MECHANICAL ENGINEERING

机械工程

大学英语专业阅读精选系列教材

FOCUS READING SERIES

上海外语教育出版社

Focus Reading Series

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Mechanical Engineering

机 械 工 程

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前　言

大学英语教学大纲规定大学本科(包括理工科和文理科)的英语教学分为基础阶段和专业阅读阶段。专业阅读阶段的任务是:指导学生阅读有关专业的英语书刊和文选,使其进一步提高阅读英语科技资料的能力,并能以英语为工具,获取专业所需要的信息。从实践中我们感到基础阶段学生所接触的语言材料在文体和词汇方面与专业阅读阶段有着较大的差别,而且一般说来学生第五学期刚开始接触专业基础课,他们还缺乏专业知识,直接进行专业阅读尚有一定困难。另外学生在基础阶段学习中所掌握的读、听、写、说四种技能在专业阅读阶段还需得到进一步的巩固和提高。

Focus Reading Series 是为解决大学英语从基础阶段过渡到专业阅读阶段的衔接问题而编写的一套系列教材。本系列教材按专业大类分成六个分册:Mechanical Engineering; Electrical and Electronic Engineering; Chemistry and Chemical Engineering; Computer Engineering; Materials Science 和 Power Engineering。教师可按学生所学专业选用对口的分册。在编写过程中编者力求打破同类教材的老框框,使学生通过大量专业基础方面的有关材料的阅读,不仅能学到英语,而且还能学到一定的专业基础知识,熟悉和了解专业题材文章的特色并掌握一定量的专业词汇,从而为他们顺利进入专业阅读阶段学习打下良好的基础。本系列教材练习形式力求新颖多样,学生可以通过各种练习在语言运用上得到锻炼,使他们在大学英语基础阶段所掌握的读、听、写、说技能得到进一步巩固和提高,并进而提高交际能力。本系列教材在编写过程中还着重强调了专业文章的特色及与之有关的功能意念和语言技能训练。

全套教材由机械工业部大学英语协作组责成华东工业大学、湖南大学、吉林工业大学和沈阳工业大学,并特邀上海大学合作编写。华东工业大学程月芳教授担任总主编,卢思源教授担任总主审。教材编写的全过程得到了机械工业部教育司的领导和上海外语教育出版社编辑同志的大力支持和帮助。

编　者

1995 年 3 月

本书使用说明

本书为 Mechanical Engineering 分册，供机械及有关专业的大学本科学生用作专业阅读阶段之前的过渡性教材。一般在第五学期使用，约需 34 学时。

本书由 15 个单元组成，各单元均按专业内容划分，既考虑到专业知识的连贯性又照顾到英语学习的循序渐进。每个单元由 Reading and Comprehension; Reading and Practice 和 Reading and Translation 三个部分组成。Reading and Comprehension 部分有一篇阅读文章，其后是检查学生对文章理解的练习，旨在训练提高学生对科技体裁文章的阅读技能。文章后面附有生词表，将大学英语 1～4 级中未出现过的词汇或虽已出现过但在专业方面有特殊词义的词汇列入表内，生词后注有汉语或英语解释并注有国际音标，生词表中出现的词汇在文章内该词用斜体标出，便于学生预习时查找。Reading and Practice 部分也有一篇文章，其内容基本与 Reading and Comprehension 部分一致，也附有生词表，但文字较浅近易懂。要求学生在理解文章内容的基础上做好练习。该部分练习由 Use of English 和 Guided Writing 两个部分组成，是为训练学生运用语言的能力而设计的。Use of English 可以是 Use of Language 也可以是 Information Transfer，旨在为学生提供运用语言的实践机会。教师在引导学生做这一练习时应注意语言的流畅和准确性并重，并要尽力鼓励学生将已有的语言知识较流利地运用到实践中去。Guided Writing 旨在指导并训练学生的书面表达能力，练习的设计从连句成段开始，最后到指导学生写出简单的实验报告以及某一零部件或图表的定义、分类和描述。在这一练习的教学过程中，教师可向学生推荐一些简单的实验报告格式，也可让学生对某些实物进行定义、分类和描述。Reading and Translation 部分有单句、段落或短文，要求学生进行英译汉练习。在做这部分练习时教师可作一些翻译指导，并要求学生不仅注意单句的译法，还要注意前后文意思对译文的影响，该部分选材以有利于指导翻译教学为主，但在内容上力求不脱离本分册的专业范围。

