First International Olympiad in Theoretical, Mathematical 
and Applied Linguistics
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Solutions to the Problems of the Individual Contest

Solution of Problem 1

1. Nouns:
   - $\hat{\Delta}$ ‘man’, $\hat{\Lambda}$ ‘woman’, i ‘boy’, $\hat{\alpha}$ ‘girl’, $\overline{\infty}$ ‘letter’, $\lbrack$ ‘work’.
     - Combinations: $\hat{\Lambda}\hat{\Delta}$ ‘man + woman = husband + wife’, $\hat{i}\hat{\alpha}$ ‘boy + girl = brother + sister’, $\hat{\Lambda}\hat{\alpha}\hat{\Delta}$ ‘man + woman + boy + girl = family’.
     - Family members are singled out by division and cancellation: $\frac{\hat{\Lambda}\hat{\alpha}\alpha}{\hat{\Lambda}}$ ‘family/(woman + kids) = father’, $\frac{i\hat{\alpha}}{\hat{\alpha}}$ ‘kids/girl = brother’, $\frac{\hat{\alpha}\hat{\alpha}}{\hat{\Lambda}}$ ‘family/kids = parents’.
     - Missing (deceased) family members are preceded by a minus sign: $\frac{i(\overline{\hat{\alpha}}\hat{\alpha})}{\hat{\alpha}}$ ‘kids (−parents)/(−parents) = orphans’ (apparently orphaned children of one and the same family).
   - $\hat{\iota}$ ‘person’, ($\hat{\iota}$) ‘giant’.

2. Pronouns are composed of the character $\hat{\iota}$ or $\hat{\Delta}$ (for feminine gender) and the subscripts 1 to 3, which indicate the person.

3. The plural of nouns and pronouns is expressed by the coefficient $\hat{n}$. The plus sign plays the part of the conjunction ‘and’.

4. Verbs: $\ll$ ‘talk’, $\lbrack$ ‘work’, t ‘hurry’, $\sslash$ ‘write’, $\bowtie$ ‘like, love’, $\bowtie\sqrt{\;\;\;}$ ‘eat’. If what the verb denotes is absent or uncharacteristic, a minus sign expresses that: $\neg\bowtie\sqrt{\;\;\;}$ ‘not inclined to affection = wicked’. (We can assume that a characteristic property is expressed by a plus sign, hence $+\bowtie\sqrt{\;\;\;}$ ‘good’, a concept we need.)

5. Sentence structure:
   - the subject is the base of the power;
   - the predicate is the exponent, whereby negation is expressed by a minus sign ($\neg\bowtie\sqrt{\;\;\;}$ ‘not like?’) and passive voice by a radical sign ($\sqrt{\;\;\;}$ be written’); additional activities can be added or subtracted ($\frac{\hat{\alpha}}{\overline{\hat{\alpha}}} - t \; \text{he is working and doesn’t hurry} = \text{he is working without haste}$);
   - past tense is marked by $-t$ ($\frac{\hat{\iota}}{\overline{\hat{\iota}}} - t \; \text{he worked}$), future tense by $+t$;
   - the direct object, if there is one, follows an equals sign.

Assignment 1
9. He loves with an unrequited love (i.e., loves without being loved).
10. The taciturn (or mute) daughter will write about the father and the mother.
11. You (sg. fem.) worked quickly (or hastily) and silently.
12. The letter was eaten by the hungry sister.

