

INTRODUCTION TO THE CHINESE LANGUAGE

I. SCRIPT AND TRANSLITERATION

1. Characters

In this primer we use only the modern simplified characters, since these have now been officially adopted not only in the People's Republic of China but also in Singapore.

The characters of the Chinese script were originally painted with a brush. Each of the following parts of a character is considered to be one brush stroke:



Here are some examples of characters, with their respective numbers of brush strokes:

一	七	力	上	也	计	边	限	商
1	2	2	3	3	4	5	8	11

In the *Index* all characters occurring in the primer are ordered according to the *total number of strokes* (with the numbers of the word lists in which they appear displayed on their right). By scrutinizing some of these, the reader will soon be able to determine the number of strokes in any character, perhaps with an initial error of one stroke more or less.

This method of arranging the characters is practicable here merely because of the limited number of characters in our lists. Ordinarily, to 'look up' a character in a Chinese-English dictionary, when the corresponding spoken sound is unknown, one determines first its *radical* or *fundamental part*. Characters with the same radical are then listed according to the number of *additional strokes* needed to build up the entire character. There are just over 200 recognized radicals.

In a number of cases the radical is the left-hand component of the character. For example, the characters

论 代 阶 没 性 过 换 行 线

have the radicals:

讠	亻	阝	冫	亅	辶	扌	彳	纟
(10)	(21)	(33)	(40)	(41)	(47)	(55)	(62)	(77)

In such cases the radical is apparent. Unfortunately there are many cases in which the radical is not at all obvious, and the method based on radicals can then be much more time-consuming than simply counting the total number of strokes.

In the examples given above we have written below each radical its number in *The Pinyin Chinese-English Dictionary* (Commercial Press, Hongkong, 1985). In the index of this primer we have enclosed in brackets, at the left of each character, the number of its radical in the same dictionary. Moreover, characters with the *same* number of strokes are ordered according to the numbers of their radicals. This will assist the reader to locate in the dictionary other characters besides those which actually appear here. It should be mentioned that the numbering of radicals is not completely standardized, and so the numbers shown here may differ from those in another dictionary.

2. Spoken sounds

Each character represents a monosyllable of the spoken language. However, each monosyllable may have one of four tones. A method of transcribing the spoken sounds into roman script has been officially adopted by the People's Republic of China. This method, known as *pinyin* (phonetic spelling), is used throughout our primer. Its phonetic values are those of standard (Mandarin) Chinese.

In pinyin the four tones are denoted by

— / \ \

(1st tone) (2nd tone) (3rd tone) (4th tone)

The tone marks do in fact correspond respectively to a high level tone, a rising tone, a falling-rising tone and a falling tone. The tone mark is always placed over a vowel. It is placed over the middle vowel if there are three, while if there are two vowels it is placed over the first, except when the first vowel is *i* or *u*:

bě^ˇn, bi^{ǎo}, bā^o, xi^à, xu^é.

Those who do not aspire to speak Chinese may read these simply as

ben-3, biao-3, bao-1, xia-4, xue-2.

On the other hand, there are some cases in which the same character corresponds to more than one spoken sound:

行	还	奇	得
háng, xíng	hái, huán	jī, qí	dé, děi

The characters in our primer are always accompanied by their pinyin transcriptions. Besides providing immediate access to the resources of a dictionary, this is also an important aid in committing the characters to memory.

3. Words

Some single characters in Chinese represent a word, or unit of meaning:

大	小	是	有	和	或	向
dà	xiǎo	shì	yǒu	hé	huò	xiàng
big	small	be	have	and	or	towards
人	数	点	线	量	值	边
rén	shù	diǎn	xiàn	liàng	zhí	biān
person	number	point	line	quantity	value	side

More commonly, words are represented by combinations of two or more characters. Characters may be combined for a number of different reasons. One basic reason is to express more complex notions:

大学	数学	同时	向量	定向	三角形
dà xué	shù xué	tóng shí	xiàng liàng	dìng xiàng	sān jiǎo xíng
[big study]	[number study]	[same time]	[direction quantity]	[fix towards]	[three angle shape]
university	mathematics	simultaneous	vector	orientation	triangle

Some other important examples for the mathematician are:

定义	引理	定理	推论	使得	只要
dìng yì	yǐn lǐ	dìng lǐ	tuī lùn	shǐ dé	zhǐ yào
[fix meaning]	[lead truth]	[fix truth]	[deduce statement]	[use get]	[only want]
definition	lemma	theorem	corollary	so that	so long as

Characters are sometimes repeated for emphasis:

人人	事事	处处	仅仅	常常
rén rén	shì shì	chù chù	jǐn jǐn	cháng cháng
everybody	everything	everywhere	only	often

Combinations of opposites are also quite common:

大小	多少	反正	左右	矛盾
dà xiǎo	duō shǎo	fǎn zhèng	zuǒ yòu	máo dùn
[big small]	[much little]	[contrary correct]	[left right]	[lance shield]
magnitude	how much?	in any case	or thereabouts	contradiction

Another important reason for combining characters is to avoid ambiguity in speech. We can distinguish one simple character from another with the same spoken sound, but a different meaning, by combining it with an additional simple character whose meaning is related to its own. Thus to distinguish

限 xiàn, *limit* from 线 xiàn, *line*

we combine it with

极 jí, *extreme* to obtain 极限 jí xiàn, *limit*,

the latter being the usual expression for *limit* in the mathematical sense. Some other examples of this construction are:

表示	代换	变换	应用	对应
biǎo shì	dài huàn	biàn huàn	yìng yòng	duì yìng
[express show]	[act for exchange]	[change exchange]	[respond use]	[opposite respond]
representation	substitution	transformation	application	corresponding

Finally, characters may be combined for reasons which are no longer so relevant:

条件	代数	函数	微分	积分
tiáo jiàn	dài shù	hán shù	wēi fēn	jī fēn
[item document]	[substitute number]	[letter number]	[tiny fraction]	[accumulate fraction]
condition	algebra	function	differential	integral

II. GRAMMAR

The structure of Chinese is quite different from that of English, or other modern European languages with which the reader may be familiar. Consequently one cannot translate from Chinese into English simply on a word-for-word basis. It is necessary to consider the sentence as a whole or even a group of sentences.

In particular, the distinction between different parts of speech, especially between nouns and verbs, is not as clear-cut in Chinese as in English. Nevertheless our discussion of Chinese grammar will largely be based on parts of speech, simply because they will be familiar to the reader. On the other hand, since our concern is with translation from Chinese into English, we will not attempt to analyse all situations in which a particular construction may be used. It is enough to recognize the construction when one meets it.

Since we are especially concerned with the translation of mathematical articles, we do not discuss some topics - such as exclamations and imperatives - which will be met only rarely.

4. Nouns

Nouns do not have different singular and plural forms in Chinese (unlike *book, books*). Whether a noun is singular or plural is either left unspecified or made clear by some additional

word. Thus a plural may be indicated by placing 些 *xiē*, *some* before the noun or 都 *dōu*, *all* or *both* after the noun in a situation where their use is not demanded in English. An example is given in the final section on word order.

New nouns may be formed by means of the agent suffix 家 *jiā*, *-er* (literally, *family*):

数学家

shù xué jiā
mathematician

科学家

kē xué jiā
scientist

They may also be formed by means of the prefixes 子 *zǐ*, *sub-* (literally, *child*) and 半 *bàn*, *semi-* or *half-*:

子集

zǐ jí
subset

子区间

zǐ qū jiān
subinterval

子空间

zǐ kōng jiān
subspace

半圆

bàn yuán
semi-circle

半稳定

bàn wěn dìng
semi-stable

半轴

bàn zhóu
semi-axis

Generality of a noun is expressed, in particular, by the adjectives

任何

rèn hé
any

任意

rèn yì
arbitrary

某一

mǒu yī
some, certain

一切

yī qiè
all

各

gè
each

每一

měi yī
every

as in the following examples:

对任何 C

duì rèn hé
for any C

对于任意 x

duì yú rèn yì
for arbitrary x

某一 T 值

mǒu yī zhí
some values (of) T

一切系数

yī qiè xì shù
all coefficients

在各邻域

zài gè lín yù
in each neighbourhood

从每一直线

cóng měi yī zhí xiàn
from every [straight] line

Diversity may be expressed by the adjectives

其他	另外	别	不同	异	反
qí tā	lìng wài	bié	bù tóng	yì	fǎn
other	other	another	different	different	opposite
[it he]			[not same]		

as in the examples:

其他形式	另外方法	别的证明
qí tā xíng shì	lìng wài fāng fǎ	bié de zhèng míng
other forms	other methods	another proof
异号	反定向	不同的相图
yì hào	fǎn dìng xiàng	bù tóng de xiàng tú
opposite sign	opposite orientation	a different phase portrait

5. Measure words

A particular feature of Chinese is that a *measure word* is placed between a number and the noun it qualifies, and that many nouns have their own special measure words. Thus

条 tiáo 张 zhāng

are measure words for long thin objects and objects with flat two-dimensional surfaces respectively:

两条线	四张平面
liǎng tiáo xiàn	sì zhāng píng miàn
[two MW line]	[four MW plane]
two lines	four planes

A measure word with a wider range of applications (mostly non-mathematical) is 件 jiàn:

一件事

yī jiàn shì
a matter

However, by far the most commonly used measure word is 个 gè:

三个奇点

sān gè qí diǎn
three singular points

至少一个极限环

zhì shǎo yī gè jí xiàn huán
at least one limit cycle

二十三个问题

èr shí sān gè wèn tí
twenty-three problems

最多两个焦点

zuì duō liǎng gè jiāo diǎn
at most two foci

Ordinal numbers do not require a measure word; they are formed from the corresponding numerals by attaching the prefix 第 dì:

第一类

dì yī lèi
the first kind

第二情况

dì èr qíng kuàng
the second case

第四象限

dì sì xiàng xiàn
the fourth quadrant

On the other hand a measure word, determined by the corresponding noun, is used with the *demonstratives*

这 zhè, *this*

那 nà, *that*

哪 nǎ, *which?, what?*

as in the examples:

这件事

zhè jiàn shì
the matter

那个问题

nà gè wèn tí
that problem

哪条线?

nǎ tiáo xiàn
which line?

These demonstratives have a plural, formed by adding 些 xiē:

这些 zhè xiē, *these* 那些 nà xiē, *those* 哪些 nǎ xiē, *which?, what?*

However, xiē acts as a measure word itself, and an additional measure word is not now required:

这些事	那些问题	一些注意
zhè xiē shì	nà xiē wèn tí	yī xiē zhùyì
these matters	those problems	some remarks

It may be noted here that these demonstratives are converted into place words by adding 里 lǐ:

这里 zhè lǐ, *here* 那里 nà lǐ, *there* 哪里 nǎ lǐ, *where*

For example:

这里假设	在那里王说明
zhè lǐ jiǎ shè	zài nà lǐ wáng shuō míng
here (we) assume	[in] there Wang explains

More colloquial, but still acceptable, expressions are:

这儿 zhèr, *here, now* 那儿 nàr, *there, then* 哪儿 nǎr, *where*

(Since the two characters are pronounced as a monosyllable, ér is contracted to -r.)

A measure word is also used with certain quantifiers, such as

几 jǐ, *a few, how many?* 整 zhěng, *whole*

For example:

几个方法

jǐ gè fāng fǎ
several methods

在整张平面

zài zhěng zhāng píng miàn
in (the) whole plane

There are no words in Chinese corresponding to the English articles *a* and *the*. However, they are sometimes replaced respectively by the numeral 一 yī, *one* and the demonstratives 这 zhè, *this* or 那 nà, *that*, as in the examples *a matter* and *the matter* above.

6. Pronouns

The various personal pronouns are given in List 20. Unlike nouns, they do have a plural form, namely the suffix 们 men:

我

wǒ

I

我们

wǒ men

we

你

nǐ

you(s.)

你们

nǐ men

you (pl.)

Pronouns do not change according to case in Chinese (unlike *he*, *him*), but the particle 的 de is placed after a pronoun to make it possessive:

关于他的猜测

guān yú tā de cāi cè
concerning his conjecture

在她的文中

zài tā de wén zhōng
in her article

因为它的困难

yīn wéi tā de kùn nán
because of its difficulty

On the other hand, the pronoun 其 qí, which may refer to either persons or things, does not require 的 de to become possessive:

在其邻域

zài qí lín yù
in its neighbourhood

We note also the useful expression 其中 *qí zhōng*, *in which*:

其中数 D 负

qí zhōng shù fù

where (the) number D (is) negative

A pronoun is made reflexive by placing after it 自己 *zì jǐ*:

闭区间到它自己的连续变换

bì qū jiān dào tā zì jǐ de lián xù biàn huàn

[closed interval to itself of continuous transformation]

A continuous transformation of a closed interval into itself

Pronouns are mainly used for persons in Chinese. When they are used for things it is generally for a grammatical reason, such as after a preposition. Moreover, pronouns cannot be qualified by a measure word or any other phrase.

Where a pronoun would be used in English, to avoid repetition of a noun, it is often simply omitted in Chinese:

如果有, 必为 稳定环

rú guǒ yǒu, bì wèi wěn dìng huán

If (it) exists, (it) must be (a) stable cycle

However, a pronoun may be used to draw attention to the noun for which it stands. Thus in relative clauses the role of the English *who* or *which* is normally taken by the connecting particle 的 *de*, but it may be replaced by the appropriate personal pronoun for more emphasis:

极限环的内部包含最多一个奇点它一定是焦点

jí xiàn huán de nèi bù bāo hán zuì duō yī gè qí diǎn tā yī dìng shì jiāo diǎn

[limit cycle of interior contain at most one singular point it must be focus]

The interior of a limit cycle contains at most one singular point, which is necessarily a focus.

