape of $\langle \text{P} \rangle \langle \text{n}^u \rangle$: $\text{P} \text{n}^u + \text{I} \rightarrow \text{P n}^u \text{I}$.
- p-coloured glyphs rest to the left of the characteristic flare of $\langle \text{C} \rangle \langle \text{p} \rangle$: $\text{C} \text{p} + \text{I} \rightarrow \text{C pI}$.

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7																												

- n^h -coloured glyphs bear the characteristic inner circle of $\langle A \rangle \langle n^h \rangle$: $A n^h + \mathbb{C} a^h \rightarrow \mathbb{C} n^h a^h$.
- If all else has failed, the two consonants are superimposed. The default order is the same as the ordering used in table 1.6.
- In coloured-consonant pairs, the colourant is assumed to occur first unless the order is switched by an order reversal mark.
- A negative-sloping mark below a glyph means that the order of consonants is switched.

Thus, after adding vowels we get $\langle \hat{F} \hat{E} \rangle$.

Table 1.9: Vowel pairs in the script.

[illegible]

Table 1.10: Miscellaneous symbols.

- 1 ¸ 2 3 4 5 6 7 8 9 ¸ Δ
- ¸ period (circumfix)
- ¸ comma
- ¸ name mark (equiv. to <\>)

2 | Syntax

2.1 | Basic word order

The basic word order is VSO. Descriptors follow what they modify.

2.2 | Questions

Binary questions have the interrogative polarity marker and no change to syntax.

In wh-questions, the wh-word is pulled to the front (i. e. before the verb). This requires case marking for the wh-word:

flen peac^əjhi nc^əʒ
who-ACC speak-FAR.PAST-Q PR.FAR.SG
Whom did you speak to?

This applies only to questions, not interrogative-mood clauses that act as relative clauses:

peac^əjhi nc^ə flel, ɣɪf ɲɔ.
speak-FAR.PAST-Q PR.FAR.SG who, see-NEAR.PAST PR.ANAPH_OBJ.INT
I saw the person whom you talked to.

2.3 | Multiple clauses

A sentence might have multiple clauses. Each clause in a sentence follows the basic VSO order, and clauses are separated with commas.

3 | Nouns

Nouns are declined for number, case and definiteness.

3.1 | Number

Lek-Tsaro has many grammatical numbers:

Table 3.1: The discrete grammatical numbers of Lek-Tsaro.

Number	Constraint on $x \in \mathbb{Z}$
Integral	none
Nullary	$x = 0$
Singular	$ x = 1$
Dual	$ x = 2$

Table 3.2: The continuous grammatical numbers of Lek-Tsaro.

Number	Constraint on $x \in \mathbb{R}$
Nullary	$x = 0$
Subsingular	$ x < 1$
Supersingular	$1 \leq x < 2$
Plural	$ x \geq 2$ or x is unknown

3.2 | Case

In a clause with both the subject and object directly expressed in that order, both the subject and object are declined in the nominative case (and their roles are inferred through word order). In a clause where only one is present, or where both are expressed in the opposite order, the subject will receive the nominative case and the object will receive the accusative case.

3.3 | Noun classes

There are three overarching groups of noun classes.

3.3.1 | Countable

Nouns in these classes are declined for a discrete number.

1. Sentient – such as humans, AIs, deities.
2. Animate – nonsentient animals.
3. Inanimate – anything else.

3.3.2 | Measurable

Nouns in this class are declined for a continuous number.

4. Measure – all measurable nouns, especially units of measurement.

3.3.3 | Uncountable

Nouns in these classes are not declined for number, and require compounding with a countable or measurable noun in order to be quantified.

5. Fluid – liquids and gases.
6. Edible – edible (to humans) non-fluids.
7. Inedible – inedible (to humans) non-fluids.
8. Abstract – abstract ideas.

3.4 | Definiteness

The definite form of a noun is formed regularly by reduplicating the first syllable (without the coda): <Dɪɪ> “a person” becomes <DɪDɪɪ> “the person”.

3.5 | Declension table

3.5.1 | Countable classes

Note that noun declensions respect vowel harmony. For nouns with back vowels, replace the front vowels with the back vowels of the same height and rounding, and vice versa.

Table 3.3: Declensions for countable nouns.

	Integral	Nullary	Singular	Dual
Sentient: <Dɪɪ> “person”				
Nominative	Dɪɪ	Dɪɪe	Dɪɪɪ	Dɪɪɪɪ
Accusative	Dɪɪɪ	Dɪɪɪɪe	Dɪɪɪɪɪ	Dɪɪɪɪɪɪ
Sentient: <ɟʰi.en> “magician”				
Nominative	ɟʰi.en	ɟʰi.efe	ɟʰi.ej	ɟʰi.el
Accusative	ɟʰi.eɲɪ	ɟʰi.enɪe	ɟʰi.eɲɪɪ	ɟʰi.eɲɪɪɪ
(Note that the final consonant is preserved only in the integral nominative form.)				
Animate: <Dənɪ> “rabbit”				

	Mass
Inedible: <ᵐᵒᵐᵒ> “stone”	
Nominative	ᵐᵒᵐᵒ
Accusative	ᵐᵒᵐᵒᵈᵉ
Abstract: <ᵃᵃᵐᵒᵈᵒ> “empathy”	
Nominative	ᵃᵃᵃᵐᵒᵈᵒ
Accusative	ᵃᵃᵃᵐᵒᵈᵒᵐᵒ
Abstract: <ᵐᵒᵐᵒ> “[the number] five”	
Nominative	ᵐᵒᵐᵒ
Accusative	ᵐᵒᵐᵒᵐᵒ

3.6 | Pronouns

Personal pronouns are not divided into first, second and third persons as in most languages. Instead, they fall into four categories which exhibit different behaviour depending on whether they occur as the first or second noun in the clause:

Table 3.6: Pronoun persons and their functions.

Person	Role in first position	Role in second position
Near	The speaker.	The first argument of the sentence.
Far	The listener.	If the first argument is the speaker, then the listener. Otherwise, the speaker.
Other	A third entity.	An entity that is neither the speaker, the listener nor the first argument.
Generic	A generic entity (akin to “one”).	
Anaphoric Subject	The subject of the previous clause.	
Anaphoric Object	The object of the previous clause.	

In wh-questions, the wh-word assumes the second position and the other argument becomes the first.

If a clause has no explicit arguments, the first argument is understood to be the subject.

Table 3.7: Personal pronouns. <-n>, <-en> or <-ᵐᵒᵐᵒ> is suffixed for the accusative case.

(continuous) (discrete)	Pl. / Sub. / Sup. Integral	Nullary Nullary	Singular	Dual
Near	ᵐᵒ	ᵐᵒᵐᵒ	ᵐᵒ	ᵐᵒᵐᵒ
Far	ᵐᵒᵐᵒ	ᵐᵒᵐᵒᵐᵒ	ᵐᵒᵐᵒ	ᵐᵒᵐᵒᵐᵒ
Other	ᵐᵒᵐᵒ	ᵐᵒᵐᵒᵐᵒ	ᵐᵒᵐᵒ	ᵐᵒᵐᵒᵐᵒ
Anaph. Sub.	ᵐᵒᵐᵒ	ᵐᵒᵐᵒᵐᵒ	ᵐᵒᵐᵒ	ᵐᵒᵐᵒᵐᵒ
Anaph. Obj.	ᵐᵒᵐᵒ	ᵐᵒᵐᵒᵐᵒ	ᵐᵒᵐᵒ	ᵐᵒᵐᵒᵐᵒ
Generic		ᵐᵒᵐᵒ		

(For the observant readers: notice the similarity to Kavinan’s system.)

3.6.1 | Last-clause pronouns

The anaphoric pronoun <bej> (accusative: <bejen>) is grammatically an other pronoun, and it refers to the previous clause said. Likewise, <bedcj> (accusative: <bedcn>) refers to the clause before the previous one.

3.7 | Compounding

Nouns can be compounded together in a head-initial manner. When that happens, only the leftmost noun is the one to be declined.

Del-mɛɔʔ^e-aʼəpəʔ-ɸɕj
 volume-cup-water-five
 five cupfuls of water

Note that integral pronouns can modify other nouns, in which personal possession is indicated:

Del-mɛɔʔ^e-aʼəpəʔ-ɸɕj-fi
 volume-cup-water-five-PR.NEAR.INTEGRAL
 (arg1)’s five cupfuls of water

Descriptors can also compound on nouns. This compounding is productive in Lek-Tsaro.

ɗɿɿ-ləʔfi
 person-old
 old people
 (Compare to ɗɿɿ ləʔfi “person old-SENTIENT”).

3.8 | Possession

“X’s Y” is translated as <Y=ɗɿ jcl X>. The possessive construction is also used to create appositives.

Observe that possession marks the head, and <-ɗɿ> is a clitic, not an affix, as in the following example:

dəðənʰɔʔ-aʼəpəʔ-ɗɿ jcl jʰi.ej
 DEF~rabbit-SING-water=GEN POS magician-SING
 the magician’s water rabbit

In more casual speech, <jcl> may be dropped.