本书阅读总量约为 30 000 词，每一阅读文章（不包括翻译部分）篇幅一般为 1000 词左右。总生词量为 400～500 个左右，并按字母顺序列于书后。在讲课中教师应注重阅读理解、翻译和语言实践的指导及交际能力的培养。学生宜在课前做好预习工作。本书的阅读和练习量较大，教师可根据学生的实际情况安排教学内容，对教材进行有选择的使用。

本书由华东工业大学颜国伟担任主编，沈润斋任副主编。颜国伟、沈润斋和朱琦编写。薄如秀负责审核。

由于编者水平有限，教材中不妥之处望广大读者提出宝贵意见。

编　者

1995 年 3 月

CONTENTS

Unit One

I. Reading and Comprehension

THE SCIENCE OF MECHANICS

That branch of scientific analysis which deals with motions, time and forces is called mechanics and is made up of two parts. *statics* and *dynamics*. Statics deals with the analysis of *stationary* systems, i. e. , those in which time is not a factor and dynamics deals with systems which change with time.

As shown in Fig. 1 dynamics is also made up of two major disciplines, first recognized as separate entities by Euler in 1775.

The investigation of the motion of *a rigid* body may be conveniently separated into two parts, the one geometrical. the other mechanical. In the first part. the transference of the body from a given position to any other position must be investigated without respect to the causes of the motion. and must be represented by analytical formulae, which will define the position of each point of the body. This investigation will therefore be referable solely to geometry, or rather to *stereotomy*.

It is clear that by the separation of this part of the question from the other, which belongs properly to Mechanics, the determination of the motion from dynamical principles will be made much easier than if the two parts were undertaken *conjointly*.

These two aspects of dynamics were later recognized as the distinct sciences of *kinematics* (from the Greek word kinema, meaning motion) and *kinetics*, and deal with motion and the forces producing it, respectively.

THEORY OF MACHINES AND MECHANISMS

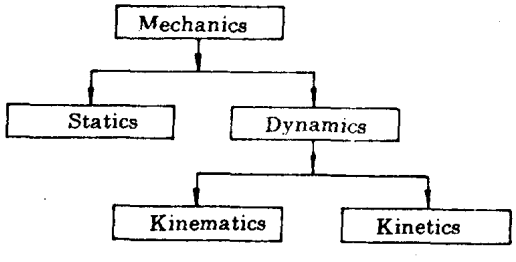

Figure 1—1

The initial problem in the design of a mechanical system is therefore understanding its kinematics. Kinematics is the study of motion, quite apart from the froces which produce that motion. More particularly, kinematics is the study of position, displacement, *rotation*, speed, *velocity*, and acceleration, The study, say, of planetary or orbital motion is also a problem in kinematics.

It should be carefully noted in the above quotation that Euler based his separation of dynamics into kinematics and kinetics on the assumption that they should deal with rigid bodies. It is this very important assumption that allows the two to be treated separately. For flexible bodies, the shapes of the bodies themselves, and therefore their motions, depend on the forces exerted on them. In this situation, the study of force and motion must take place simultaneously, thus significantly increasing the complexity of the analysis.

Fortunately, although all real machine parts are flexible to some degree, machines are usually designed from relatively rigid materials, keeping part *deflections* to a minimum. Therefore, it is common practice to assume that deffections are *negligible* and parts are rigid when analyzing a machine's kinematic performance, and then, after the dynamic analysis when loads are known, to design the parts so that this assumption is justifled.

From *Theory of Machines and Mechanisms* by Shigley. J. E

New Words

statics /ˈstætiks/ *n.*	静力学
dymamics /daiˈnæmiks/ *n.*	动力学
stationary /ˈsteiʃənəri/ *a.*	静止的
rigid /ˈridʒid/ *a.*	刚性的
stereotomy /ˌstiəriˈɔtəmi/ *n.*	实物体切割术
conjointly /ˈkɔndʒɔintli/ *adv.*	联合地
kinematics /ˌkainiˈmætiks/ *n.*	运动学
kinetics /kaiˈnetiks/ *n.*	动力学
rotation /rəuˈteiʃən/ *n.*	旋转
velocity /viˈlɔsiti/ *n.*	速度
deflection /diˈflekʃən/ *n.*	弯曲
negligible /ˈneglidʒəbl/ *a.*	可以忽略的

Reading Comprehension

Decide whether each of the following statements is true or false.

1. Dynamics and statics deal with the same systems. ( )
2. The investigation of the motion of a rigid body may be divided into the geometrical part

and the mechanical part. ( )

3. It is made as easy to determine the motion from dynamical principles by dividing the two parts as by associating the two parts. ( )
4. Kinematics and kinetics stem from the two aspects of dynamics. ( )
5. In the design of a mechanical system, it is essential to have a good knowledge of its kinematics. ( ).
6. In dealing with flexible bodies, the study of force and motion can be treated separately. ( )
7. All real machine parts are made of rigid materials. Machines are usually designed from relatively rigid materials. ( ).