7. The three de's

A noun may be converted into an adjective by placing after it the particle 的 de or into an adverb by placing after it the particle 地 de:

严格	严格的	严格地
yán gé	yán gé de	yán gé de
rigour	rigorous	rigorously
困难	困难的	困难地
kùn nán	kùn nán de	kùn nán de
difficulty	difficult	with difficulty

The same distinction between adjectives and adverbs is observed even when the corresponding noun is not the primitive concept:

直接	直接的	直接地
zhí jiē	zhí jiē de	zhí jiē de
directness	direct	directly

To save space the adjectival and adverbial particles are omitted in our word lists, even though the translation given is an adjective or adverb. In Chinese itself the particle is often omitted if the adjective or adverb immediately precedes the word it qualifies:

开集	闭曲线	奇点
kāi jí	bì qū xiàn	qí diǎn
open set	closed curve	singular point
复数	实部	正号
fù shù	shí bù	zhèng hào
complex number	real part	positive sign

下界

xià jiè
lower bound

上限

shàng xiàn
upper limit

右边

yòu biān
right side

单根

dān gēn
simple root

初值

chū zhí
initial value

左侧

zuǒ cè
left side

高阶

gāo jiē
higher order

二次系统

èr cì xì tǒng
quadratic system

齐次坐标

qí cì zuò biāo
homogeneous coordinates

幂级数

mì jí shù
power series

周期解

zhōu qī jiě
periodic solution

独立变量

dú lì biàn liàng
independent variable

足够小

zú gòu xiǎo
sufficiently small

渐近稳定

jiàn jìn wěn dìng
asymptotically stable

充要条件

chōng yào tiáo jiàn
necessary and sufficient condition
[sufficient necessary condition]

The particle 的 *de* has other important roles. Its use in forming possessive pronouns has already been noted. Similarly it may be used to connect two nouns with the meaning *of*, although the order of the nouns is that used in English with 's rather than with *of*:

例 2 的方法

lì de fāng fǎ
[example 2 ~ method]
the method of Example 2

变数的更换

biàn shù de gēng huàn
[variable ~ change]
change of variables

点的邻机

diǎn de lín yù
[point ~ neighbourhood]
neighbourhood of a point

坐标的原点

zuò biāo de yuán diǎn
[coordinate ~ origin]
origin of coordinates

Nevertheless, 的 de is not required in many cases where *of* is used in English:

方程组

fāng chéng zǔ

[equation system]

system of equations

相交角

xiāng jiāo jiǎo

[intersection angle]

angle of intersection

More generally, a noun phrase or relative clause which modifies a noun must precede it and be linked to it by the particle 的 de:

与 L 相交的轨线

yǔ xiāng jiāo de guǐ xiàn

[with L intersect ~ trajectory]

the trajectories intersecting L

已经得到的公式 (1)

yǐ jīng dé dào de gōng shì

[already obtain ~ formula]

the formula (1) which we have already obtained

一些没有极限环的二次系统

yī xiē méi yǒu jí xiàn huán de èr cì xì tǒng

[some not have limit cycle ~ quadratic system]

some quadratic systems without limit cycles

Finally we note the alias forms 的 dì, *target* and 地 dì, *earth* as in:

目的 mù dì, *aim, purpose*

地方 dì fāng, *place*

The third particle 得 de is placed between a verb and its complement to indicate result, possibility or degree:

因为 C 可以取得任意大

yīn wèi kě yǐ qǔ de rèn yì dà

Because C can be taken arbitrarily large

However, the alias forms 得 dé, *obtain* and 得 děi, *must* are no less common:

由 (1) 可得到	选取 a,b 使得 $a < x < b$ 以及 $b - a < 1$
yóu kě dé dào	xuǎn qǔ shǐ dé yǐ jí
Because of (1) (we) can obtain	Choose a,b so that $a < x < b$ and $b - a < 1$

所以我们得采用其他方法

suǒ yǐ wǒ men děi cǎi yòng qí tā fāng fǎ

Therefore we must adopt other methods

8. Comparison and degree

Adjectives form the comparative with either 较 jiào or 更 gèng, and the superlative with 最 zuì:

小	较小	最小
xiǎo	jiào xiǎo	zuì xiǎo
small	smaller	smallest
多	较多	最多
duō	jiào duō	zuì duō
many, much	more	most
好	更好	最好
hǎo	gèng hǎo	zuì hǎo
good	better	best

Besides its use in forming comparatives, 较 jiào is often used in the less specific sense of *quite, rather*. Other adverbs which may be used to express *degree* are

仅	只	相当	颇	很	非常	甚	极
jǐn	zhǐ	xiāng dāng	pō	hěn	fēi cháng	shèn	jí
only	only	quite	rather	very, quite	very	very, extremely	extremely

For example:

仅一个	只有两个	相当困难	颇复杂
jǐn yī gè	zhǐ yǒu liǎng gè	xiāng dāng kùn nán	pō fù zá
only one	only two	quite difficult	rather complicated

很有用	非常容易地	甚高频	极小值
hěn yǒu yòng	fēi cháng róng yí de	shèn gāo pín	jí xiǎo zhí
very useful	very easily	very high frequency	minimum [value]

When two objects are being compared in manner or degree, the preposition 比 *bǐ* substitutes for the English *than*. It is placed between the two objects, and the second is followed by a description of the difference:

这一结果比 [2] 的 (更) 好
 zhè yī jié guǒ bǐ de (gèng) hǎo
 This result (is) better than (that) of [2].