4 | Verbs

Verbs are conjugated for person of the subject, tense, polarity and tellicity, in two paradigms. Conjugation respects vowel harmony.

Table 4.1: Person-tense conjugations for verbs, using <ḏilɪn> “(S) eats (O)”.

	Nonpast	Past
Near	ḏilɪn	ḏilɪf
Far	ḏilɪn	ḏilc ^ə j
Other	ḏilɪ	ḏilc ^ə
Anaph. Sub.	ḏile	ḏilel
Anaph. Obj.	ḏilc.e	ḏilc.el
Generic	ḏilc ^ɔ	ḏilc ^ɔ

Table 4.2: Person-tense conjugations for verbs, using <peacn> “(S) spreads (O)”.

	Nonpast	Past
Near	peacn	peacɪ
Far	peaɪn	peac ^ə j
Other	peaɪ	peac ^ə
Anaph. Sub.	peae	peael
Anaph. Obj.	peac.e	peac.el
Generic	peac ^ə	peac ^ə

to which a suffix is added:

Table 4.3: Polarity-tellicity suffixes for verbs. The interrogative affix can also follow a negative affix.

	Positive	Negative	Interrogative
Telic	-	-le / -l ^e	-hɪ
Atelic	-ɔc / -ɔc ^c	-ɪ	-lc ^ə / -lə

Notes:

- “Negative atelic” means something akin to “unsuccessfully tried to avoid doing X”.

- The interrogative polarity, in addition to marking questions, is used to mark clauses that may or may not be true but are referred to later in the sentence.

Some examples:

ḍilīn sīde flwḥ.
eat-NEAR.NONPAST fish flower
Fish eat flowers.

ḍilīn sīde flwḥ, ḍilīn ḥyḥyḥneḥ.
eat-NEAR.NONPAST fish flower, eat-NEAR.NONPAST cat PR.ANAPH_SUB
Fish eat flowers, and cats eat fish.

ḍilīn sīde flwḥ, ḍile pīḥbe.
eat-NEAR.NONPAST fish flower, eat-ANAPH_SUB.NONPAST grass-ACC
Fish eat flowers, and they eat grass.
(Grass is inedible to humans, but edible to fish.)

ḍilīnle flwḥ sīde.
eat-NEAR.NONPAST-NEG flower fish
Flowers don't eat fish.

ḍyḥn scḥ ḥyḥyḥneḥ, jenīn lī bej.
carry-NEAR.NONPAST PR.OTHER.SG DEF~book-SG, worry-NEAR.NONPAST PR.NEAR.INT
PR.LAST_CLAUSE
He has the book; that worries me.
or: That he has the book worries me.

ḍyḥnhī scḥ ḥyḥyḥneḥ, jenīn lī bej.
carry-NEAR.NONPAST-INTERROGATIVE PR.OTHER.SG DEF~book-SG, worry-NEAR.NONPAST
PR.NEAR.INT PR.LAST_CLAUSE
He might have the book; that worries me.
or: That he might have the book worries me.

4.1 | Aspect

Verbs can also be marked for aspect, either using a rod sign directly on the verb, or a particle with a rod sign, placed anywhere between the verb it modifies and the next verb.

Table 4.4: Aspect markers. Those with hyphens are attached to verb. Those without hyphens are placed as separate particles anywhere after the verb.

Aspect name	Marking	Meaning
Imperfect	–1	An action that is currently going on. Also used to distinguish static actions as opposed to dynamic (e. g. <i>wear</i> as opposed to <i>put on</i>).
Interrupted	flcl1	An action that was interrupted.

Aspect name	Marking	Meaning
Perfect	–ɿ	An action that has already finished. Changes present tense to immediate past. Also used to distinguish dynamic actions as opposed to static (e. g. <i>put on</i> as opposed to <i>wear</i>).
Gnomic	–ʔ	A general truth or aphorism, or an action done habitually.
Gnomic dubitative	ɿcɿʔ	A general truth or aphorism that the speaker considers to be false.
Deontic necessity	–ɲ	An action that the speaker insists on happening.
Epistemic necessity	ɿəʔɲ	An action that the speaker infers is happening.
Deontic potential	–ɸ	An action that the speaker permits to occur.
Epistemic potential	ɿəʔɸ	An action that the speaker infers that might happen.
Unexpected	–ɿ	An action that is unexpected (akin to using “but”).
Comparative	deɿ	Indicates an action of greater intensity than what was described in the previous clause.
Nonexclusive subject	ɿcɿ	Indicates that the subject comprises not only of what is explicitly mentioned, but also other things.
Nonexclusive object	ɿcʔ	Indicates that the object comprises not only of what is explicitly mentioned, but also other things.
Nonexclusive argument	ɿcɲ	Combination of both nonexclusive subject and nonexclusive object.

An example:

ɿɿɿɿɿɿɿɿ de nc, ɿcnc.ɿɿɿ dənʔɿɿɿɿ–ɿɿ.
 fight-NEAR.PAST-ATELIC-IMPERFECT PR.NEAR.SG PR.OTHER.INT, shoot-ANAPH_OBJ.PAST-
 UNEXPECTED knee-SG.ACC-PR.ANAPH_SUB.INT
 I tried to fight them, but they shot my knee.

4.2 | Obliques

Lek-Tsaro lacks oblique arguments. Instead, equivalent expressions employ serial verb constructions. For instance, “he ate soup with a spoon” would be reduced to “he held a spoon and ate soup”:

dɿcʔ scʔ ɿəʔɿɿɿ, dɿɿɿ ɿɿɿɿɿ.
 INST-OTHER.PAST PR.OTHER.SG spoon-SG, eat-ANAPH_SUB.PAST soup-ACC
 He held a spoon and ate soup.
 or: He ate soup with a spoon.

Likewise:

ni.i nc jəjəl-hi.ɪp, ncbe hihiɾəʔdɔ̃.
 TEMPORAL-OTHER PR.OTHER.INT DEF~day-SG-spring, dance-ANAPH_SUB DEF~statue-SG.ACC
 They will wait until the spring equinox and dance around the statue.
 or: They will dance around the statue on the spring equinox.

A similar construction can be used for the negation of obliques:

dʲɪcʰə scʰ ɔʰɪɔ̃ʰ, ɔ̃ɪɪɪ siɟcn.
 INST-OTHER.PAST-NEG PR.OTHER.SG spoon-SG, eat-ANAPH_SUB.PAST-UNEXPECTED soup-ACC
 He did not hold a spoon, but ate soup.
 or: He ate soup without a spoon.

4.3 | Conjunctions

Conjunctions such as “and” are treated like obliques. For instance, “and” is represented by the verb <acn>, and precedes the clause in which the two are used:

acʰ ʲɪcʰəje ʲɪpəl, ɔ̃ɪɪɪ ɪɐ.cʰn.
 and-OTHER.PAST Ryse Tarul, eat-ANAPH_SUB.PAST beef-ACC
 Ryse and Tarul ate beef.

Sufficiently complex nesting may be unrepresentable using only anaphoric referents. The easiest way to resolve this issue is to use definite nouns in place of anaphoric referents.

acʰ ʲɪcʰəje ʲɪpəl, acʰ ɪɐ.cʰ siɟc, ɔ̃ɪɪɪ ɔ̃ɪɪɪ ɪɪ.
 and-OTHER.PAST Ryse Tarul, and-OTHER.PAST beef soup, eat-OTHER.PAST DEF~person-DU PR.ANAPH_SUB.CONT
 [They,] Ryse and Tarul ate beef and soup.

4.4 | Subordinate clauses

Ideas such as “if” or “because” are also expressed with verbs. For example, <ni.cn> “wait, when” is also used for “if”:

ɪɐɪɪɪhi, ni.cn ɪɪ bej, ɔ̃ɪɪɪ.
 rain-OTHER-NEG-Q, wait-NEAR PR.NEAR.INT ANAPH_CLAUSE, play-NEAR
 If it doesn’t rain, we will play.

Note the clausal argument to <ni.cn>, since our condition is an entire clause instead of a noun.

Table 4.5: Comparators in Lek-Tsaro.

□	Comparator
>	nef
<	ac ^ə l
=	fe ^ə n ^ə
≥	f ^ə il
≤	dcj
≠	.c ^ə j
≈	pej
≫	a ^h e
≪	din

4.7 | Transitivity

Verbs that are used intransitively (i. e. have no object passed at this time) can be turned into a causative form with the prefix <φC->:

flcrcl^f aqeapen^ue.
 fall-NEAR.PAST DEF~coin
 The coins fell.

de φcflcrcl^a aqeapen^ue.
 PR.NEAR.SG TRANS-fall-OTHER.PAST DEF~coin
 I dropped the coins.

Note that the word order changes to SVO. In addition, the verb is conjugated for its object, rather than the subject as expected. If the following clause uses an anaphoric subject, it refers to the object of the current clause.