Comprehension questions

1. What is mechanics?
2. What is statics?
3. What is dynamics?
4. What are the two parts that make up dynamics? Why do we separate the two parts? And what are these two parts called later?
5. What is Kinematics?
6. What did Euler base his separation of dynamics into kinematics and kinetics on? And why?
7. Why can we assume that the machine parts are rigid although all real machine parts are flexible to some extent?

II. Reading and Practice

Read the following Passage and do the exercises

THE SIMPLE MACHINES

Figure 1—2 shows three arrangements of a straight *lever*; in each case f is the *fulcrum*; P the effort, applied at b; and W the load, applied at c. When the lever is balanced or in *equilibrium*, the tendency of P to turn the lever about f in one direction must be balanced by the tendency of W to *rotate* the lever in the opposite direction. Neglecting *friction* at the fulcrum, this relation can be expressed mathematically as

$$P \times bf = W \times cf \tag{1}$$

which states that the applied effort multiplied by the distance to the fulcrum on one side is equal to the same product on the other side. From this can be *derived* a quantity known as the mechanical advantage, which is equal to the load divided by the effort:

$$\text{mechanical advantage} = \frac{W}{P} = \frac{bf}{cf} \tag{2}$$

In Figure 1—2A, if $bf/cf = 3$, it means that a load W of 30 pounds, for example, can be balanced by an effort P of 10 pounds. If P exceeds this value slightly, the bar will rotate about f with P moving farther and faster than W by the ratio of bf to cf, the velocity ratio, which again is the mechanical advantage, neglecting friction. Obviously, the shorter the distance between f and c the greater the force-*amplifying* ability of the lever, and the shorter the distance c will move for a given movement of b.

The arrangement if figure 1 — 2 A is found on *pliers* and scissors , while that in figure 1—2B is found on *wheelbarrows*; f represents the wheel, W the load, and P the effort *exerted* on the handles by the operator. In figure 1—2C the lever functions as a motion-multiplying device. It is used on foot *treadles* for driving some small machines. A small movement of the foot at b produces a larger movement at c.

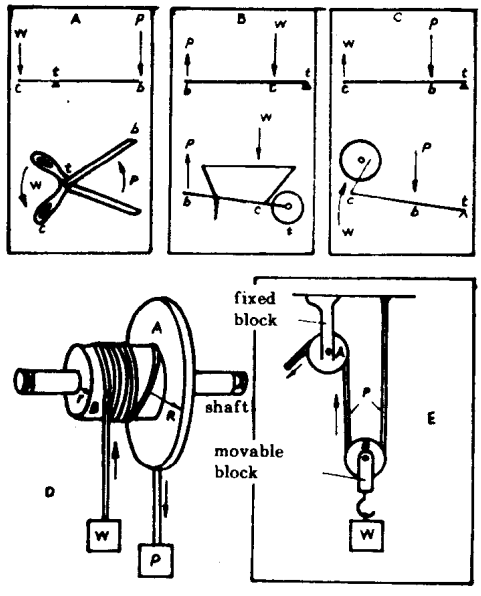

Figure 1—2 Simple machines.
(A—C) Straight lever arrangements. (D) Wheel and axle. (E) Pulley and blocks (see text).

The wheel and *axle* shown in figure 1—2D operates basically on a leverage principle. The wheel A, of *radius* R, and the axle B, of radius r, are fastened to the *shaft*, which can rotate. The effort P is applied by means of a cord lying in a *groove* on the *periphery* of the wheel, and the load W is raised by a cord wrapped around the axle. When the axle is stationary, the tendencies of P and W to cause rotation are equal and opposite. Neglecting bearing friction, the product of the effort P and the wheel radius R is equal to the product of the load W and the axle radius r:

$$P \times R = W \times \mathrm{r}.$$

The mechanical advantage is again equal to W/P, which is equal to the ratio of the radius of the wheel R to the radius of the axle r.

The situation is similar to that for the lever. A lever, however, can move a load for only short distances, while the wheel and axle can move the load for a distance limited only by the available lengths of the cords.

With the wheel A and cord replaced by a *spoked* wheel, the wheel and axle is well suited for raising buckets of water from a well. More importantly, however, the wheel-and-axle principle is *perceptible* in many tools and machines. On a *screwdriver*, for example, the force applied by the hand on a large radius is *converted* to a larger force on the screw at a smaller radius.

