



[5 problem sets, each worth 20 points]

SOLUTIONS: Problem 1. Wembawemba *expressing possession*

Wembawemba is an indigenous Australian language previously spoken in Victoria. There are no longer any fluent speakers of this language; the last speakers were recorded by Luise Hercus in the 1960's; in compiling her Wembawemba dictionary (and in her other writings on Victorian languages) Hercus also included the work of earlier recorders of the language.

Possession is marked by a set of pronoun suffixes or endings (with meanings akin to *my*, *your*, *his/her/its* etc.) which attach to the word referring to the possessed entity. However each of these suffixes takes at least three distinct forms.

Study these Wembawemba words and their English counterparts:

| Wemba-wemba | English | Wemba-wemba | English | Wemba-wemba | English | Wemba-wemba | English |
|-----------------|---------------------|------------------|------------------|------------------|--------------------|-----------------------|----------------------|
| <i>wutyup</i> | stomach | <i>tyinə</i> | foot | <i>kurrm</i> | breast | <i>lar</i> | country |
| <i>wutyupek</i> | my stomach | <i>tyinəngək</i> | my foot | <i>kurrmbuk</i> | her breast | <i>larnuk</i> | his/her country |
| <i>wutyupin</i> | your stomach | <i>tyinəngin</i> | your foot | <i>kurn</i> | throat | <i>mir</i> | eye |
| <i>wutyupuk</i> | his/her/its stomach | <i>tyinənyuk</i> | his/her/its foot | <i>kurnduk</i> | his/her/its throat | <i>mirnuk</i> | his/her/its eye |
| <i>tjel</i> | net | <i>ngani</i> | waddy | <i>paring</i> | track | <i>yiren-yiren</i> | eyebrows |
| <i>tjelek</i> | my net | <i>nganingek</i> | my waddy | <i>paringguk</i> | his/her/its track | <i>yiren-yirendek</i> | my eyebrows |
| <i>tjelin</i> | your net | <i>nganingin</i> | your waddy | <i>kurratyuk</i> | his/her/its fat | <i>yiren-yirendin</i> | your eyebrows |
| <i>tjeluk</i> | his net | <i>nganinyuk</i> | his/her waddy | <i>merterruk</i> | his/her/its bone | <i>yiren-yirenduk</i> | his/her/its eyebrows |

NOTE: In the Wembawemba writing system *ng* represents the consonant sound in English *singer* and not the sequence of the two consonant sounds *n + g* as in *finger*. The sequence *ty* represents a single consonant sound close to English *ch* in *chin*. There are two distinct 'r' sounds in this language: the consonant sound written with a single 'r' symbol is quite different from the one written with two 'r' symbols. In other words 'rr' does not represent two consonant sounds, but just one. ə represents the vowel sound of 'e' in *open* or of 'er' in *singer*.

**Part 1. (10 points)**

The Wembawemba possessive pronoun endings each come in several forms.

- In Column 1, below, list all the forms which translate as English *his*, *her* or *its*
- In Column 2, write a word containing the possessive ending written in Column 1
- In Column 3, explain the environment or condition in which each form is used

| Wembawemba endings | Example word | Environment in which form is used | |
|--------------------|---------------------------------|---|-----|
| -uk | <i>wutyupuk/ tjel</i> | following word ending in a consonant other than nasal (n, ng, m) or r | 2 |
| -nyuk | <i>tyinənyuk/ nganinyuk</i> | following word ending in a vowel | 2 |
| -duk | <i>kurnduk</i> | following word ending in 'n' | 1.5 |
| -nuk | <i>larnuk / mirnuk</i> | following word ending in 'r' | 1.5 |
| -buk | <i>kurrmbuk</i> | following word ending in 'm' | 1.5 |
| -guk | <i>paringguk</i> | following word ending in 'ng' | 1.5 |

Part 2. (6 points: 1 each)

| | | | |
|----|--|---|--------------------------|
| a. | <i>kunənyuk</i> means 'its guts' | what is the word for 'guts'? | <i>kunə</i> |
| b. | <i>mirrkuk</i> means 'its egg' | what is the word for 'egg'? | <i>mirrk</i> |
| c. | <i>kurrk</i> means 'blood' | how do you say 'your blood'? | <i>kurrkin</i> |
| d. | <i>mula</i> means 'hip' | how do you say 'your hip'? | <i>mulangin</i> |
| e. | <i>ngapundek</i> means 'my grandchild' | use a hyphen to break the word into the part meaning 'grandchild' and the part meaning 'my' | <i>ngapun-dek</i> |
| f. | <i>kurratyuk</i> means 'its fat' | use a hyphen to break into the part meaning 'fat' and the part meaning 'its' | <i>kurraty-uk</i> |

Part 3. (4 points: 2 points for right form and 2 points for correct reasoning)

If we know that *ngarrəngək* means 'my hair', is the word for 'hair' *ngarrə* or *ngarrəng*? Give the reasoning behind your answer. (Recall that *ng* represents a single sound as in English *singer*.)