Moreover, the verb does not need to be one that can never take an object. In the above example, <flcrcln> means “(S) falls on (O)”. However, if the verb in question is taking an object, it cannot be transitivity directly and a more roundabout way is required:

flcrcl^f aqeapen^ue pifi.
 fall-NEAR.PAST DEF~coin grass
 The coins fell on the grass.

de φcflcrcl^a aqeapen^ue, flcdel pifi^{be}.
 PR.NEAR.SG TRANS-fall-OTHER.PAST DEF~coin, fall-ANAPH.SUB.PAST grass-ACC
 I dropped the coins; they fell on grass.
 or: I dropped the coins on grass.

4.8 | Clauses with nullary arguments

A clause with one or more arguments that are nullary or modified by nullary-number nouns (either through compounding or possession) will have a negative verb as well:

dəfinle dijile.

recall-NEAR-NEG person-NULL
No one knows.

ʃɔɫʃɪnle de ʃɪʃɪɪɪ ʃɪ ʃʰi.ele.
want-NEAR-NEG PR.NEAR.SG ring=GEN POS magician-NULL
I don't want the rings of any magician.

4.9 | The copula

The copula <ɟɕn> can take a noun as an object, in which case it can mean identity or membership. (Location is expressed with <ɟɪn> “be at”.) With no object at all, it is used to denote existence.

It can also accept a descriptor, in which case the descriptor is attached before <ɟɕn> in the dictionary form.

5 | Descriptors

Descriptors act as adjectives or adverbs. They follow what they modify, and are inflected for the noun class or verbal person of their antecedents.

Table 5.1: Descriptor declensions, using the descriptors <hedfi> “large” and <laʔfi> “old”.

Class or person	Declined form	
Sentient	hedfi	laʔfi
Animate	hedfi	laʔfi
Inanimate	hedfe	laʔfə ^e
Measure	hedfiy	laʔfiy
Fluid	hedfej	laʔfə ^j
Edible	hedfc	laʔfə ^c
Inedible	hedfeʔ	laʔfə
Abstract	hedfcə	laʔfə
Near	hedfiy	laʔfiy
Far	hedfiy	laʔfiy
Other	hedfey	laʔfey
Anaph. Sub.	hedfiy	laʔfiy
Anaph. Obj.	hedfey	laʔfey
Generic	hedfcəy	laʔfəy

5.1 | Conversion

A noun can be converted to a descriptor by appending <-ji>.

A descriptor can be converted to an abstract noun meaning “the nature of being ~” by replacing the final <-i> with <-cnel>.

6 | Tree mode

As mentioned in section 4.3, anaphoric referents in a linked-list sentence are sometimes insufficient for expressing even simple sentence structures. While the easiest method of resolving this issue is using definite nouns, Lek-Tsaro also provides a mode where sentences are not linked lists of clauses, but rather (binary) trees.

6.1 | Activation

Tree mode is enabled automatically when the treeing particle $\langle n^4i^9 \rangle$ is used, and disabled at the end of a sentence.

6.2 | Branch-switching

The aforementioned particle $\langle n^4i^9 \rangle$ marks the beginning of the right branch of the tree. The right branch is ended by the particle $\langle n^4i^{\Delta} \rangle$, which causes the next clause to join the left and right branches.

(N. B. $\langle n^4i^9 \rangle$ and $\langle n^4i^{\Delta} \rangle$ can occur only between clauses. If the particles are represented by left and right brackets, respectively, then the brackets should match.)

6.3 | Anaphoric pronouns in joiner clauses

In clauses that join two branches, anaphoric pronouns require marking whether the antecedent occurs in the left predecessor $\langle n^4i^9 \rangle$ or the right predecessor $\langle n^4i^{\Delta} \rangle$. This is done by marking the pronoun with $\langle -^9 \rangle$ or $\langle -^{\Delta} \rangle$.

Likewise, verbs can be modified with $\langle -^9 \rangle$ or $\langle -^{\Delta} \rangle$ to indicate which branch the subject came from.

6.4 | Errors

The following are ungrammatical:

- Using the particle $\langle n^4i^{\Delta} \rangle$ or the branched anaphoric pronouns when tree mode is disabled
- Using the particle $\langle n^4i^{\Delta} \rangle$ other than to close a corresponding $\langle n^4i^9 \rangle$
- Using the unbranched anaphoric pronouns in clauses with two predecessors

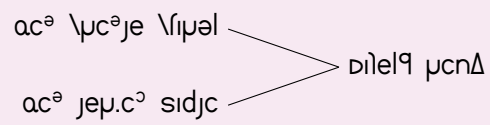
- Using the branched anaphoric pronouns in clauses with one predecessor
- Starting a new branch with $\langle n^4i^9 \rangle$ when the current branch is empty

6.5 | Example

The second example in section 4.3 can be expressed as follows:

$ac^a \setminus \mu c^a je \setminus i^9 \mu \partial$, $n^4i^9 ac^a je \mu.c^3 si d^9 j c$, $n^4i^9 \Delta \partial i^9 \mu c n \Delta$.

The resulting tree is shown below:



7 | Numerals

Lek-Tsaro uses a mixed-base system for its numerals. Numerals are abstract nouns. A Perl 6 program to convert numerals can be found in Section A.3.

7.1 | Single-digit numerals

Here are the numerals for $n < 17$:

Table 7.1: The cardinal numbers from 0 – 16.

base 10	base v	word
0	0	μəɔ
1	1	ac ^ə l
2	J	ʃij
3	ʔ	ɔ ^h e ^ɔ n
4	ŋ	a ^l ɪμ
5	ʔ	ʔcɟ
6	ʃ	ɔɥe
7	ɣ	ʃɟɟ
8	Δ	də ^ɔ n
9	L	hed
10	F	bən ^ʔ
11	ʔ	nə ^c
12	£	le ^ɔ
13	‡	j ^h cd
14	A	ɥin
15	V	lel
16	Ψ	.ɪμ

Note that digits above 9 use capital hacm letters.

7.2 | Numerals up to $19 \cdot 17$

These are represented by two digits. The multiples of 17 are shown below:

Table 7.2: Multiples of 17, up to $18 \cdot 17$.

base 10	base v	word
17	10	selc ^a
34	J0	dīlc ^a
51	?0	ṇ ⁴ e ³ lc ^a
68	Ṁ0	īdīlc ^a
85	†0	φcīlc ^a
102	ŷ0	dyeīlc ^a
119	90	ījcīlc ^a
136	Δ0	də ³ nə
153	L0	helc ^a
170	F0	bən ⁴ ə
187	70	nə ^c lə
204	£0	le ³ lc ^a
221	‡0	j ^h cdīlc ^a
238	A0	yīnc ^a
255	V0	īelyc ^a
272	ψ0	.īlyc ^a
289	Ð0	jīlsc ^a
306	Ψ0	heddc ^a

Thus $y \cdot 17 + x$ is written $\langle x-y \rangle$.

7.3 | Numerals up to $13 \cdot 19 \cdot 17 = 4199$

These are represented by three digits. The multiples of $19 \cdot 17$ are listed below:

Table 7.3: Multiples of $19 \cdot 17$, up to $12 \cdot 19 \cdot 17$.

base 10	base v	word
323	100	hījīfīn
646	J00	ījīfīn
969	?00	ṇ ⁴ e ³ jefīn
1292	Ṁ00	ā ⁴ īpīfīn
1615	†00	φcīfīn
1938	ŷ00	dyejīfīn
2261	900	ījcīfīn
2584	Δ00	də ³ nīfīn
2907	L00	heāfīn
3230	F00	bən ⁴ īfīn
3553	700	nə ^c jīfīn
3876	£00	le ³ jīfīn

Thus $(z \cdot 19 \cdot 17) + (y \cdot 17) + x$ is written $\langle z-x-y \rangle$.

7.4 | Numerals up to and including $4199 \cdot (4199 + 1)/2 = 8817900$

The numeral for 4199 is $\langle \text{ṇ}^4\text{e}^3\text{lc}^a \rangle$, written as $\langle 1:000 \rangle$.

Likewise, two $\langle \text{le.ɔle}^c \rangle$ is written as $\langle \text{!000} \rangle$ and pronounced $\langle \text{le.ɔle}^c - \text{!ij} \rangle$, but the second $\langle \text{le.ɔle}^c \rangle$ is one smaller than the first. In other words, $\langle \text{!000} \rangle = 4199 + (4199 - 1) = 8397$.

Table 7.4: “Multiples” of $\langle \text{le.ɔle}^c \rangle$.

“Multiple”	Difference from last	Total
(0)		0
1:000	4199	4199
!000	4198	8397
?000	4197	12594
0!000	4196	16790
!000	4195	20985
...		
£¥V:000	3	8817897
£¥4:000	2	8817899
1::000:000	1	8817900

Thus the n th “multiple” differs from the $(n-1)$ th multiple by $(4199+1-n)$ (given $1 \leq n \leq 4199$), and the sum of the first n “multiples” is

$$\begin{aligned}
 y(n) &= \sum_{i=1}^n (4200 - i) \\
 &= \frac{1}{2} \cdot (8399 \cdot n - n^2)
 \end{aligned} \tag{7.1}$$

And likewise, for some given y , the largest “multiple” of $\langle \text{le.ɔle}^c \rangle$ not smaller than y has the index

$$N(y) = \left\lfloor \frac{1}{2} \cdot (8399 - \sqrt{70543201 - 8 \cdot y}) \right\rfloor \tag{7.2}$$

In other words, for any numeral $\langle n_1:n_2 \rangle$, $n_1 + n_2$ must be less than 4199.