Assignment 2
13. $(\hat{\Delta}1 + \frac{\hat{\alpha}\hat{\alpha}}{\hat{\Delta}})\ll - t = -\hat{n}\overline{1}_3$
14. $(\hat{n}\overline{1}_1)^{\neg\bowtie\sqrt{\;\;\;\;}$
15. $(\frac{\hat{\alpha}(\hat{\alpha})}{\overline{\hat{\alpha}}} + \bowtie\bowtie)\overline{\bowtie} = (\hat{\iota}) - \lbrack$
16. $(\hat{n}\overline{1}_2)^{\bowtie\bowtie} + t$
Solution of Problem 2

All Arabic words in the problem are made according to one of the patterns 1a2a3b, i2a3b, 1b3, and 1a23en (whereby words using the first and the second pattern always come together in this order and words using the other two patterns occur on their own). In these patterns 1-2-3 is one of the triples of consonants r-bl-s, s-bl-r, s-bl-s, t-bl-t, b-m-w, b-s-r, b-m-s, s-s-r. Let us assume that the consonant triples correspond to numbers between 1 and 10 and the arrangements of the vowels indicate certain functions, in particular, 1a23bl i123bl is either $\frac{1}{10}$ or $\frac{1}{15}$ (and in either case xamast laam is $\frac{1}{10}$ = 1), and 1b3 = $\frac{1}{8}$ and 1a23en = $\frac{1}{15}$, for some as yet unknown i and j.

From equality (5) we see that s-bl-r and x-m-s are 5 and 7 (in one order or the other), and from $\frac{1}{2} + \frac{1}{2} = (\frac{1}{2} + \frac{1}{5}) = \frac{3}{5}$ it follows that j = 2, that is, 1a23en = $\frac{1}{15}$. Since 1b3 is shorter than 1a23en, we can assume that this pattern corresponds to a more basic function, and the only candidate for such a one is $\frac{1}{10}$.

From (1) it follows that b-bl-t is 3 (and that the numerator precedes the denominator in the Arabic fractions). From (4) we see that b-m-w is greater than s-bl-r by one. From (3) it follows that 3s-d-s = 2b-s-r. Thus t-s-r is divisible by three. Since the value 3 is already taken, t-s-r and s-d-s are either 6 and 4 or 9 and 6, respectively, and b-m-w, s-bl-r and x-m-s are respectively 8, 7 and 5.

We have yet to use equality (2). Letting s-bl-r be equal to 4 gets us nowhere ($\frac{2}{2} + \frac{1}{2} = \frac{4}{2}$ can’t be reduced to a fraction with a numerator and denominator between 1 and 10), consequently s-d-s = 6, and $\frac{2}{2} + \frac{1}{2} = \frac{6}{2} = 3 = \frac{12}{4} = s-s-r/r-b-s$. (The root r-b-s is the source of the word ruba’a ‘quatrain’, used also in English.)

Assignment 1. (1) $\frac{1}{2} + \frac{2}{3} = \frac{3}{2}$, (2) $\frac{2}{2} + \frac{1}{2} = \frac{4}{2}$, (3) $\frac{3}{2} + \frac{1}{2} = \frac{5}{2}$, (4) $\frac{2}{2} + \frac{1}{2} = \frac{5}{2}$, (5) $\frac{2}{2} + \frac{2}{3} = \frac{10}{3}$.

Assignment 2. rub + cašar itdás = $\frac{1}{4} + \frac{1}{9} = \frac{13}{36}$ and sabast itdás = $\frac{7}{6}$. Thus either $\sqrt{\text{rub} + \text{cašar itdás}} = \text{sabast itdás}$ or, perhaps, rub + cašar itdás = (sabast itdás)² (if we don’t consider brackets to be a sign).
Solution of Problem 3

There are two types of English expressions in the problem: some (I) consist of a date, a month and a day of the week, others (II) name the number of the day of the week within the month instead of the date. The word order in the Basque expressions of type (I) is (month) (date), (day of the week), whilst in type (II) it is (month) (number of the day) (day of the week). The last word ends in -a, whereas the preceding words have no final -a (except for the word hogeita, which means '20' in compound numerals). The element -garren forms ordinal numbers. The word astea is not a name of a day of the week (six of those we have seen in examples 1–10, the seventh occurs in Assignment 3). Since Assignment 2 features the word ‘week’, we can guess that this is the meaning of the word astea.