'hair' = *ngarrə* because the 'my' ending following a word ending in a vowel is *ngək*, whereas if 'hair' were *ngarrəng* then the 'my' ending would be *gək* as with *paring* 'track' giving *ngarrənggək* (for 'my neck') which is not the correct recorded form.

**SOLUTIONS: PROBLEM 2: Zoque word formation**

Zoque is a language from southern central Mexico. There are several dialects of Zoque which are spoken by over 30,000 indigenous Mexicans. The Zoque language is a member of the larger Mixe-Zoque group of languages.

Zoque words can be very complex, incorporating parts which mark plural and also parts expressing meaning which in English are expressed by separate words (such as prepositions, e.g., *on, for...*). An example of an English complex word is *un-manag(e)-abil-ity*.

Study these Zoque words:

NOTE: ə represents the vowel sound of English 'e' in *open*; ʔ represents a glottal stop which is the sound we get in the middle of the expression of disagreement *nuh-uh*; ŋ is the consonant sound represented by 'ng' as in *sing*; š is the sound written 'sh' in *she*.

| | | | |
|----------------|--------------------|------------------------|-----------------------------|
| 1. pən | <i>man</i> | 11. yomo | <i>woman</i> |
| 2. pəntaʔm | <i>men</i> | 12. yomohiʔŋ | <i>with a woman</i> |
| 3. pənkəsi | <i>on a man</i> | 13. yomotih | <i>just a woman</i> |
| 4. pənkotoya | <i>for a man</i> | 14. yomoʔune | <i>girl</i> |
| 5. pənhiʔŋ | <i>with a man</i> | 15. kahši | <i>hen</i> |
| 6. pənkəsitaʔm | <i>on men</i> | 16. kahšiʔune | <i>chick</i> |
| 7. pənkəsišeh | <i>as on a man</i> | 17. maŋu teʔ pən | <i>The man went</i> |
| 8. pənšeh | <i>manlike</i> | 18. maŋpa teʔ pən | <i>The man goes.</i> |
| 9. pənšehtaʔm | <i>like men</i> | 19. maŋkeʔtpa teʔ yomo | <i>The woman also goes.</i> |
| 10. teʔ pən | <i>the man</i> | 20. minpa teʔ ʔune | <i>The child comes.</i> |

PART 1. (14 points)

List all of the meaningful parts of these Zoque words and write their English equivalent beside it. (14 points - 1 point for each correct Zoque form and English translation. 0.5 off if either is incorrect)

| Zoque | English | Zoque | English |
|--------|-----------------------------|-------|---------------------------|
| pən | <i>man</i> | hiʔŋ | <i>with</i> |
| taʔm | <i>plural/more than one</i> | yomo | <i>woman</i> |
| kəsi | <i>on</i> | ʔune | <i>small/little/child</i> |
| kotoya | <i>for</i> | maŋ | <i>go</i> |
| keʔt | <i>also</i> | min | <i>come</i> |
| šeh | <i>like/as</i> | u | <i>past (on verb)</i> |
| tih | <i>just/only</i> | pa | <i>present (on verb)</i> |
| kahši | <i>hen</i> | teʔ | <i>the</i> |

**PART 2: (4 points)**

Translate the following phrases into Zoque: (4 points: half marks if right form but wrong order)

| English | Zoque |
|---------------------|------------------------|
| The child came. | Minu te? ?une. |
| The girl also went. | Maŋke?tu te? yomo?une. |
| with children | ?unehi?ŋta?m |
| for women | yomokotoyata?m |

PART 3: (2 points)

Translate the following Zoque words into English: (2 points) [These English translations can be expressed in a variety of word orders, of course, so full marks for translations with the right meaning]

| Zoque | English |
|----------------------|---------------------------------|
| maŋutih te? yomo?une | <i>The girl just/only went.</i> |
| yomotihta?m | <i>Just/only women.</i> |



SOLUTIONS: PROBLEM 3: *Pitjantjatjara words borrowed from English*

Pitjantjatjara is one of the Western Desert languages spoken by about 2,000 Australian Aboriginal people living in the northern part of South Australia and the southwest part of the Northern Territory.