However, 比 *bǐ* does not replace *than* in other situations:

多于三个的正根
 duō yú sān gè de zhèng gēn
 more than three positive roots

Furthermore, 比 *bǐ* is not used for negative comparisons. The construction in this case is illustrated by the counterpart of the previous example (the characters in brackets may be omitted):

这一结果没 (有) [2] 的 (那么) 好
 zhè yī jié guǒ méi (yǒu) de (nà me) hǎo
 This result is not as good as (that) of [2].

9. Negatives

The most common way of expressing negation is to put 不 *bù*, *not* before the word or phrase it qualifies:

不等

bù děng

un-equal

不全

bù quán

in-complete

不定积分

bù dìng jī fēn

in-definite integral

不但...而且...

bù dàn ér qiě

not only...but also...

然而证明是不正确的

rán ér zhèng míng shì bù zhèng què de

However, the proof is not correct.

Other adverbs which are used in place of 不 *bù* in certain situations are

无 *wú*未 *wèi*非 *fēi*

For example:

无界的

wú jiè de

[not bounded]

unbounded

无限的

wú xiàn de

[not limited]

infinite

未知量

wèi zhī liàng

[not know quantity]

unknown (n.)

非线性

fēi xiàn xìng

[not line property]

nonlinear

All verbs but one can be negated by 不 *bù*. The verb 有 *yǒu*, *have* or *exist* is exceptional in that it forms its negative only with 没 *méi*. Either 没 *méi* immediately precedes 有 *yǒu*, or 有 *yǒu* is omitted and 没 *méi* stands in its place:

因此方程 (3) 没(有)实根

yīn cǐ fāng chéng (3) méi (yǒu) shí gēn

Hence equation (3) does not have real roots.

Moreover 没 méi, with or without 有 yǒu, can be used with another verb to deny completion of an action (like the English *has not*):

但这一点没有解释清楚

dàn zhè yī diǎn méi yǒu jiě shì qīng chǔ

But this point has not been explained clearly

The negatives of verbs in situations involving *aspect* are discussed in Section 10.

10. Verbs

Verb forms in Chinese do not change according to whether the subject is singular or plural:

他有 tā yǒu, *he has*

他们有 tā men yǒu, *they have*

Verb forms also do not change according to tense. The same sentence may represent past, present or future action:

我是数学家

wǒ shì shù xué jiā

I am a mathematician

Poincaré 是数学家

shì shù xué jiā

Poincaré was a mathematician

If the meaning is not sufficiently clear from the context, a time word or phrase may be inserted:

以后我们选择合适常数

yǐ hòu wǒ men xuǎn zé hé shì cháng shù

Afterwards we (shall) choose a suitable constant

On the other hand, various *aspect markers* may be placed before or after the verb to relate the time of action to the matter under discussion. The following three particles are placed after the verb:

了 le,

to indicate *completed action*

着 zhe,

to indicate *action in progress*

过 guò,

to indicate *experienced action*

For example:

Poincaré 研究了这问题

yán jiū le zhè wèn tí

Poincaré studied this problem

我在学着中国话

wǒ zài xué zhe zhōng guó huà

I am learning Chinese [talk]

他去过北京

tā qù guò běi jīng

He has been (to) Beijing

Another way of indicating *action in progress* is to place 在 *zài* before the verb:

她(正)在研究这个问题

tā (zhèng) zài yán jiū zhè gè wèn tí

She is studying this problem

We may think of a sentence in Chinese containing 过 *guò* as answering a question in English containing the word *ever*. Often 了 *le* will correspond to the English *-ed*, and 着 *zhe* and 在 *zài* will correspond to the English *-ing*. But it is important to note that whether an action is completed or in progress depends on the internal world of the discourse, rather than the external world of the speaker:

定理的证明完了之后,我们举例说明

dìng lǐ de zhèng míng wán le zhī hòu, wǒ men jǔ lì shuō míng

[theorem of proof finished after, we example illustrate]

After we have finished the proof of the theorem, we will illustrate it with examples.