Assignment 1.  uztarrilaren hogeita hirugarrena, larunbata  the 23rd of January, Saturday
abenduaren asken astea  the last week of December
otsailaren lehenengo osteguna  the first Thursday of February
ekainaren beratzigarrena, igandea  the ninth of June, Sunday
abenduaren lehena, astezkena  the first of December, Wednesday
irakaren asken astezkena  the last Wednesday of September
azaroaren hirugarren ostirula  the third Friday of November
urriaren asken larunbata  the last Saturday of October
irakaren lehena, astelchena  the first of September, Monday
urtarrikaren bigarren, ostirula  the second of January, Friday

Assignment 2.  the first Monday of December  abenduaren lehenengo astelchena
the 29th of November, Saturday  azaroaren hogeita beratzigarrena, larunbata
the second week of January  urtarrilaren bigarren astea
the third of February, Monday  otsailaren hirugarrena, astelchena

Assignment 3.  Astelchena ‘Monday’, astezkena ‘Wednesday’; asteartea, the only day of the week not found in in Assignment 1, is ‘Tuesday’. All three names are formed from the word aste ‘week’. Astelchena means literally ‘first (day) of the week’, astezkena ‘last (day) of the week’. Tuesday’s Basque name can be translated more or less as ‘day in the middle of the week’.

No one knows for sure why Basque calls Wednesday ‘last day of the week’. In Basque dialects other variants of the names of the days of the week are also found, including loans from Romance languages.
Solution of Problem 4

The Adyghe sentences have the following structure:

$\begin{array}{c|c|c|c|c}
(1, 3, 4) & X-r & Y-m & P-e-V, & \text{He } V \text{ X } P Y; \\
(2, 5) & syda & Y-m & P-i-V-r\overline{m}? & \text{What does he V } P Y? \\
(6, 7) & X-r & tyda & sy-P-i-V-r\overline{m}? & \text{Where does he V X}? \\
\end{array}$

where X and Y are nouns, V is a verb (or its stem) and P is, in English, one of the prepositions into, onto or under and in Adyghe it is one of the prefixes $d-,$ $t-,$ or $\&$. As the third schema shows, the Adyghe locative prefix may not correspond to anything in the natural (but imprecise) English translation.

Assignment 1. We specify (at the expense of naturalness):

6. Under what does he put the plate?
7. Onto what does he throw the plate?

Assignment 2. 8. He throws the stool into the stove.
9. Where (into what) does he drop the money?

Assignment 3. 10. lastr lanyym $\&$esnuc.
11. syda pyramym $\&$s\overline{m}? \\
12. syda $\&$sywanym da$a$m\overline{m}?

Assignment 4. 13. $\&$amy tyda $\&$ydis\overline{m}woc? Into what does he put the table?
13'. $\&$amy tyda $\&$ydis\overline{m}woc? Onto what does he put the table?
13''. $\&$amy tyda $\&$ydis\overline{m}woc? Under what does he put the table?

Solution of Problem 5

réassortir  pick again  assortir  pick
récurer  clean  curer  clean
réformer  reform  form again
réformer  reform  form
rêfuter  refute  form again
rêlancer  throw again  lancer  throw
rêmunérer  remunerate  lancer  throw
rêpartir  distribute  lancer  throw

The table features verbs with two different prefixes: $r-$ and $r\&$. All verbs with $r-$ indicate a repetition or a renewal of the action named by the verb without a prefix. Contrariwise, if the prefix is $r\&$, then the corresponding prefixless verb either doesn’t exist or means the same thing as the prefixed one does. The verbs whose stems begin with vowels are an exception: the prefix they take is $r-$ regardless of the existence and the meaning of a corresponding prefixless verb. There are other exceptions from this rule in French, but on the whole it is fairly reliable.

Note: The vowel in the prefix $r\&$- is not unlike the first vowel in mideter, whereas the one in the prefix $r-$ bears a certain similarity to the second, and needs to be fortified when it finds itself next to another vowel.

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