Here are some examples of English words which have been incorporated into Pitjantjatjara. Some of them are pronounced in a similar way to their English counterparts, whereas others are pronounced in ways that are quite different.

| English | Pitjantjatjara | English | Pitjantjatjara |
|----------------|-----------------------|---------------------------|-----------------------|
| <i>teacher</i> | tiitja | <i>John</i> | Tjaana |
| <i>paper</i> | piipa | <i>school</i> | kuula |
| <i>shovel</i> | tjapila | <i>bus</i> | paatja |
| <i>room</i> | ruuma | <i>tent</i> | tiinta |
| <i>crowbar</i> | kurupa | <i>flour</i> | palawa |
| <i>ration</i> | ratjina | <i>bucket</i> | pakata |
| <i>rabbit</i> | rapita | <i>drunk (inebriated)</i> | tarangka |

NOTE: The vowel 'a' is pronounced like the vowel in *but* or *us* while 'aa' is a 'long a' pronounced more like the vowel written 'a' in *father*. The vowel written 'i' is pronounced like the vowel in *bit*, while *ii* is 'long i' which is more like the vowel sound in *bee* or *seed*. The vowel *u* is like the vowel in *put*, while the 'long u' written as *uu* is more like the vowel sound in *school* or *pool*. The long vowels, *ii*, *uu*, *aa*, in the Pitjantjatjara words tend to be longer than in the corresponding English word. The letters *tj* represent a sound similar to English *ch* in *chin* but a little closer to *t* especially if followed by the vowel *a*. You will notice that English 's' changes into the Pitjantjatjara *tj* sound.

By comparing the English and Pitjantjatjara pairs of words, we can learn quite a bit about the vowel and consonant sounds of Pitjantjatjara, and also about the way in which these sounds may or may not pattern to form words. We can also see that certain rules or processes are applied in converting English words into Pitjantjatjara ones.

HINT: To answer the questions below, it is important to think about how the English words *sound* and not just how they are written.

**Question 1:** (2 points)

Under what condition must the initial vowel in these Pitjantjatjara words be a long vowel (written *aa*, *uu* or *ii*)?

If the Pitjantjatjara word derived from English has one or two syllables, then the first syllable of the borrowed word must have a long vowel in the first syllable.

Question 2: (2 points)

All these Pitjantjatjara words borrowed from English end in 'a'. Does this word final vowel have a single source (or origin)? Explain the reasoning behind your answer.

NO. Words borrowed from English ones ending in a vowel sound, e.g., *teacher*, *paper*, *flour*, *crowbar* keep that vowel which is written as 'a' in Pitjantjatjara. If the English word ends in a consonant (e.g., *bus*, *school*...) then the vowel 'a' is added to the Pitjantjatjara form.

Question 3. (6 points: 2 for each of a, b & c)

- a. What sequences of consonant sounds are not permitted in the Pitjantjatjara words?

p+l (flour), s+k (school), t+r (drunk), k+r (crowbar), w+p (crowbar) (THESE CAN BE WRITTEN USING ENGLISH LETTERS OR A MIXTURE OF BOTH English and Pitjantjatjara writing) (The trickier ones are **sk** and **wb**. I would be inclined to give full marks if 'wp/wb' is missing) (Some might consider that 'shovel' has a v+l sequence which is broken up in Pitj as *pil*. I would accept this also.) Some students might select *n+k* as an unacceptable sequence: *drunk* > *tarangka*. This would change answer to c. e.g. *n* is changed to *ng* before *k*. Again I'd be inclined to give at least some credit for this (even though it's wrong in that P does allow both *nk* and *ngk* but they can't know this from the data given, and more importantly they have failed to recognize that *n* in *E. drunk* represents the same sound as P *ng* - but this is very sophisticated stuff!)

- b. Which examples illustrate this?

palawa, *kuula*, *tarangka*, *kurupa* OR *flour*, *school*, *drunk*, *crowbar*. (would expect fewer examples depending on answer to a. Full 2 points if answer to b is consistent with answer to a)

- c. How have the Pitjantjatjara speakers changed the sequence of sounds to avoid an 'illegal' consonant sequence inherited from the English borrowing?

To avoid the sequences *pl*, *tr* and *kr* a vowel identical to the following vowel is placed between the consonant sounds; to avoid the sequences *s+k* (from *school*) or *w+b* (from *crowbar*) the first consonant is 'dropped'. (Need to see both patterns to get full marks. Again need to adjust to answers to a and b) See extra comments on a. above re *n+k* in 'drunk'. Again answers to c. must be compatible with those for a. and b.

**Question 4.** (4 points: 2 + 2)

a. Which English sounds correspond to the Pitjantjatjara sound written 'p'?

f, p, b, v (0.5 for each one) (they might write bb given 'rabbit' is one of the words - I'd allow this)

b. What do the English sounds you have listed in answering Question 4a have in common? (HINT: Say them silently to yourself and note which part of your mouth moves in order to pronounce these sounds.)

They are all pronounced by moving the bottom lip/jaw into contact with another part of the mouth [upper lip (p, b) or upper teeth (f,v) in order to stop or constrict the outgoing airflow. [The last part of this answer (inside []) is not needed for full marks (=2).]