7.5 | Higher numerals

The bases of higher numerals b_i can be derived from the recurrence relation

$$b_i = \begin{cases} 4199 & \text{if } i = 1 \\ \frac{b_{i-1} \cdot (b_{i-1} + 1)}{2} & \text{otherwise} \end{cases} \tag{7.3}$$

Then b_i acts as a new triangular base. Equations 7.1 and 7.2 can be generalised to the following:

$$y(n, b_i) = \sum_{i=1}^n (b_i + 1 - n) \quad (7.4)$$

$$= \frac{1}{2} \cdot (n \cdot (2 \cdot b_i + 1 - n)) \quad (7.5)$$

$$N(y, b_i) = \left\lfloor \frac{1}{2} \cdot \left(2 \cdot b_i - \sqrt{4 \cdot b_i^2 + 4 \cdot b_i + 1 - 8 \cdot y} \right) \right\rfloor \quad (7.6)$$

It follows that $y(n_1, b_i) + n_2$ is represented as $\langle n_1 :^i n_2 \rangle$ (i colons), and such a numeral must satisfy $n_1 + n_2 < b_i$.

Here are the names of the bases themselves:

Table 7.5: Names of higher bases.

Base	base v	word
b_1	1:000	ḡə.ɔlə ^c
b_2	1::000:000	ɒɐɲc ^ɔ fi
b_3	1:::000:000::000:000	fiɪpə ^ɔ
b_4		əɛncɔɪ

7.6 | Cardinal and ordinal numerals

Cardinal numerals compound to their antecedents; ordinal numerals use the possessive $\langle -\text{Dɪ} \text{ jcl} \rangle$ construction:

ɒcɔɪ-ə^ce^ɔn
 child-three
 three children

ɒcɔɪɔɪ jcl ə^ce^ɔn
 child-SG=GEN POS three
 the third child

8 | Derivational morphology

The following methods are used to derive related terms from existing ones.

8.1 | Abstraction

Abstraction is a derivation that takes a non-abstract noun and returns the abstract noun representing the concept of the argument. This formation appends <-ne> or <-nɔ̃^e> to the noun.

Examples:

- <hɥɔ̃nɛn> *book* → <hɥɔ̃nɛne> *literature*
- <hɔ̃lɔ̃> *cart* → <hɔ̃lɔ̃nɔ̃^e> *transportation*

Note that any double letters collapse into a single.

8.2 | Dematuration

Dematuration is a derivation that takes a noun and returns a noun of the same class that represents an immature form of the argument (not necessarily a diminutive). <fɔ̃- > or <fə̃- > are prepended to nouns that begin in <j> or <l>, or <jɔ̃- > or <jə̃- > otherwise.

Examples:

- <ɔ̃ɔ̃ɔ̃> *person* → <jɔ̃ɔ̃ɔ̃> *child*
- <fɔ̃ɔ̃ɔ̃> *fruit* → <jə̃^cfɔ̃ɔ̃ɔ̃> *unripe fruit*
- <jɛɔ̃ɔ̃ɔ̃> *essay* → <fɔ̃jɛɔ̃ɔ̃> *draft*

8.3 | Verb-to-noun conversions

Verb-to-noun conversions involve an operation called *inversion*; this operation swaps certain phonemes of a word:

- front vowels ↔ back vowels
- voiceless plosives ↔ voiced plosives (in any position other than in a coda)
- f ↔ ɲ, d ↔ ɖ (in coda position)

- $a \leftrightarrow j^h$
- $j \leftrightarrow a^h$ (in any position other than in a coda)
- $h \leftrightarrow a^l$
- $p \leftrightarrow d$ (in any position other than after a fricative in an onset or in a coda)
- $s \leftrightarrow l$ (in any position other than in a coda)
- $p \leftrightarrow l$ (in coda position)
- $u \leftrightarrow o$

For instance, $\langle \mu i.cfin \rangle$ would be inverted to $\langle di.ə^nfin \rangle$.

All other phonemes are unchanged.

Since all of the conversions below are straightforward, only their names will be mentioned.

Table 8.1: Verb-to-noun conversions, from the inversion of the verb stem.

Name	Affix
Agent	$-e^n n^0$ / $-ɔ n^0$
Patient	$-e^0 d$ / $-ɔ d$
Location	$-e^0 \mu$ / $-ɔ \mu$
Instrument	$-i f j$

Table 8.2: An example with $\langle nə^0 bin \rangle$ to *steal*.

Name	Derivation	Meaning
Agent	$nc^0 de^0 n^0$	thief
Patient	$nc^0 de^0 d$	stolen goods
Location	$nc^0 de^0 \mu$	site of theft
Instrument	$nc^0 di f j$	tool used for theft

9 | Names

Names fall into two grammatical categories:

- *Nominal names* act as nouns. They are usually single words.
- *Clausal names* are entire clauses. These names usually refer to places, although a few people have clausal names. In extreme cases, such a name can span multiple clauses.

9.1 | Nominal names

These names act as nouns, and they are preceded by a backslash <\>. If the name spans multiple words (as common in foreign names), spaces are escaped by backslashes. No distinction is made between native and foreign names.

Only personal names can stand on their own, and even then, only given or full names. Other names must modify a common noun describing the nature of what is named, in the integral number without definiteness.

Table 9.1: Some examples of nominal names.

Name	Type
\ɰc ^a je	Personal (native)
\iɰəɭ	Personal (native)
\ɰeɰcn	Personal (foreign)
dɰe ^ɔ ɰe-\oɭɭ.c	Place (foreign)

Native names will usually respect vowel harmony. Children of parents who work in professions demanding physical labour (e. g. bricklaying) will usually have names with back vowels. In contrast, those born to parents of professions that do not demand physical strength (e. g. computer programming) will usually bear names with front vowels.

9.2 | Clausal names

These names comprise of one or more clauses. Due to the nature of clausal names, they are all considered native. Most of these names refer to places; personal clausal names are almost always nicknames or such. Orthographically, they are put into square brackets <[]>.

Clausal names are used by saying them as their own clauses, then using an anaphoric pronoun to backreference the entity described by the name in question. The type of anaphoric pronoun used varies from name to name. It might be the anaphoric subject pronoun, the object pronoun or the last-clause pronoun.

We call the *referent* the subject, the object or the verb of the last clause, respectively depending on the type of anaphoric pronoun used to refer to the name. If the referent is a noun, it must be declined in the integral number without definiteness.

Here, as common in maps and such, the referent will be capitalised. However, other contexts that make the type of anaphoric pronoun to use clear do not use this type of capitalisation.

Table 9.2: Some examples of clausal names.

Name	Type	Literal meaning
[AEXΨΕ³ dɾiʃjɪ ʃɔɔɔ]	Place	The trees <i>covered</i> the ground
[ɔəʃi ɸXΕ³ΘΕ μcəʃ-\\leɲμc³]	Place	The <i>city</i> remembers the Šedrý star
[ac³ ʎpɪfə-ɔɪ jcl jəp jʰɪ.en-ɔɪ jcl ʎɪnc³, ɸœjc.el ɸXΕ³ΘΕΘ]	Place	The <i>city</i> was founded by the warrior of the sun and the wizard of the moon
[ɔejɪ \\ΨΕTF³ jc³-\\selc³]	Personal	<i>Gulto</i> takes care of 17 foxes

An example of usage:

ni.ɪ bɪnɛn-bəj, [ɔəʃi dɸe³ɔe μc³-\\leɲμc³], jʰɪn ɔɪɔɪjɪ .cɔ.
 wait-OTHER year-future, (name), go-NEAR DEF~person-SG PR.ANAPH_SUB.SG
 He will go to Muta Pröme Ryk-Šedrý next year.

10 | Calendar

Domain II, which contains *Rymako*, has a day that is 26.99410 hours long. Other figures are given in terms of local days:

Table 10.1: Astronomical measures for Domain II.

Period	Length in local days
Local (synodic) day	1.00000
Sidereal day	0.99699
Tropical year (l_y)	301.94714
Sidereal year	302.03719
Synodic month (l_m)	30.80152
Sidereal month	27.95032

10.1 | Tides

In Domain II, the offset of the sea level due to the tide can be modeled by the following equations:

$$y = y_s + y_m \quad (10.1)$$

$$y_s = A_s \cdot (1 + A_{sa} \cdot \cos(\tau \cdot t)) \cdot \cos(2 \cdot \tau \cdot t) \quad (10.2)$$

$$y_m = A_m \cdot \left(1 + A_{ma} \cdot \cos\left(\frac{\tau \cdot t}{l_m}\right)\right) \cdot \cos\left(\frac{2 \cdot \tau \cdot (1 - l_m) \cdot t}{l_m}\right) \quad (10.3)$$

where:

$$\tau = 2 \cdot \pi$$

$$A_s \approx 0.675$$

$$A_{sa} \approx 0.0532$$

$$A_m \approx 1.267$$

$$A_{ma} \approx 0.176$$

y = offset of sea level in metres

t = time since HAT in local synodic days

An exact solution to $dy/dt = 0$ is not known to exist. However, the solutions to this equation can be found numerically. Consult Section A.1 for a Sage program to do so.