In negative statements the constructions are different and depend on the aspect:

an affirmative statement of the form

~了, ~ le

~着, ~ zhe

~过, ~ guò

在~, zài~

has a negative counterpart of the form

没(有)~, méi (yǒu)~

没有, méi yǒu

没(有)~过, méi (yǒu)~ guò

不在~ bù zài~,

where ~ represents the verb and (yǒu) denotes that the inclusion of yǒu is optional. For example:

他们也没有考虑这个情况

tā men yě méi yǒu kǎo lù zhè gè qíng kuàng

They too did not consider this case

他没去过北京

tā méi qù guò běi jīng

He has not been (to) Beijing

It should be noted that the particle 了 le may also be placed at the end of a sentence to signal a changed state of affairs or to indicate a past event (rather than completed action), and that 过 guò can also mean *over* or *pass*. Moreover 在 zài can also mean *exist*, especially in the combination 存在 cún zài, and *at* or *in*, especially in many phrases denoting position (see List 4).

Many nouns in Chinese serve equally as verbs:

表示

biǎo shì

representation

express

代换

dài huàn

substitution

substitute

变换

biàn huàn

transformation

vary

应用

yìng yòng

application

apply

注意

zhù yì

remark

take note of

Verbs can also be formed from nouns and adjectives by adding the suffix 化 huà, corresponding to the English -ize or -ify:

正 规 化	简 化
zhèng guī huà	jiǎn huà
normalize	simplify

Finally we mention that sometimes when a verb is followed both by a direct object and by an adverbial phrase the verb is repeated after the direct object.

11. Some important verbs

The verb 是 shì, *be* has a more restricted use in Chinese than in English. It is not used as an auxiliary verb (as in *I am studying* or *it was shown*), and is generally omitted when the predicate is an adjective or adjectival phrase:

但证明很困难	然而论证 无效
dàn zhèng míng hěn kùn nán	rán ér lùn zhèng wú xiào
but the proof (is) very difficult	However, the demonstration (is) invalid

其中 A 的系数不等于零
 qí zhōng de xì shù bù dèng yú líng
 [in which of coefficient not equal to zero]
 where the coefficient of A is not equal to zero

即直线与积分曲线相切
 jí zhí xiàn yù jī fēn qū xiàn xiāng qiē
 i.e. the straight line and the integral curve (are) tangent to one another

On the other hand, it is used when the predicate is a noun:

原 点 是 中 心 点	如 果 $f(x)$ 是 x 的 递 减 函 数
yuán diǎn shì zhōng xīn diǎn	rú guǒ shì de dì jiǎn hán shù
the origin is a centre	[if be of decreasing function]
	if $f(x)$ is a decreasing function of x

It is also used for affirmation or emphasis when the predicate is not a noun:

这也是不可能的

zhè yě shì bù kě néng de

This also is impossible

论证 是容易的

lùn zhèng shì róng yì de

The demonstration is an easy one

The emphatic use of 是 shì is similar to the English *do* (as in *he did go*):

轨道 L 是位于 G

guǐ dào shì wèi yú

the trajectory L does lie in G

Unlike other verbs, 是 shì is used without aspect particles and is negated only by 不 bù.

The basic meaning of 是 shì is *(it) is true that*, rather than *(it) exists*. In fact it can also be used as an adjective, *correct* or *right*.

Existence is more commonly rendered by the verb 有 yǒu. In particular, it can begin a sentence, corresponding to the English *there is* (or *are*):

有闭轨线

yǒu bì guǐ xiàn

There is a closed trajectory or a separatrix cycle surrounding the origin

或分界线环在原点周围

huò fēn jiē xiàn huán zài yuán diǎn zhōu wéi

The other basic meaning of 有 yǒu, *have* or *possess*, is illustrated by the examples:

此方程有两个奇点

cǐ fāng chéng yǒu liǎng gè qí diǎn

this equation has two singular points

它具有下列性质

tā jù yǒu xià liè xìng zhì

it possesses the following properties

It has already been mentioned that the negative of 有 yǒu is formed with 没 méi.

The flexibility of Chinese is illustrated by 要 yào. It can be either a verb, *want* or *need*, or an adjective, *important*:

重 要 的 书

zhòng yào de shū
an important book

我 们 要 证 明 这 不 可 能 的

wǒ men yào zhèngmíng zhè bù kě néng de
We want to show (that) this (is) impossible

It can also be used as a conjunction, *if*, and it can serve to indicate the near future, like the English *going to*:

其 次 我 们 要 讨 论 它 的 稳 定 性

qí cì wǒ men yào tǎo lùn tā de wěn dìng xìng
Next we are going to discuss its stability.

