

COMPREHENDING TECHNICAL JAPANESE

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# 科学技術 日本語入門

THE UNIVERSITY OF WISCONSIN PRESS  
UNIVERSITY OF TOKYO PRESS

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THE UNIVERSITY OF WISCONSIN PRESS  
UNIVERSITY OF TOKYO PRESS

Published 1975  
in Japan, Asia, Oceania, and Australia  
by University of Tokyo Press  
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First printing  
Printed in Japan  
ISBN 0-86008-136-2  
UTP 3081-87153-5149

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## PREFACE

Japan is one of the leading technological nations in the world. Although its scientific and engineering achievements have been most impressive, few scientists and engineers have developed the ability to read the literature of their Japanese counterparts. There are several reasons for this: (a) the extensive efforts of the Japanese to learn Western languages and their willingness to share their research results in those tongues; (b) the complexity of the Japanese language for foreigners; and (c) the absence of appropriate instructional materials for scientists and engineers. These points are discussed here briefly.

Although much of Japan's scholarly research has been published in English and other languages, there remains a vast literature of patents, handbooks, engineering journals, government reports, and transactions of technical meetings which is not normally translated. Furthermore there is substantial interest in graduate and postdoctoral study in Japan, joint US-Japan research projects, and multinational industrial ventures. All these activities serve to emphasize the need for providing more people with the opportunity to learn that part of the Japanese language which is vital to them, namely the technical part.

The Japanese used in modern technical writing is not nearly as difficult as that encountered in the literary or the spoken language. Written technical Japanese is considerably more direct in grammar and style than the literary language with its delightful nuances and tantalizing ambiguities. Large segments of Japanese grammar, such as humble and honorific verbs, irregular "counters", words for family relationships, the verbs for giving and receiving, the formulas for polite requests, and the whole hierarchy of greetings and apologies are entirely absent. Moreover, surprisingly, causatives, desideratives, alternatives, the *-masu* conjugation, and other verb forms do not occur frequently. The basic grammar needed to read scientific texts is remarkably limited and can be easily mastered. The big hurdle—and this cannot be minimized—is the development of a recognitional knowledge of the Chinese characters, the *kanji*.

Until the publication of this book there has been no reader designed specifically to meet the needs of the scientist or engineer. Concerned with the efficient use of his time, the technical man may wonder which of the approximately 2000 *kanji* he should learn first in order to gain access to Japanese technical literature. In the preparation of this book, therefore, we have stressed the mastery of the five-hundred most important *kanji*, and the scientific vocabulary which can be constructed from them.

The organization of lessons is such that the reader will learn these characters as a result of relentless repetition. To insure that we are introducing the most important *kanji*, we have made use of frequency counts which have been made

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on physics,<sup>1</sup> chemistry,<sup>2</sup> and biology texts.<sup>2</sup> We believe that the mastery of the five-hundred *kanji* emphasized in this book will provide a very sound basis for technical reading.

Assuming that the student has had a one-year course in beginning Japanese (basic grammar, the two *kana* systems, and the use of a *kanji* dictionary), we have structured the lessons in the following way:

1. At the beginning of each lesson a tabulation of the 20 new REQUIRED *KANJI* with *ON* and *kun* reading which are of importance for scientists and engineers is presented. These required *kanji* should be learned thoroughly; the reader is expected to recognize them in all subsequent lessons.

Next to each *kanji* two numbers are given. The upper one refers to the *kanji* designation in F. Sakade, *A Guide to Reading and Writing Japanese*, Tuttle, Rutland, Vt. (1959). The lower one refers to the number of the character in A. N. Nelson, *The Modern Reader's Japanese-English Character Dictionary*, Tuttle, Rutland, Vt. (1962). The Sakade book gives the stroke order and the most important readings; the Nelson reference gives a complete listing of the readings as well as a number of compounds.

2. Next the READING SELECTION, using the twenty new *kanji*, is given. Many of these texts are taken from high school books, which are less difficult and less formal in style than research journals or reference works. The subject material is rather elementary and hopefully the topics selected will also be of general interest. A vocabulary list, *romaji* version of the text, a complete translation, and explanatory notes accompany the reading selection. For this part of the lesson no effort is spared to help the reader.