As the calendar used by Lek-Tsaro uses the high and low tides to count time, it is not synchronised even with days. The basic unit of time in the calendar is the *tidal day* $\langle \mu\partial\partial\partial^c \rangle$ (l_t) – the amount of time between a high tide and the second high tide thereafter, which is, on average, 1.03356 local synodic days, but can vary considerably. Thus:

$$l_m/l_t \approx 29.80148 \quad (10.4)$$

$$\approx 4053/136 \quad (10.5)$$

$$l_y/l_m \approx 9.80299 \quad (10.6)$$

$$\approx 7215/736 \quad (10.7)$$

This suggests that:

1. most months will have 30 days, but every 136 months, 27 months will have only 29.
2. most years will have 10 months, but every 736 years, 145 years will have only 9.

10.2 | Months

Months follow a 136-month cycle wherein the $5n+2$ -numbered months (zero-indexed, $n \in \mathbb{N}$) have 29 days and the other months have 30.

The names of months, on the other hand, are determined from their positions relative to the first month of the year:

Table 10.2: The months of the year.

#	Name
0	αα ³ bα ³
1	μc ^α .ed
2	fjιφɔl
3	dəpəjι
4	lɾepιɔ
5	fɔ ^e dəf
6	n ^ʰ əpə ^c f
7	lɔbɔlι
8	bɔdɔ ³ l
9*	.cje ³ μι

Days within a month are indexed from one.

10.3 | Years

The lengths of the year follow a 736-year cycle as specified in Figure 10.1. The code used to generate this table can be found in Section A.2.

Figure 10.1: Table of year lengths in a cycle.

0123456789	0123456789	0123456789	0123456789
0 XXXXX9XXXX	19 XX9XXXX9XX	38 9XXXX9XXXX	57 XXX9XXXX9X
1 9XXXX9XXXX	20 XXX9XXXX9X	39 9XXXX9XXXX	58 XXX9XXXX9X
2 9XXXX9XXXX	21 XXX9XXXX9X	40 9XXXX9XXXX	59 XXX9XXXX9X
3 9XXXX9XXXX	22 XXX9XXXX9X	41 X9XXXX9XXX	60 XXX9XXXX9
4 9XXXX9XXXX	23 XXX9XXXX9X	42 X9XXXX9XXX	61 XXX9XXXX9
5 9XXXX9XXXX	24 XXX9XXXX9X	43 X9XXXX9XXX	62 XXX9XXXX9
6 9XXXX9XXXX	25 XXX9XXXX9X	44 X9XXXX9XXX	63 XXX9XXXX9
7 X9XXXX9XXX	26 XXX9XXXX9	45 X9XXXX9XXX	64 XXX9XXXX9
8 X9XXXX9XXX	27 XXX9XXXX9	46 X9XXXX9XXX	65 XXX9XXXX9
9 X9XXXX9XXX	28 XXX9XXXX9	47 XX9XXXX9XX	66 XXX9XXXXX
10 X9XXXX9XXX	29 XXX9XXXX9	48 XX9XXXX9XX	67 9XXXX9XXXX
11 X9XXXX9XXX	30 XXX9XXXX9	49 XX9XXXX9XX	68 9XXXX9XXXX
12 X9XXXX9XXX	31 XXX9XXXX9	50 XX9XXXX9XX	69 9XXXX9XXXX
13 X9XXXX9XXX	32 XXX9XXXX9	51 XX9XXXX9XX	70 9XXXX9XXXX
14 XX9XXXX9XX	33 XXXX9XXXX	52 XX9XXXX9XX	71 9XXXX9XXXX
15 XX9XXXX9XX	34 9XXXX9XXXX	53 XX9XXXX9X	72 9XXXX9XXXX
16 XX9XXXX9XX	35 9XXXX9XXXX	54 XXX9XXXX9X	73 9XXXX9
17 XX9XXXX9XX	36 9XXXX9XXXX	55 XXX9XXXX9X	
18 XX9XXXX9XX	37 9XXXX9XXXX	56 XXX9XXXX9X	

9: 9 months

X: 10 months

10.4 | Eras

Years are grouped further into *eras* <ἱῆς>, which change on major historical events. The start of a new era resets the month and year cycle. Eras can also start in the middle of a year of the previous era; thus, the start of the year is different for each era. The *crossover date* of an era is the date of the era that coincides with the first day of the next; in other words, it is the date immediately after the last day of the era.

The first day of <ἱῆς-ἡμέρας> coincides with the founding of the (not yet named).

10.5 | Subdivisions of the day

Lek-Tsaro has two systems for subdividing the day.

10.5.1 | Traditional timekeeping

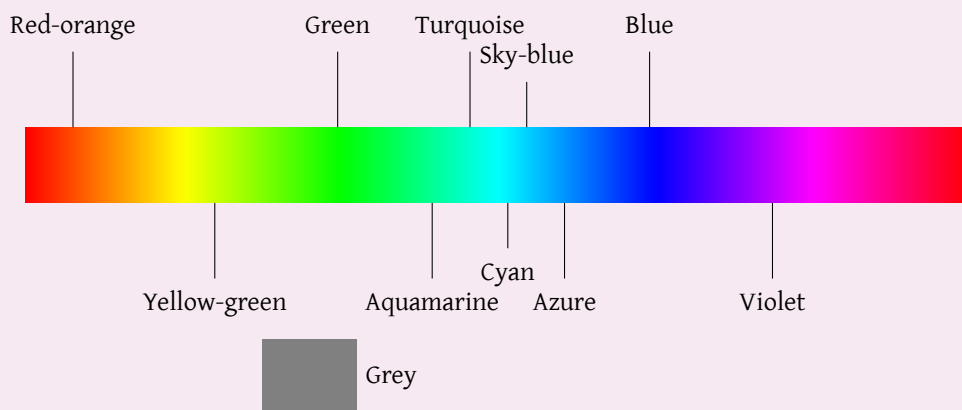
The traditional system of timekeeping relies on subdivisions of the solar day. As shown in Figure 10.2, the period between sunrise and sunset are divided into six equally-sized parts <ῆς>, and the night is considered a separate category. This implies that the length of the “hours” depends on the seasons.

The traditional timekeeping system is vague – typically, the most precise interval used is a quarter or eighth of an “hour”.

11 | Miscellanea

11.1 | Colour

Lek-Tsaro has eleven non-derived colour terms:



Note that “grey” refers generically to a loss of chroma. There is no distinction between a decrease in saturation and a decrease in value.

Lek-Tsaro works with colour *transitions*, not static colours, and uses abstract nouns to represent them. See table 11.1.

Table 11.1: Colour transitions in Lek-Tsaro. Each row represents a different starting colour; each column represents a different ending colour.

	RO	YG	Gn	Aq	Tu	Cy	SB	Az	Bl	Vi	Gy
RO	hij	deɪ	ɲʰen	ail	ʃʰɕɸ	dəl	beɔ̃f	dil	ɑ̃ʰɔ̃d	fɛnʰ	ɔ̃c
YG	ɔ̃ɔ̃f	ɸəɔ̃ɔ̃	hɔ̃ɔ̃d	ɲcəɪ	nʰcɔ̃ɔ̃	fɛɪ	nʰɸɸ	ɑ̃ʰɛf	fjeɔ̃nʰ	yed	dəɔ̃
Gn	fʰɔ̃ɛn	ɑ̃ʰɛfʰ	seɪ	ɲəɔ̃	ɸɔ̃ɔ̃f	nəɔ̃ɪ	bɔ̃ɔ̃nʰ	leɔ̃fʰ	jcəɪ	ʃʰəɔ̃ɔ̃	ɔ̃ɔ̃
Aq	ʃʰɸɸ	fəɸ	ɸcəɔ̃ɔ̃	ocɪ	fʰəl	.əɔ̃ɪ	fɔ̃ɔ̃ɸ	ɔ̃ɔ̃ɔ̃	noed	fɲid	beɔ̃
Tu	ɑ̃əɔ̃ɪ	nʰəɔ̃ɔ̃	ɔ̃ɛɪ	ɲʰcəɸ	ɔ̃yɛn	ɸcɔ̃	hɔ̃ɔ̃	fʰɛɪ	jocɪ	ɲəɔ̃ɸ	ɲə
Cy	bɔ̃əɸ	ɲəɔ̃f	nɔ̃ɔ̃ɸ	.cɪ	ɲəɔ̃ɔ̃	bɲɛɪ	fɔ̃cɔ̃ɪ	nʰɸɪ	ɑ̃ɸcɲ	bəɔ̃f	nɔ̃
SB	dɔ̃ɪ	nʰɸɪ	deɔ̃nʰ	fɛɔ̃ɪ	ɑ̃ʰɔ̃ɔ̃	fɛɔ̃ɸ	oid	ʃʰɸɔ̃d	den	ɲcd	fjcə
Az	ɔ̃ɸɸ	jcəɪ	ɔ̃ɔ̃d	ɸɲɛɔ̃ɔ̃	ɲəɔ̃ɸ	nʰɸf	ɑ̃ɸəɔ̃fʰ	ɑ̃cɔ̃	fɔ̃ɔ̃	ɸəd	oi
Bl	hɛfʰ	fjɔ̃nʰ	ɑ̃ʰəɸ	nʰɔ̃əɸfʰ	ɑ̃ʰyəɔ̃ɪ	ʃʰɸəɔ̃n	bəɔ̃n	ɲəɔ̃ɪ	hɪɪ	ɔ̃cəɲʰ	yəɔ̃
Vi	ɲəɔ̃nʰ	ɔ̃əɸfʰ	ɑ̃cɔ̃ɔ̃	ɲɸɸfʰ	fɔ̃cɔ̃ɪ	dɔ̃cɔ̃ɪ	ɸəɔ̃fʰ	ɲcəɸfʰ	ɸənʰ	hɔ̃n	ai
Gy	ɲə	bɔ̃ə	ɔ̃ɛ	də	ɸɛ	jc	fjɪ	yɪ	ɑ̃ʰɛ	ʃʰc	.cɔ̃