In fact the previous example admits the alternative interpretation *We are going to show...*

The verbs of motion

来	去	到	走	进	出
lái	qù	dào	zǒu	jìn	chū
come	go	arrive	leave	enter	exit

also have several other meanings. In particular, 到 dào, *to* can serve as a preposition. Other verbs which can serve as prepositions are

在	给	对	跟
zài	gěi	duì	gēn
exist	give	answer	follow
at, in	to, for	to	with

12. Auxiliary verbs

Main verbs are preceded by such auxiliary verbs as

能	会	应当	得
néng	huì	yīng dāng	děi
can	be able to	should	must

能够	可以	应该	必须
néng gòu	kě yǐ	yīng gāi	bì xū
be capable of	may	ought to	have to

For example:

如此方程 (3) 不能有
rú cǐ fāng chéng bù néng yǒu
Thus equation (3) cannot have

半稳定环会消失
bàn wěn dìng huán huì xiāo shī
a semi-stable cycle may disappear

而且极限环必为唯一
ér qiě jí xiàn huán bì wéi wéi yī
Moreover (the) limit cycle must be unique

首先应该注意
shǒu xiān yīng gāi zhù yì
First (it) should (be) observed

We note that 可 kě is used both as a verb, *can* and as a prefix (like the English suffix *-able*):

仿前可证	连续可微函数
fǎng qián kě zhèng	lián xù kě wēi hán shù
As before (we) can prove	continuously differentiable function

13. Conditional statements

Conditional sentences typically begin with such words as

设	假	如果	若	当	虽然	除非
shè	jiǎ	rú guǒ	ruò	dāng	suī rán	chú fēi
suppose	assume	if	if	when, if	although	unless

For example:

其次设成立下列条件

qí cì shè chéng lì xià liè yáo jiàn

[next suppose hold following condition]

Suppose next that the following conditions hold

现在假设 $n \neq 0$

xiàn zài jiǎ shè

Now assume $n \neq 0$

若再改 $A < B$ 为 $A > B$, 但仍设 $m < 0$, 则

ruò zài gǎi wéi dàn réng shè zé

If again (we) change $A < B$ to $A > B$, but still assume $m < 0$, then

如果存在, 就一定唯一

rú guǒ cún zài, jiù yī dìng wéi yī

If (it) exists, [then] (it is) necessarily unique

当且仅当

dāng qiě jǐn dāng

if and only if

虽然这个证明很简要, 还清楚

suī rán zhè gè zhèng míng hěn jiǎn yào, hái qīng chǔ

Although this proof (is) very concise, [still] (it is) clear

除非该直线本身是轨线

chú fēi gāi zhí xiàn běn shēn shì guǐ xiàn

[unless should straight line itself be trajectory]

unless the straight line is itself a trajectory

14. Questions

For confirmatory questions, i.e. questions requiring only a *yes* or *no* answer, the particle 吗 *ma* may be placed at the end of a sentence to make it interrogative:

这必要条件也是充分的吗?

zhè bì yào tiáo jiàn shì yě chōng fēn de ma

[this necessary condition be also sufficient ~]

Is this necessary condition also sufficient?

Confirmatory questions may also be asked by placing the negative form of a verb immediately next to its affirmative form:

意义是不是明显的?

yì yì shì bù shì míng xiǎn de

[meaning be not be clear]

Is the meaning clear?

This construction is similar to the English *The meaning is clear, isn't it?*

For *disjunctive* questions, i.e. questions asking *either...or...?*, the two options are connected by 还是 *hái shì*, *or*. The answer is given by simply repeating one of the options.

In *information* questions, when pronouns and adverbs such as

谁 *shuí*, *who?* 什么 *shén me*, *what?* 哪儿 *nǎr*, *where?* 几 *jǐ*, *how many?*

are used interrogatively, they are put in the place of the word giving the answer:

例子是什么?

lì zǐ shì shén me

[example be what]

What is an example?

方程有几解法?

fāng chéng yǒu jǐ jiě fǎ

[equation has how many solutions]

How many solutions does the equation have?

The non-interrogative meanings are slightly different:

谁 *shuí*, *whoever* 什么 *shén me*, *or whatever* 哪儿 *nǎr*, *wherever* 几 *jǐ*, *a few*

The replacements for the English *who* and *what* in relative clauses have already been considered in Sections 6 and 7. For reference we include here also

怎么

zěn me

how?

为什么

wèi shén me

why?

什么时候

shén me shí hòu

when?

15. Passives

Chinese often uses an active mode of expression, where the passive voice is preferred in English (cf. this sentence). A common replacement for the passive is the *topic-comment* construction, in which the object is placed at the beginning of the sentence, in the position normally reserved for the subject:

这些问题解答了

zhè xiē wèn tí jiě dá le

[as for these problems (topic), they have been solved (comment)]

These problems have been solved

However, a genuine passive construction is the use of 被 bèi, placed after the recipient of the action and before the agent (if the latter is not omitted):

这结果被陈中 位推广

zhè jié guǒ bèi chén zhōng wèi tuī guǎng

[this result ~ Chen Zhong-wei generalize]

This result was generalized by Chen Zhong-wei

At one time 被 bèi was used only in situations of *adversity*, but this restriction is disappearing.