Question 5. (6 points = 1 + 5)

a. If English *blood* were borrowed into Pitjantjatjara, how would the Pitjantjatjara word be written? **palata**

b. Set out your reasoning for the form you have written for *blood*.

1. 'b' would be written as 'p'

2. the vowel sound written 'oo' in English would be written as 'a'

3. p+l sequence would be broken up by insertion of vowel 'a' as the English vowel sound in *blood* is written as 'a'. (inserted vowel is a copy of the following vowel)

4. The 'd' sound would be written as 't'.

5. The word must end in 'a', so that vowel would be added./ OR English word ends in a consonant so 'a' must be added in Pitjantjatjara.

[Each of these 5 steps gets 1 point; they might conflate steps, e.g., 1 and 4, in their answer but it would be worth a point for each part. If they write a 'wrong' form for 'blood' 0.5 we may need to adjust marking for the reasons given for their form]

**SOLUTION: Problem 4: Syntax rules to transform strings**

This problem is about rules that turn things into other things. You start with a sequence (or ‘string’) of characters. If your string contains a character that appears on the left side of the arrow in a rule, you can turn that character into whatever is on the right side of the arrow in that rule. You can apply different rules to your string over and over again until no more moves are possible. You're *not* allowed to twiddle the order of the characters in your string.

Here are the rules:

$S \rightarrow AB$

$A \rightarrow ab$

$A \rightarrow aAb$

$B \rightarrow bcd$

$B \rightarrow bBc$

PART 1: (11 points for Part one)

If you start with ‘S’, which of these strings is it possible to end up with using these rules? (Put a tick to the right of the possible strings, and a cross to the right of the impossible ones.)

1. abcd
2. abbcd
3. aabbbcd
4. aaabbbcd
5. abbbbcddcc
6. aabbccddcc
7. aabbbbcddc
8. aaabbbbcd
9. aaabbbbcddc
10. aabbbbcddcc
11. aaabbbbcddcc

Part one: Strings 2, 3, 5, 7, 8, 10, and 11 can be generated.

[The template is $ax + bx + cy + bcd + dy$ That is, x repetitions of the character ‘a’ followed by x repetitions of the character ‘b’ (and so on).]

PART 2: (9 points for Part two)

Here is a string that can *not* be generated by these rules: bbbbcddcc

Can you add a rule to all the others so that this string *can* be generated?

Part two: There are a couple of possibilities. Contestants would be most likely to think of adding this to the list of rules: $S \rightarrow B$

It’s also possible some would try allowing an empty right-side: $A \rightarrow \emptyset$



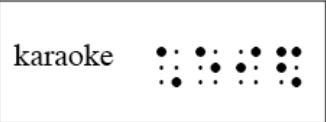
SOLUTION: PROBLEM 5: *Japanese Tenji script*

Braille is a tactile writing system, based on a series of raised dots, that is widely used by the blind. It was invented in 1821 by Louis Braille to write French, but has since been adapted to many other languages.



English, which uses the Roman alphabet just as French does, required very little adaptation, but languages that do not use the Roman alphabet, such as Japanese, Korean, or Chinese, are often organized in a very different manner!

To the right is a Japanese word written in the *tenji* ("dot characters") writing system. The large dots represent the raised bumps; the tiny dots represent empty positions.



A1. The following *tenji* words represent *atari*, *haiku*, *katana*, *kimono*, *koi*, and *sake*. Which is which? You don't need to know either Japanese or Braille to figure it out; you'll find that the system is highly logical.

| | |
|----------|----------|
| a. _____ | b. _____ |
| c. _____ | d. _____ |
| e. _____ | f. _____ |

A2. What are the following words?

| | |
|----------|----------|
| g. _____ | h. _____ |
|----------|----------|

A3. Write the following words in *tenji* characters:

| | |
|------------|---------|
| i. samurai | j. miso |
|------------|---------|

A1: (6 points: 1 point each)

- a. *haiku* b. *sake* c. *katana* d. *kimono* e. *koi* f. *atari*

A2 (4 points: 2 points each)

- g. *karate* h. *anime*

A3:

- i. samurai (4 points)





j. miso (2 points)



A4. (4 points) Explain the logic behind this Tenji script.

Tenji is an **alphabetical** writing system in which each Vowel and each Consonant has a specific sign. Syllables are represented by combining the consonant and vowel sound into a block made up of 6 cells arranged into 2 columns and 3 rows; (some syllables only have a vowel sound).

This is an essential part of the answer to get full marks:

The vowel signs use the cells in the top row and the middle row left cell; the consonant signs use the remaining cells: bottom row cells and the middle row right cell.

(Need to use discretion in how to award marks here)