Note that the vocabulary introduced in the reading selection will not be repeated in later parts of the lesson or in subsequent lessons. *Furigana* will always be appended to *kanji* not previously included as required *kanji* so that the reader need not master these *kanji* and may concentrate on the required twenty in each lesson.

3. In each reading selection several constructions appear which recur frequently in technical reading. We single these out and give several examples further illustrating their use. These CONSTRUCTION EXAMPLES should be studied with great care, and any new vocabulary words introduced here should be learned thoroughly, for they will not be repeated subsequently.

4. Next several SUPPLEMENTARY READINGS are included. For these additional vocabulary is given but no other assistance. The new words introduced here need not be memorized. Many of these readings are taken from college

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1. R.B. Bird, *Scientific Japanese*, Univ. of Wis., Engr. Expt. Sta. Report # 33, Part I (Jan. 1967), and part II (Aug. 1967).

2. N. Inoue, unpublished compilation.

level textbooks, reference works, and technical journals. Their purpose is to provide additional experience in *kanji* recognition and comprehension.

5. The final essay is a TRANSLATION TEST. Here *furigana* are added to non-required *kanji*, but otherwise no help is given. The reader is on his own here—he may have to use a dictionary or grammar book to perform the translation. In this translation test each of the twenty required *kanji* for the lesson will appear at least once.

Thus each lesson progresses from elementary texts with considerable assistance, to more difficult readings with some vocabulary aids, and then on to a fairly realistic translation task with no help at all. The final essay should serve as a guide to the student in judging his mastery of the lesson and in deciding whether to move on to the next.

Although written primarily to assist the engineer and scientist in learning to read technical literature, the book may be useful to some technical people who are interested only in acquiring vocabulary for conversation purposes. Such people can take a "short course" by using just the romanized readings and the vocabulary lists. In addition several other groups of people might find this book helpful: technical librarians, who wish to translate titles and tables of contents; language majors, who want to train themselves to do technical translation; and students from non-English-speaking countries who plan to study technical subjects at Japanese universities.

Our primary purpose, however, is to provide the means for courageous scientists or engineers to learn to read technical Japanese by hard work. We trust this book will guide them through those first critical stages of learning to comprehend written technical texts and hope that the riches of Japanese scientific thought will be their reward.

井の上に 舞いおりし鳥 雪の鳩

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#### ACKNOWLEDGMENTS

The authors wish to acknowledge financial support and encouragement provided by the Office of International Studies and Programs, the Engineering Experiment Station, and the Graduate School of the University of Wisconsin. In addition some financial aid was made possible to one of us (RBB) through the William F. Vilas Trust Estate. We are greatly indebted to Mr. and Mrs. Eiichi Hamanishi for preparation of the manuscript, to her for the calligraphy and typing, and to him for advice and proofreading.



# EXPLANATORY NOTES

## 1. ROMANIZATION

The following system is used

a	(ア)	i	(イ)	u	(ウ)	e	(エ)	o	(オ)
ka	(カ)	ki	(キ)	ku	(ク)	ke	(ケ)	ko	(コ)
sa	(サ)	shi	(シ)	su	(ス)	se	(セ)	so	(ソ)
ta	(タ)	chi	(チ)	tsu	(ツ)	te	(テ)	to	(ト)
na	(ナ)	ni	(ニ)	nu	(ヌ)	ne	(ネ)	no	(ノ)
ha	(ハ)	hi	(ヒ)	fu	(フ)	he	(ヘ)	ho	(ホ)
ma	(マ)	mi	(ミ)	mu	(ム)	me	(メ)	mo	(モ)
ya	(ヤ)			yu	(ユ)			yo	(ヨ)
ra	(ラ)	ri	(リ)	ru	(ル)	re	(レ)	ro	(ロ)
wa	(ワ)							o	(ヲ)
ga	(ガ)	gi	(ギ)	gu	(グ)	ge	(ゲ)	go	(ゴ)
za	(ザ)	ji	(ジ)	zu	(ズ)	ze	(ゼ)	zo	(ゾ)
da	(ダ)	ji	(ヂ)	zu	(ヅ)	de	(デ)	do	(ド)
ba	(バ)	bi	(ビ)	bu	(ブ)	ba	(ベ)	bo	(ボ)
pa	(パ)	pi	(ピ)	pu	(プ)	pe	(ペ)	po	(ポ)
kya	(キヤ)			kyo	(キユ)			kyo	(キヨ)
sha	(シヤ)			shu	(シュ)			sho	(シヨ)
cha	(チヤ)			chu	(チュ)			cho	(チヨ)
nya	(ニヤ)			nyu	(ニユ)			nyo	(ニヨ)
hya	(ヒヤ)			hyu	(ヒユ)			hyo	(ヒヨ)
mya	(ミヤ)			myu	(ミユ)			myo	(ミヨ)
rya	(リヤ)			ryu	(リュ)			ryo	(リヨ)
gya	(ギヤ)			gyu	(ギユ)			gyo	(ギヨ)
ja	(ジャ)			ju	(ジュ)			jo	(ジヨ)
bya	(ビヤ)			byu	(ビユ)			byo	(ビヨ)
pya	(ピヤ)			pyu	(ピユ)			pyo	(ピヨ)
-n	(ン)								