Sometimes one of the following is used in place of 被 bèi:

给 gěi, give

叫 jiào, call

让 ràng, let

Another passive construction is 为 wéi, followed by 所 suǒ:

类似的结果也为 [4] 所得到

lèi sì de jié guǒ yě wéi suǒ dé dào

[similar result also ~ [4] ~ obtain]

A similar result was also obtained in [4].

16. Word order

A sentence in Chinese often begins with a word or phrase which provides a framework for it. We have already encountered examples involving some of the time adverbs

首先	现在	今	其次	然后	后来	最后	最近
shǒu xiān	xiàn zài	jīn	qí cì	rán hòu	hòu lái	zuì hòu	zuì jìn
first	now	now	next	then	later	finally	recently

and some of the linking words

而且	然而	但	如此	因此	因为	为了	又
ér qiě	rán ér	dàn	rú cǐ	yīn cǐ	yīn wèi	wèi le	yòu
moreover	however	but	thus	hence	because	in order to	again

此外	不过	可是	由此	于是	由于	所以	则
cǐ wài	bù guò	kě shì	yóu cǐ	yú shì	yóu yú	suǒ yǐ	zé
in addition	nevertheless	but	thus	consequently	since	therefore	then

Some other common initial phrases are

当然	其实	即	例如	特别	同样	下面
dāng rán	qí shí	jí	lì rú	tè bié	tóng yàng	xià miàn
of course	in fact	that is	for example	in particular	similarly	in the following

显见	实际上	再	也许	根据	另一方面
xiǎn jiàn	shí jì shàng	zài	yě xǔ	gēn jù	lìng yī fāng miàn
obviously	actually	again	perhaps	according to	on the other hand

Conditional sentences may begin with one of the words discussed in Section 13.

The other main way in which a sentence may begin is with its *topic* - what the sentence is about. The topic is often the subject of the sentence, but not invariably. (Indeed the subject is sometimes omitted). However, we may regard subject-verb-object as the standard word order, especially in complex sentences. Sometimes, in order to make a stronger statement, the object is placed before the verb and this may be signalled by placing immediately before the object the preposition 把 *bǎ*. An example of this construction appeared in Section 10.

As a general rule, the 'modifier' precedes the 'modified'. Thus both adjectives and demonstratives precede the noun they qualify. Also, as we have seen in Section 7, noun phrases and relative clauses, that in English would be formed with *who* or *which*, always come before the main noun and are typically linked to it by the particle 的 *de*. Again, negative words such as 不 *bù* precede the word or phrase they negate; a word or phrase placed before the negative is not negated. Similarly an adverb precedes the verb or adjective it qualifies, and the main verb is preceded by an auxiliary verb. An exception to the general rule of this paragraph is that 也 *yě*, *too* and 都 *dōu*, *all* refer to a preceding noun phrase:

与 C 相交的轨线 都从它的外部穿过向它的内部
 yǔ xiāng jiāo de guǐ xiàn dōu cóng tā de wài bù chuān guò xiàng tā de nèi bù
 [with C intersect trajectory all from its exterior cross to its interior]
 (all) the trajectories intersecting C cross from its exterior to its interior

Adverbs which describe the manner in which the subject carries out an activity are placed after the subject and before the verb:

李 [7] 独立地得到了同一的结果
 lǐ dú lì de dé dào le tóng yī de jié guǒ
 Li [7] obtained the same result independently.

Another feature of Chinese is that two or more clauses may be juxtaposed without anything to indicate the relation between them. In such a case the clauses are regarded as parts of one inclusive entity. For example:

合并 (1) 至 (3) 各式, 即得不等式

hé bìng zhì gè shì jí de bù děng shì

Combining the (various) formulas (1)-(3), we at once obtain the inequality.

利用 此式计算 D , 立即看出 M 是鞍点

lì yòng cǐ shì jì suàn lì jí kàn chū shì ān diǎn

[use this formula compute immediately see be saddle point]

Using this formula to compute D , we see immediately that M is a saddle.

Our concluding example is intended to show that we have learnt much, but not all:

最后注意当 a 为正 时, 奇点 成 为不稳定的

zuì hòu zhù yì dāng a wéi zhèng shí qí diǎn chéng wéi bù wěn dìng de

Finally we note that, when a is positive, the singular point becomes unstable

因之而出现 一个极限环.

yīn zhī ér chū xiàn yī gè jí xiàn huán

and (so) a limit cycle appears.

定理证 毕.

dìng lǐ zhèng bì

The theorem is completely proved.