A | Listings of programs

A.1 | workfiles/7/tides.sage

```
1 # How many values to output
2
3 limit = int(sys.argv[1]) if len(sys.argv) > 1 else 1000
4
5 # :P
6
7 tau = 2 * pi
8
9 t = var("t")
10
11 # Constants
12
13 A_s = 0.675; A_sa = 0.0532; A_m = 1.267; A_ma = 0.176; l_m = 30.80152
14
15 # Solar component
16 y_s2 = A_s * (1 + A_sa * cos(tau * t)) * cos(2 * tau * t)
17 # Lunar component
18 y_m2 = A_m * (1 + A_ma * cos(tau * t / l_m)) * cos(2 * tau * t / l_m -
19             2 * tau * t)
20 y = y_s2 + y_m2
21 yp = diff(y, t)
22
23 # High and low tides occur at values of t where dy/dt = 0.
24
25 i = 0
26 time = 0
27 print(0)
28 while i < limit:
29     try:
30         time2 = find_root(yp == 0, time + 0.000000001, time + 0.35)
31         print(time2)
32         time = time2
33         i += 1
34     except:
35         time += 0.01
```

workfiles/7/tides.sage

A.2 | workfiles/7/bins.pl6

```

1  # CONSTANTS
2
3  constant \MONTHS_PER_YEAR_CYCLE = 7215;
4  constant \YEARS_PER_YEAR_CYCLE = 736;
5  constant \AVG_MONTHS_PER_YEAR = MONTHS_PER_YEAR_CYCLE /
6      YEARS_PER_YEAR_CYCLE;
7
8  # COMPUTATION
9  # For each year, take as many months as are needed
10 # in order to cycle to the next.
11
12 my $c = 0;
13 my @k;
14
15 for 0 .. ^ YEARS_PER_YEAR_CYCLE -> $i {
16     my $need = 1 - ($c - floor($c));
17     my $objs = ceiling($need * AVG_MONTHS_PER_YEAR);
18     @k[$i] = $objs;
19     $c += $objs / AVG_MONTHS_PER_YEAR;
20 }
21
22 # DISPLAY
23
24 my \cols = 4;
25 my $len = @k.elems;
26
27 say ("    0123456789" xx cols).join(" | ");
28
29 my \total-rows = ceiling($len / 10);
30 my \rows = ceiling(total-rows / cols);
31
32 for 0 .. ^ rows -> $j {
33     for 0 .. ^ cols -> $p {
34         print(" | ") if $p != 0;
35         my $q = $j + rows * $p;
36         next if $q >= total-rows;
37         printf("%3d ", $q);
38         for 0 .. ^ 10 {
39             my $i = 10 * $q + $_;
40             if $i >= $len { print " "; }
41             else {
42                 print "0123456789XE".substr(@k[$i], 1);
43             }
44         }
45     }
46     say "";
47 }

```

workfiles/7/bins.pl6

A.3 | workfiles/7/conno.pl6

```

1 my $digits-str = "0123456789TKXSNVFM";
2 my @digits = $digits-str.comb;
3

```

```

4 sub convert-small-fwd($n, $pad = False) {
5     die "$n must be < 4199" if $n >= 4199;
6     my $a = $n div (19 * 17);
7     my $b = ($n div 17) % 19;
8     my $c = $n % 17;
9     return
10         (!$pad && $a == 0 ?? " " !! @digits[$a]) ~
11         (!$pad && $b == 0 && $a == 0 ?? " " !! @digits[$b]) ~
12         @digits[$c];
13 }
14
15 sub convert-small-back($s) {
16     die "$s must be 3 chars or fewer" if $s.chars > 3;
17     my $c = $digits-str.index($s.substr(* - 1, 1) // "0");
18     my $b = $digits-str.index($s.substr(* - 2, 1) // "0");
19     my $a = $digits-str.index($s.substr(* - 3, 1) // "0");
20     return $c + 17 * ($b + 19 * $a);
21 }
22
23 sub triangle($n, $p) {
24     return ($n * (2 * $p + 1 - $n)) div 2;
25 }
26
27 sub sqrt-floor($y) {
28     die "$y is negative" if $y < 0;
29     return $y if $y < 2;
30     my $small = sqrt-floor($y +> 2) +< 1;
31     my $large = $small + 1;
32     return $small if $large * $large > $y;
33     return $large;
34 }
35
36 sub sqrt-ceil($y) {
37     my $n = sqrt-floor($y);
38     return $n if $n * $n == $y;
39     return $n + 1;
40 }
41
42 sub untriangle($y, $p) {
43     return (2 * $p + 1 - sqrt-ceil(4 * $p * $p + 4 * $p - 8 * $y + 1))
44         div 2;
45 }
46
47 my @powers = (4199);
48
49 for 0 .. 10 {
50     my $p = @powers[* - 1];
51     @powers.push: $p * ($p + 1) div 2;
52 }
53
54 sub convert-large-fwd-h($n, $i, $pad = False) {
55     # base case
56     if $i == 0 {
57         return convert-small-fwd($n, $pad);
58     }
59     # recursive
60     my $super = untriangle($n, @powers[$i - 1]);
61     my $infra = $n - triangle($super, @powers[$i - 1]);
62     if $super == 0 && !$pad {
63         return convert-large-fwd-h($infra, $i - 1, False);
64     }
65     return
66         convert-large-fwd-h($super, $i - 1, $pad) ~

```

```

65     (":" x $i) ~
66     convert-large-fwd-h($infra, $i - 1, True);
67 }
68
69 sub convert-large-fwd($n, $pad = False) {
70     my $i = 0;
71     ++$i while @powers[$i] <= $n;
72     convert-large-fwd-h($n, $i, $pad);
73 }
74
75 sub convert-large-back($s) {
76     # Find the longest run of colons
77     my @matches = ($s ~~ m:g/":"/+); #/"
78     if (!@matches) {
79         return convert-small-back($s);
80     }
81     my $longest-match = @matches.max(*.chars);
82     my $i = (~$longest-match).chars;
83     my $left = $s.substr(0, $longest-match.from);
84     my $right = $s.substr($longest-match.to);
85     my $sup = convert-large-back($left);
86     my $inf = convert-large-back($right);
87     return triangle($sup, @powers[$i - 1]) + $inf;
88 }
89
90 multi MAIN(Int :$fwd) {
91     say convert-large-fwd($fwd);
92 }
93 multi MAIN(Str :$back) {
94     say convert-large-back($back);
95 }

```

workfiles/7/conno.pl6

A.4 | workfiles/7/count-days.pl6

```

1  # Count the number of days between 1/0/0 and D/M/Y, inclusive.
2
3  # CONSTANTS
4
5  constant \MONTHS_PER_YEAR_CYCLE = 7215;
6  constant \YEARS_PER_YEAR_CYCLE = 736;
7  constant \AVG_MONTHS_PER_YEAR = MONTHS_PER_YEAR_CYCLE /
8      YEARS_PER_YEAR_CYCLE;
9  constant \MONTHS_PER_MONTH_CYCLE = 136;
10 constant \DAYS_PER_MONTH_CYCLE = 4053;
11
12 # COMPUTATION
13 # For each year, take as many months as are needed
14 # in order to cycle to the next.
15
16 my $c = 0;
17 my @k = (0);
18
19 for 0 ..^ YEARS_PER_YEAR_CYCLE -> $i {
20     my $need = 1 - ($c - floor($c));
21     my $objs = ceiling($need * AVG_MONTHS_PER_YEAR);
22     @k[$i + 1] = $objs;
23     $c += $objs / AVG_MONTHS_PER_YEAR;

```

```

23 }
24
25 my @cumk = [\+] @k;
26
27 sub months-before-year($year) {
28     my $whole-cycles = $year div YEARS_PER_YEAR_CYCLE;
29     my $remainder = $year % YEARS_PER_YEAR_CYCLE;
30     return $whole-cycles * MONTHS_PER_YEAR_CYCLE + @cumk[$remainder];
31 }
32
33 my @m = (0);
34
35 for 0 .. ^ MONTHS_PER_MONTH_CYCLE -> $i {
36     @m.push: ($i % 5 == 2) ?? 29 !! 30;
37 }
38
39 my @cumm = [\+] @m;
40
41 sub days-before-month($month) {
42     my $whole-cycles = $month div MONTHS_PER_MONTH_CYCLE;
43     my $remainder = $month % MONTHS_PER_MONTH_CYCLE;
44     return $whole-cycles * DAYS_PER_MONTH_CYCLE + @cumm[$remainder];
45 }
46
47 sub days-before-date($d2, $m, $y) {
48     my $d = $d2 - 1; # d is 0-indexed
49     my $bm = months-before-year($y) + $m;
50     return days-before-month($bm) + $d;
51 }
52
53 sub MAIN($d2, $m, $y) {
54     say days-before-date($d2, $m, $y);
55 }

```

workfiles/7/count-days.pl6

B | Arithmetic in base v

This chapter describes algorithms for performing arithmetic operations in Lek-Tsaro's number system.

