

MT00702/SL26601
 Ideas in Mathematics: The Grammar of Numbers
 Examination 1
 February 27, 1998

You must be explicit in discussing how you arrived at your solutions. Little or no credit will be given for solutions without explanation. We will pay close attention to the *quality* of the presentation of your ideas as well as to the content.

Do all of your work in the blue booklets, copying any tables into the books. Please label all of your answers clearly.

Cheating will be severely punished.

1. (10 points) Answer only **one** of the following two questions. In either case make the manner and terms used to get the result absolutely clear. The right answer counts for far less than a good explication. Of course, a wrong answer won't help much at all!

1a) Using the Indian *nikhilam* method to multiply two numbers, compute the following product:

$$\begin{array}{r}
 \\
 \\
 \times \\
 \hline

 \end{array}$$

1b) Use the Indian *yāvadūnam* method to compute the square of 993:

$$\begin{array}{r}
 \\
 \\
 \hline

 \end{array}$$

2. (15 points) Do only **one** of the following two problems:

2a) Many people think that the proverb “Spare the rod and spoil the child” is an endorsement of liberal, hands-off child rearing, *i.e.*, “It’s better not to use the stick and to let the child get spoiled [than to cause great psychic trauma].” From what you know about conditions with *if/if not* and the syntactic behavior of the English conjunctions *and/or*, show quickly that this common reading is not correct and what the proverb really means.

2b) The Indo-European initial cluster **dw-* appears in Armenian as *erk-*. This seems strange but is a perfectly regular sound change, as one can see in Armenian *erku* ‘two’ (IE **dwōu*), *erkiwt* ‘fear’, *erknč’im* ‘I doubt’, all related to the notion of duality.

What is dual about fear and doubt?

Now, the Armenian word for heaven is *erkink’*, a masculine *i*-stem, and the word for earth is *erkir*, a feminine *a*-stem. Noting the respective genders of the words and the initial *erk-*, what might be said about them semantically as a “twosome”?

3. (20 points) Do only **one** of the following two problems:
- 3a) As we did in class, call $J(n)$ the solution of the Josephus problem, in which alternating people in a circle of n people kill themselves starting with person number 2. What is $J(65)$? Explain your answer carefully.
- 3b) One night while watching cable television, I came across a new and mysterious sporting event, in which teams scored “little goals” and “big goals.” The little goals were worth 5 points, and the big goals were worth 7 points. Teams could score either little goals or big goals or both. What point totals under 100 could a team reach during a game?
4. (10 points) Be sure to do **both** parts of this problem:
- 4a) How is the fraction $\frac{15}{14}$ written as a binary (decimal) expansion?
- 4b) What fraction is the repeated binary expansion $0.10\overline{110}_2$ equal to?
5. (10 points) In class, we practiced binary classification on a reduced group of the so-called primary cardinal vowels {i, e, æ, a, o, u}.
- a) Assign + (yes) and – (no) in the following feature matrix for these six vowels:

	i	e	æ	a	o	u
HI						
LOW						
BACK						

- b) How many vowels *should* we be able to classify with three binary features and why?
- c) Why, in this case, can't we classify a full quantum?
6. (15 points) What is the historical linguistic principle under which philologists explain the correspondence of the initial consonants in the following word sets? Can you comment?
- Engl. *five* : Greek *pentē*, Sanskrit *pañca*
 Engl. *three* : Latin *tres*, Greek *treis*, Sanskrit *trayah*
 Engl. *two* : Latin *duo*, Greek *dyo*, Sanskrit *dva*
 Engl. *hundred* : Latin *centum*, Greek *-katon*, Old Irish *cét* [k'e:d]
9. (20 points) *Quickies*: Answer any **four** of the following.
- 9a) Why does $9=12$? *Hint*: Think about liturgical offices.
- 9b) Why does $9=2$? *Hint*: Think about musical intervals.
- 9c) What does the following Sanskrit sūtra mean: *nikhilam navataś caramaṃ daśataśca*?
- 9d) Why might the words *nine* and *new* be semantically (and hence also formally) related? (cf. also Latin *novem* ‘9’ and *novus* ‘new’ or German *neun* ‘9’ and *neu* ‘new’)
- 9e) Why is Latin *nonaria* a synonym for *meretrix* ‘prostitute’?
- 9f) How does one calculate the *complement* of 87349 using the Indian *nikhilam* sūtra?