Long vowels are written with a macron (ā, ō, ū) except for *ii*. The terminal ん is always transcribed as *-n* although it is pronounced as *-m* before *b*, *m*, and *p*; if it is followed by a vowel sound, then an apostrophe is used, as in *sen'i* (せんい). Doubled consonants are written as *tt*, *pp*, *kk* etc., except for the doubled *sh* and *ch* sounds, which are written *ssh* and *tch*. The particles は, へ, and を are written as *wa*, *e*, and *o*, (and never as *ha*, *he*, and *wo*) to correspond to their pronunciation. The Romanization used here is that found in the leading Japanese-English dictionaries.

We make liberal use of hyphens in transcribing words which are compounds of three or more characters in order to facilitate reading. For example:

shūki-teki	周期的	periodic
en-undō	円運動	circular motion
enshin-ryoku	遠心力	centrifugal force

We also use a hyphen to separate the two parts of a double verb:

kuri-kaesu	くり返す	to repeat
tori-atsukau	取りあつかう	to deal with

Note that verbs are given in their plain present form, but the English "equivalent" is always given as the infinitive.

## 2. OKURIGANA

We have followed the *Monbushō* (Japan Ministry of Education) rules for *tōyō kanji* and *okurigana* throughout. In the *kanji* lists at the beginning of each lesson the official *okurigana* are given in parentheses.

## 3. SOURCES FOR READINGS

The majority of the Reading Selections and Supplementary Readings were taken from Japanese technical books and have been adapted for instructional purposes in one or more of the following ways: 1) the *okurigana* have been changed to conform with modern standard usage; 2) older forms of *kanji* have been replaced with modern standard ones; 3) *furigana* have been appended to those *kanji* which do not appear in the *kanji* lists at the beginning of the lessons; 4) particularly difficult passages have been rewritten and passages not germane to the immediate topic have been eliminated.

The selections were taken from the following books:

- B *Kōtō-gakkō Butsuri B*, Seishi Kaya (ed.) Kōgakusha, Tōkyō, 1963.
- BK *Butsuri-kagaku*, Haruhiko Noda, Asakura Shoten, Tōkyō, 1971.
- BKJ *Butsuri-kagaku Jikken-hō*, Akira Kotera (ed.), Asakura Shoten, Tōkyō, 1955.
- BN *Butsuri-gaku Nyūmon*, Nobuo Hori (ed.), Maki Shoten, Tōkyō, 1959.
- FK *Fu-kanzen Kitai*, Tarō Kibara, Asakura Shoten, Tōkyō, 1950.