B.1 | Operations on small numbers

B.1.1 | Additions

If both addends are smaller than 4199, then it is sufficient to use mixed-base addition:

$$\begin{array}{r} \begin{array}{ccc} & 1 & \\ \text{D} & \text{F} & \text{L} \\ \text{q} & \text{?} & \text{A} \\ \hline \text{F} & \text{A} & \text{?} \end{array} \\ \begin{array}{ccc} 1 & 1 & \\ & \text{J} & \text{?} \text{ P} \\ & \text{£} & \text{?} \text{ ?} \\ \hline 1 & \text{J} & \text{D} \text{ A} \end{array} \end{array}$$

B.1.2 | Subtraction

If both of the operands are smaller than 4199, then it is sufficient to use mixed-base subtraction.

9	12.	
9	7	A
0	F	L
1	£.	P

B.1.3 | Determining parity

A number less than 4199 is even iff the sum of its digits in base v is even – that is, either none of its digits are odd, or if exactly two are.

B.1.4 | Dividing by two

If a number's base- v representation contains only even digits, then divide each digit by two.

If the representation has two odd digits, then take advantage of the identities

$$11_v/2 = 9_v$$

$$101_v/2 = 99_v$$

$$110_v/2 = T0_v$$

This operation is written as $\langle \triangleright \rangle$, short for $\langle \triangleright \text{yine} \rangle$ “one half”. Thus, in hacm:

- $\triangleright 11 = L$
- $\triangleright 101 = LL$
- $\triangleright 110 = F0$

B.1.5 | Multiplication

With the previous two operations, it is now possible to use peasant multiplication to multiply small numbers.

B.2 | Operations on larger numbers

B.2.1 | Addition

For some $i \in \mathbb{N}$, and two numbers number $a = x_a :^i y_a$ and $b = x_b :^i y_b$, we take advantage of the fact that

$$x_a :^i y_a + x_b :^i y_b = (x_a + 1) :^i y_a + (x_b - 1) :^i y_b + (x_a - x_b + 1) \quad (\text{B.1})$$

$$x_a :^i y_a + x_b :^i y_b = (x_a + x_b) :^i y_a + 0 :^i y_b + x_a \cdot x_b \quad (\text{B.2})$$

$$= (x_a + x_b) :^i (y_a + y_b) + x_a \cdot x_b \quad (\text{B.3})$$

Romanisation

In this text, the romanisation is used only to transcribe names into English. Whenever possible, the hacmisation should be used.

Table B.1: The consonants of Lek-Tsaro.

	Bilabial	Alveolar	Palatal	Velar	Glottal
Nasal	m	n	ɲ	ŋ	
Plosive	p b	t d	tʃ dʃ	k g	ʔ
Fricative	f	s	ʃ	h	
(coarticulated)	ɸh	ʃh		fʃ	
Affricate		ts	tʃ		
Lateral fricative		ɬ			
Approximant		r	j	w	
Lateral approximant		l			
Trill		ʀ			

Table B.2: The vowels of Lek-Tsaro.

Spread	Half-rounded	Rounded
i	y	ɥ
ĩ	u	ũ
e		ö
ẽ		o
a		

Rod signs are represented by the Arabic digits <1 2 3 4 5 6 7 8> attached to the end of the verbs they encompass. Proper words are preceded by a backslash <\>.

<ɲ> should be capitalised as <N> only if one can depend on the majuscule glyph appearing like an N with a hook. Otherwise, it should be spelled <Ng>.

C | Dictionary

| .

.c]ḡḡ *desc* new
 .cnai *desc* hot
 .cḡen *ninanim* house
 .c^aḡc^a.cn *v* (S) perceives, detects, finds (O)
 .ḡḡc *nabst* perception, detection
 .ḡḡc *nabst* sadness, grief

| f

ḡḡḡ *ninanim* river
 ḡḡḡ *v* (S) fights (O)
 ḡḡḡ *v* (S) falls on (O)
 ḡḡḡ *v* (O) breaks (S)
 ḡḡḡ *ninanim* flower
 ḡḡḡ *desc* sufficient, wanted, wished-for
 ḡḡḡ *desc* complete, full, mature
 ḡḡḡ *nsent* who?
 ḡḡḡ *nabst* power, magic, motivation
 ḡḡḡ *v* (S) stabs, stings (O)
 ḡḡḡ *v* (S) wants (O), benefactive
 ḡḡḡ *ninanim* fruit
 ḡḡḡ *v* (S) answers to (O)
 ḡḡḡ *nsent* child (young person)
 ḡḡḡ *ninanim* cloud
 ḡḡḡ *v* (S) loses, frees (O); (O) escapes
 ḡḡḡ *desc* heavy
 ḡḡḡ *ninanim* tree

ḡḡḡ *nined* wood
 ḡḡḡ *nedib* ice
 ḡḡḡ *nfluid* rain
 ḡḡḡ *v* (S) buys (O)
 ḡḡḡ *nedib* beef
 ḡḡḡ *v* rain (S = other)
 ḡḡḡ *nsent* coward, knave
 ḡḡḡ *nined* blood vessels

| ḡ

ḡḡḡ *v* (S) is determined by (O); (S) is a function of (O)
 ḡḡḡ *nsent* warrior
 ḡḡḡ *ninanim* stairs
 ḡḡḡ *desc* potent, powerful not in a physical sense
 ḡḡḡ *nabst* south
 ḡḡḡ *v* (S) makes a loud noise
 ḡḡḡ *ninanim* bone
 ḡḡḡ *nined* mirror
 ḡḡḡ *v* (S) is at (O), locational verb
 ḡḡḡ *nmeas* subdivision of the day cf Grammar / Calendar / Subdivisions of the day / Modern timekeeping
 ḡḡḡ *ninanim* moon
 ḡḡḡ *ninanim* era
 ḡḡḡ *nined* stone
 ḡḡḡ *desc* all, every
 ḡḡḡ *desc* whole, entire
 ḡḡḡ *ninanim* tooth
 ḡḡḡ *v* (S) needs (O)
 ḡḡḡ *desc* old

| l

lpe³ncn v (S) hunts for (O)
 lcnin v (S) shoots an arrow to (O)
 lcl nabst nature, disposition

| j

jɣɿ ninanim ring
 jcn v (S) is (O)
 jcncn v (S) attaches to, loves (O)
 jcne nmeas subdivision of the day
 cf Grammar / Calendar / Subdivisions of
 the day / Modern timekeeping
 jc^əl nanim fox
 jɔɔ nmeas subdivision of the day
 cf Grammar / Calendar / Subdivisions of
 the day / Traditional timekeeping
 jɔ^əɣɿ ninanim table
 je.in v (S) knows (O) answers (last
 clause)
 je.in v (S) describes (O)
 jenin v (S) is worried by (O)
 jea^lc nabst daytime
 jerlilcn ninanim essay
 je³le ninanim land, country
 jəɿ desc many, again
 jəp ninanim day, sun

| j^h

j^hi.en nsent magician
 j^hin v (S) goes toward (O)
 j^hɣɿcn v (S) creates (O)
 j^hcn nabst how many?
 j^he³ncn v (S) befriends (O)
 j^hən nabst how much?