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- I *Idō-sokudo-ron*, Daizō Kunii et al., Iwanami Shoten, Tōkyō, 1968.
- IG *Iden-gaku*, Yoshito Shinotō and Kaichirō Yanagisawa, Iwanami Shoten, Tōkyō, 1971.
- 1K *Kagaku B*, 1st edition, Yūji Shibata, Sakae Tsuda, Osamu Shimamura, Dai-Nihon Tosho, Tōkyō, 1961.
- K *Kagaku B*, new revised edition, Yūji Shibata, Sakae Tsuda, and Osamu Shimamura Dai-Nihon Tosho, Tōkyō, 1966.
- KB *Kō-bunshi no Butsuri*, 3rd edition, The Japan Physical Society (Ed.) Asakura Shoten, Tōkyō, 1966.
- KJE *Kōjien*, Izuru Shimamura (ed.), Iwanami Shoten, Tōkyō, 1955.
- KK *Kagaku Kikai no Riron Keisan*, Saburō Kamei (ed.), Sangyō Tosho, Tōkyō, 1959.
- KKT *Kagaku Kōgaku Tsūron*, 3rd edition, Kōichi Iinoya, Asakura Shoten, Tōkyō, 1959.
- KS *Kagaku Sen'i*, revised edition, Minoru Iinoto, Iwanami Shoten, Tōkyō, 1972.
- N *Netsu-rikigaku*, Masahiro Yorizane, Kagaku Gijutsu-sha, Tōkyō, 1957.
- 2RJ *Rika-gaku Jiten*, revised 2nd edition, Iwanami Shoten, Tōkyō, 1958.
- 3RJ *Rika-gaku Jiten*, 3rd edition, Iwanami Shoten, Tōkyō, 1971.
- S *Seibutsu*, Tomo-o Miwa and Midemichi Oka, Sanseidō, Tōkyō, 1972.
- SJ *Seibutsu-gaku Jiten*, Iwanami Shoten, Tōkyō, 1960.
- SK *Sei-kagaku*, Fujio Egami, Iwanami Shoten, Tōkyō, 1971.
- SN *Soryūshi no Nazo*, Hideki Yukawa, Asahi Press, Tōkyō, 1972.
- SS *Seimei o Saguru*, Fujio Egami, Iwanami Shoten, Tōkyō, 1967.

The symbols at the left are used in referring to these sources.

## 4. KANJI LISTS

A list of twenty required *kanji* appears at the beginning of each lesson. The following are explanations and examples of the notation:

- 1) Identifying numbers, ON and kun readings.

<div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin-right: 10px;"> <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">間</div> <div style="text-align: center;">58</div> </div> <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;">4949</div> <div style="text-align: center;">aida</div> </div> </div> <div style="margin-left: 10px;"> <p>Number of <i>kanji</i> in Sakade's book</p> <p>ON reading in capital letters [the additional official ON reading, <i>KEN</i>, is omitted, since it occurs so rarely in scientific texts]</p> <p>Number of <i>kanji</i> in Nelson's book</p> <p>kun reading in lower case letters [the additional official reading <i>ma</i> is omitted, since it occurs infrequently in scientific texts]</p> </div> </div>
--

## 2) Verbs and okurigana.

定	471	TEI	The syllables in parentheses are called <i>okurigana</i> and are written in <i>hiragana</i> .
	1296	{sada (meru) sada (maru)}	

The infrequent reading *JŌ* is omitted

The brace indicates a pair of related verbs, the upper always being the *transitive* verb, the lower always being the *intransitive* verb. If there are two verbs not joined by a brace, they are not a transitive-intransitive pair.

## 3) Unofficial readings.

例	737	REI	Reading enclosed in brackets is not currently an official reading. Since this reading is, however, often encountered in technical Japanese, it is included.
	428	[tato(eba)]	

4) Omission of *dakuon* readings.

比	697	HI	The pronunciation <i>PI</i> as in (反比例 <i>hanpirei</i> ) is not included, since this is a standard phonetic change replacing <i>ひ</i> by <i>ぴ</i> . Similar phonetic changes, called <i>dakuon</i> , such as <i>ka</i> (か) to <i>ga</i> (が), <i>su</i> (す) to <i>zu</i> (ず), are also not explicitly included.
	2470	kura(beru)	

## 5) Omission of verbs derived from ON readings.

熱	490	NETSU	No separate entry is given for the verb <i>nes(suru)</i> . Similarly in the entry for 庇, no separate entry for <i>ō(zuru)</i> or <i>ō(jiru)</i> will be found.
	2797	atsu(i)	

## 5. VOCABULARY ENTRIES

In the vocabulary lists which accompany the various readings, generally only the translation of the word which is appropriate in the text at hand has been listed. For example in Supplementary Reading C in Lesson 1, for the entry

大きさ              ōkisa              magnitude

we have not listed the meanings "largeness, bulk" since they are not appropriate there. Similarly, for the entry

与える              ataeru              to give

we do not include the meanings "present, award, bestow, provide."



# LESSON 1

## 第一課

## KANJI

等	484	TŌ
	3396	hito(shii) [nado, -ra]
速	453	SOKU
	4700	haya(i)
度	288	DO
	1511	
運	157	UN
	4725	hako(bu)
動	296	DŌ
	730	[ugo(kasu) ugo(ku)]
向	213	KŌ
	101	mu(ku) mu(kau)
表	309	HYŌ
	108	omote ara(wasu)
物	313	BUTSU MOTSU
	2857	mono
体	270	TAI
	405	(karada)
一	1	ICHI ITSU
	1	hito(tsu)

定	474	TEI
	1296	[sada(meru) sada(maru)]
同	295	DŌ
	619	ona(ji)
距	253a	KYO
	4548	
離	276a	RI
	5040	[hana(su) hana(reru)]
時	87	JI
	2126	toki
間	58	KAN
	4949	aida
比	697	HI
	2470	kura(beru)
例	737	REI
	428	[tato(eba)]
直	472	CHOKU
	775	[nao(su) nao(ru)]
線	447	SEN
	3580	

## READING SELECTION

速度

sokudo

velocity

等速度

tōsokudo

constant velocity

運動

undō

motion

速さ

hayasa

speed

向き

muki

direction

表わす

arawasu

to show, express, represent

物体

buttai

body

一定の

ittei no

constant

動く

ugoku

to move

(pres. tense) + とときには

(pres. tense) + toki ni wa when..., whenever...

いつも	itsumo	always
同じ	onaji	same
距離	kyori	distance
要した	yō shita	required
時間	jikan	time
…に比例する	...ni hirei suru	to be proportional to...
…を $v$ とすれば	...o $v$ to sureba	if we let $v$ be...
あるいは	aruiwa	or
直線	chokusen	straight line

## 等速度運動 (B 14)

速度というのは<sup>(1)</sup>速さ<sup>(2)</sup>と向き<sup>(3)</sup>で表わされるものである。物体が一定の速度で動くとき<sup>(4)</sup>には、運動の向きと速さとはいつも同じであるから、動いた距離 $s$ は、それに<sup>(5)</sup>要した時間 $t$ に比例する。このとき<sup>(4)</sup>の速さ<sup>(6)</sup>を $v$ とすれば

$$s = vt^{(7)} \text{ あるいは }^{(8)} v = \frac{s}{t}^{(9)}$$

で表わされる。このように<sup>(10)</sup>、速度が一定の<sup>(11)</sup>運動を等速度運動、または等速直線運動という<sup>(12)</sup>。

## TÔSOKUDO UNDŌ

Sokudo to iu no wa<sup>(1)</sup> hayasa<sup>(2)</sup> to muki<sup>(3)</sup> de arawasareru mono de aru. Buttai ga ittei no sokudo de ugoku toki<sup>(4)</sup> ni wa, undō no muki to hayasa to wa itsumo onaji de aru kara, ugoita kyori  $s$  wa sore ni<sup>(5)</sup> yō shita jikan  $t$  ni hirei suru. Kono toki<sup>(4)</sup> no hayasa<sup>(6)</sup> o  $v$  to sureba

$$s = vt^{(7)} \text{ aruiwa }^{(8)} v = s/t^{(9)}$$

de arawasareru. Kono yō ni,<sup>(10)</sup> sokudo ga ittei no<sup>(11)</sup> undō o tōsokudo-undō, mata wa tōsoku-chokusen-undō to iu.<sup>(12)</sup>

## UNIFORM MOTION

Velocity is a quantity which is described by (giving) the speed and direction. When a body moves with constant velocity, the speed and the direction of the motion are always the same, and so the distance  $s$  which it has travelled is proportional to the time required  $t$ . If we let  $v$  be the speed for this case, then

$$s = vt \text{ or } v = s/t.$$

Motion at constant velocity is called uniform (velocity) motion or uniform linear motion.