| n

nɣɿɿ nanim cat
 ni.cn v (S) waits for/until (O), tem-
 poral verb, if
 ni.eɣɿcn v (S) covers, spans (O)
 nidcɿ nabst now, the present, today
 niɣɿɿ nanim parent (animal)
 ncɿ ninanim face
 ncɔcn v (S) dances around (O)

nchel ninanim group, organisation,
 order

nc³ ninanim point nc³-ɔɣine
 halfway point

nelcn v (S) swims in (O)

neac nined fire

neɔ desc male

nebin v (S) gives something to (O)

neɣacn v (S) hides from (O)

neɣɿ desc sudden

nel nabst nature, temperament,
 disposition

neldi nsent mind, brain

nə^cɣɿ nanim wolf

nə³nɔn v (S) kills (O), (O) dies

nə³bin v (S) steals from (O)

nə³biɣɿ^ən nsent thief

| n^ɸ

n^ɸɔɣɿn v (S) thinks, ponders about
 (O)

| u

uɔ^əɣɿ nfluid poison

| a

aɣen⁴e ninanim coin

aɣɿn v (S) falls into (O)

ac.cɿ nabst centre, origin

acɿcn v (S) obeys (O)

acn v (S) joins (O), and

acnɔ desc early

acɿcn v touch

acɣe nabst what

acɣe nabst light

ac^əl desc female

ac^əɿɿj ninanim stick, rod

ac^əɿɔ^ə ninanim spoon

aehcn v (S) plays with (O)

aecn v stand, get up

a^cɔ^ə.ɔn^ɸ nabst description

aə³ ninanim event, occurrence

| **ᠠᠯ**

ᠠᠯᠢᠭᠡ *nabst* quote, words, speech
 ᠠᠯᠡ *ninanim* what
 ᠠᠯᠠᠮᠠᠳᠤ *nfluid* water

| **ᠠᠬ**

ᠠᠬᠢᠳᠤᠨ *nabst* empathy

| **ᠳ**

ᠳᠠᠭᠢᠨᠡ *nabst* one half
 ᠳᠠᠯᠢᠨ *v* (S) eats (O)
 ᠳᠠᠯᠢᠭᠢ *desc* empty
 ᠳᠠᠵᠢ *nsent* person
 ᠳᠠᠨ *nedib* rice
 ᠳᠴᠢᠯᠢ *desc* far
 ᠳᠴᠢᠨᠢ *ninanim* wall
 ᠳᠴᠠᠨᠰᠡᠨᠲᠤ *nsent* child (offspring)
 ᠳᠴᠣᠴᠢᠨ *v* (S) serves (O)
 ᠳᠴᠣᠳᠡᠳᠤ *nanim* tongue
 ᠳᠴᠣᠴᠤᠯᠢ *nabst* evening
 ᠳᠠᠰᠢᠨᠢ *v* (S) produces (O)
 ᠳᠠᠰᠢᠨᠢ *v* (S) is destroyed to make, for
 (O)
 ᠳᠠᠨᠠᠮᠢ *nanim* head
 ᠳᠠᠨᠠᠮᠠᠳᠤ *nanim* scorpion
 ᠳᠡᠯᠢ *ninanim* hole
 ᠳᠡᠯᠢᠨᠢ *v* dig a hole
 ᠳᠡᠯᠢᠨᠢ *v* (S) gives birth to (O), (O) is
 born (S) is not necessarily the mother;
 this can be either parent
 ᠳᠡᠯᠡ *nabst* time
 ᠳᠡᠵᠢᠨᠢ *v* (S) raises, takes care of,
 tends to (O)
 ᠳᠡᠨᠰᠢᠨᠢ *v* begin, start
 ᠳᠡᠨᠰᠢᠨᠡ *nabst* morning
 ᠳᠡᠭᠠᠮᠢᠨᠢ *v* (S) stands on, is on (O)
 ᠳᠡᠭᠠᠮᠢᠨᠢ *v* (S) drowns in (O), (O) fills
 (S)
 ᠳᠡᠳᠢ *desc* in return
 ᠳᠡᠳᠢᠨᠢ *v* (S) succeeds at (O), (S)
 does something to (O)
 ᠳᠡᠳᠢᠨᠢ *v* err, miss
 ᠳᠡᠪᠴᠢ *nabst* shape, structure
 ᠳᠡᠪᠴᠢ–ᠳᠡᠯᠪᠡᠳᠤ *nabst* grammar
 ᠳᠡᠮᠴᠢᠨᠢ *ninanim* opposite side

ᠳᠡᠯᠢ *nmeas* volume in expressions
 such as ᠳᠡᠯᠢ–ᠬᠠᠵᠤᠵᠠᠳᠤ “cupful”

ᠳᠡᠯᠢᠨᠢ *desc* similar
 ᠳᠡᠯᠢᠨᠢᠨᠢ *v* (S) imitates (O)
 ᠳᠡᠳᠤᠨᠢᠨᠢ *v* (O) branches from (S), or
 ᠳᠡᠳᠢᠨᠢ *v* (S) recalls (O)
 ᠳᠡᠨᠠᠮᠢᠳᠤ *nanim* rabbit

| **ᠨ**

ᠨᠠᠨᠢᠨᠢᠨᠢ *v* (S) is inside (O)
 ᠨᠠᠨᠠᠨᠢ *ninanim* back (body part)
 ᠨᠠᠪᠠᠳᠤ *nabst* life, existence
 ᠨᠡᠯᠡᠳᠤ *nfluid* nitrogen
 ᠨᠡᠳᠢᠨᠢ *v* (S) sleeps
 ᠨᠠᠵᠢᠨᠢ *ninanim* pathway

| **ᠨᠠ**

ᠨᠠᠵᠢᠨᠢᠨᠢ *v* follow (in terms of move-
 ment; not synonymous with ᠠᠴᠢᠵᠢᠨᠢ)

| **ᠰ**

ᠰᠠᠵᠢᠨᠢᠨᠢ *v* (S) laughs at (O)
 ᠰᠠᠵᠢᠨᠢᠨᠢ *v* (S) founds (O)
 ᠰᠠᠴᠢᠯᠢ *desc* well (not sick)
 ᠰᠠᠴᠢ *nabst* five

| **ᠳ**

ᠳᠠᠯᠢᠰᠢᠨᠢ *nabst* ground, floor
 ᠳᠠᠯᠢᠨᠢ *nanim* owl
 ᠳᠠᠭᠠᠨᠢ *v* (S) passes (O)
 ᠳᠠᠵᠢᠨᠢ *v* hold, carry, instrumental
 verb
 ᠳᠠᠭᠡᠳᠡ *ninanim* city
 ᠳᠢᠰᠢᠨᠢ *v* (S) sits at (O)
 ᠳᠢᠰᠢᠨᠢ *v* (S) dislikes, objects to, disap-
 proves of (O)
 ᠳᠢᠰᠢᠨᠢ *ninanim* landmass, domain
 ᠳᠠᠰᠢᠨᠢ *v* (S) chases away (O), (O) flees
 from (S)
 ᠳᠡᠭᠢᠨᠢ *v* (S) wears, experiences (O)
 ᠳᠡᠭᠡᠳᠤ *nedib* noodles
 ᠳᠡᠯᠪᠡᠳᠤ *nabst* sentence, utterance
 ᠳᠡᠳᠢᠨᠢ *nanim* large animal
 ᠳᠡᠨᠠᠮᠢᠳᠤ *ninanim* knee

| b

bine *ninanim* year
 birəɭ *nmeas* subdivision of the day
 cf Grammar / Calendar / Subdivisions of
 the day / Modern timekeeping
 bcjcn v (S) walks to (O)
 behi *nfluid* sea
 bæj *nabst* future, next (time period)
 bæʔnʔin v (S) succumbs to their im-
 pulses
 bæʔɔɔ *nsent* adult person

| h

hɥcæn *ninanim* book
 hi.ɥ *nabst* spring (season)
 hijɔɔ *ninanim* nose
 hijde *ninanim* leaf
 hirəʔ *ninanim* statue
 hcn v (S) claims that (O)
 hcɥcn v (S) is named (O)
 hcʔɔɔ *nedib* food
 hɔɭ *ninanim* cart
 heaɥn v (S) asks for, requests (O)
 heɔɭi *desc* large
 heʔɭin v transgress, commit a
 crime
 hæʔɔɔ *desc* evil, malicious

| ɥ

ɥɭjɥn v (S) enslaves (O)
 ɥɥn v (S) sees (O), because
 ɥɥn[O=jəɥ] (“see the sun”) = “wish”
 ɥənɥn v (S) raises, lifts (O)

| d

dɥjɥn v discipline, punish, constrain

dcn v (S) allows (O)

| ɥ

ɥi.cɭn v (S) is beside (O)
 ɥɭɭi *nined* grass
 ɥɭɭɔɔ *ninanim* blade of grass
 ɥɭɭn v (S) climbs, rises in (O)
 ɥcɭjcn v (S) is (O) old
 ɥcɭcn *ninanim* wave
 ɥcʔɭ *ninanim* star
 ɥeaɥn v (S) speaks to (O), (S) asks
 (O)
 ɥeaɥn v (S) spreads (O)
 ɥellɭ *ninanim* place
 ɥeʔɥi *desc* friendly, kind, consider-
 ate, nice
 ɥəɭi *desc* late
 ɥəɭəʔ *nabst* nighttime
 ɥəɭəʔ *ninanim* cup
 ɥəɔɔʔ *nmeas* tidal day
 ɥəʔɔɔ *nined* gold

| s

sɭɭc *nfluid* soup
 sɭɭe *nanim* fish
 seɔɭɥn v (S) perceives (O) non-
 visually

| o

oelje *nined* forest

| l

leɭ *nabst* language
 leɭeɭ *ninanim* a language