## Explanatory Notes

- (1) sokudo to iu no wa Literally "the thing called velocity"; translate simply

- by "velocity"; although *い* is conventionally romanized as *iu*, it is pronounced *yū*.
- (2) *sokudo* vs. *hayasa* *Sokudo* and *hayasa* correspond to the English "velocity" and "speed", the first being the vector quantity and the second being the scalar. In both languages this distinction is not always clearly made. The word *hōkō* (方向) could also be used.
- (3) *muki* (向き) "Toki" here is written in *kana* (とき) but may also be written in *kanji* (時). The present tendency in Japan is to use *kana* rather than *kanji* for prepositions, conjunctions, and adverbial phrases, but the reader should expect to encounter both usages (occasionally in the same paragraph!).
- (4) *toki ni wa* Other examples are:
- |        |         |                   |
|--------|---------|-------------------|
| 次に     | つぎに     | next              |
| 従って    | したがって   | therefore         |
| 例えば    | たとえば    | for example       |
| ...の場合 | ...のばあい | in the case of... |
| ...等   | ...など   | ...etc.           |
- (5) *Sore ni* Literally "for that" (i.e., for the body to move the distance *s*); in a free translation this can be omitted in English.
- (6) *kono toki no hayasa* This *toki* refers to the *toki niwa* of the previous sentence.
- (7)  $s=vt$  Read in Japanese "*s ikōru ut*" with the roman letters being pronounced as in English. (See Appendix E, Readings of Mathematical Expressions).
- (8) *aruiwa* Note that the "wa" is written *は* and not *わ*.
- (9)  $v=s/t$  Read in Japanese: "*v ikōru s ōbā t*".
- (10) *kono yō ni* Literally "in this way" (i.e., in the manner above described); in free translation this could be omitted.
- (11) *sokudo...no* This is a modifying clause telling "what kind of *undō*." It indicates that it is an *undō* for which *sokudo ga ittei de aru*. Here *no* is the copula, taking the place of *de aru*.
- (12) *A o B to iu* "We designate A by B." More often the phrase will be rendered in English by the passive voice "A is called B."



## CONSTRUCTION EXAMPLES

A というのは…である	"A is..."
-------------	-----------

1. 等速直線運動というのは速度が一定の運動のことである。
2. 時間表というのはタイム・テーブルのことである。
3. 動物というのはじぶんの<sup>からだ</sup>体を動かすことができるいき物のことである。

時間表	jikan-hyō	time-table
動物	dōbutsu	animal
じぶんの体	jibun no karada	its own body
動かす	ugokasu	to move (an object)
いき物	ikimono	living thing

…ときには	"whenever; when"
-------	------------------

1. 物体が直線運動をするときには、運動の向きはいつも同じである。
2. 物体の速さ  $v$  が時間  $t$  に比例するときには、動いた距離  $s$  は  $t^2$  に比例する。

…を $a$ とすれば	"if we let... be $a$ "
-------------	------------------------

1. 動物の動いた距離を  $s$  とすれば…
2. A, B 間 (A と B との間) の距離を  $s_{AB}$  とすれば…

A, B 間	A, B <sup>kan</sup>	between A and B
--------	---------------------	-----------------

(verb) とすれば	"if we suppose that"
-------------	----------------------

1. おのおの等速度運動をしている物体 A と物体 B が離れていくとすれば、それぞれの速度は同じではない。
2. 物体が時間  $t$  の間に一定の速度  $v$  で動く とすれば、動いた距離は  $s=vt$  である。
3. 物体が一定でない速度で動く とすれば、距離  $s$  は時間  $t$  に比例しない。

おのおの	ono-ono	each
離れていく	hanarete iku	to move apart
それぞれ	sore-zore	their respective

A を B という	"A we call B; A is called B"
-----------	------------------------------

1. 速度がいつも一定である運動を等速直線運動という。
2. 向きがいつも同じである運動を直線運動という。