The *pulley* is one of the most useful of the basic simple machines. It consists essentially of a wheel with a grooved *rim* carrying a flexible cord and supported in either a fixed or a movable bearing block. When used singly with a fixed bearing block, like pulley A in figure 1—2E, a downward pull creates an upward force of the same *magnitude*. In figure 1—2E this pulley and one with a movable block B are combined. If friction is neglected, the tension P in the cord is the same at all points, and consequently a given downward pull on the loose end of the cord will lift twice as much as the weight at W, and the weight W will move half as far as the cord. The mechanical advantage is therefore two. Mechanical advantages greater than two can be obtained by using a variety of combinations of pulleys having both fixed and moving blocks. Such an arrangement, known as a block and *tackle*, is basically a force-amplifying device.

From *The New Encyclopaedia Britannica*, Vol. 11. 15th, ed., 1974

New Words

lever /ˈliːvə/ *n.*	杠杆
fulcrum /ˈfʌlkrəm/ *n.*	支点
equilibrium /ˌiːkwiˈlibriəm/ *n.*	平衡
rotate /rəuˈteit/ *v.*	旋转
friction /ˈfrikʃən/ *n.*	摩擦
derive /diˈraiv/ *v.*	取得，获得
amplify /ˈæmplifai/ *v.*	放大
pliers /ˈplaiəz/ *n.*	(复)老虎钳
wheelbarrow /ˈwiːlˌbærəu/ *n.*	(独轮)手推车
exert /igˈzəːt/ *v.*	尽力，施加
treadle /ˈtredl/ *n.*	踏板
axle /ˈæksl/ *n.*	车轴
radius /ˈreidjəs/ *n.*	半径

shaft /ʃɑ:ft/ *n.* 车杠,轴
groove /gru:v/ *n.* 槽,纹
periphery /pə'rifəri/ *n.* (圆体的)外面
spoke /spəuk/ *v.* 给……装上轴
perceptible /pə'septəbl/ *a.* 可看到的
screwdriver /'skru:draivə/ *n.* 旋凿
convert /kən'və:t/ *v.* 转变
pulley /'puli/ *n.* 滑轮
rim /rĭm/ *n.* 边
magnitude /'mægnitju:d/ *n.* 大小;数量
tackle /'tækl/ *n.* 滑车

1. Use of Language

Exercise A

Choose the best answer for each of the following.

1. When the lever is in equilibrium, the effort to turn the lever about the fulcrum must be _____ to the weight to rotate the lever in the _____ direction.
   a. opposite/opposite
   b. opposite/equal
   c. equal/opposite
   d. equal/same
2. The mechanical advantage equals _____.
   a. the load
   b. the effort
   c. the load divided by the effort
   d. the effort divided by the load
3. The shorter the distance between _____ the greater the force amplifying ability of the lever.
   a. f and W
   b. f and c
   c. c and b
   d. W and f
4. In the example of a wheelbarrow as an arrangement of levers, f, W and P respectively represent _____.
   a. the effort, the load and wheel
   b. the load, wheel and effort
   c. the wheel, the load and effort
   d. the wheel, the effort and load
5. A small force at the foot treadles in figure 1—1 c can generate _____.
   a. an equal movement
   b. a smaller movement

c. a greater movement　　d. an opposite movement

6. In the case of the wheel and axle, the tendencies of P and W to cause rotation are _____ when the axle is stationary.
   a. unequal and opposite
   b. unequal and go in the same direction
   c. equal and go in the same direction
   d. equal and go in the opposite direction
7. In the light of the leverage principle, _____.
   a. when the effort is applied farther from the fulcrum than the resistance, the effort is smaller than the resistance
   b. when the effort is applied nearer the fulcrum than the resistance, the effort is smaller than the resistance
   c. when the effort is applied farther from the fulcrum than the resistance, the effort is larger than the resistance
   d. when the effort is applied nearer the fulcrum than the resistance, the effort is the same as the resistance
8. As far as a movable pulley is concerned, the hand by exerting a force of 50 pounds can lift a load of _____ if friction is neglected.
   a. 50 pounds　　b. 100 pounds
   c. 150 pounds　　d. 200 pounds

Exercise B

Choose the word or phrase from Column B that best matches one in Column A.

A	B
a. fulcrum	a. turn
b. in equilibrium	b. combinations of pulleys
c. derive	c. obtain
d. rotate	d. use
e. exert	e. noticeable
f. perceptible	f. the support of a lever
g. magnitude	g. balanced
h. neglect	h. speed
i. a block	i. greatness of size
k. velocity	k. pay no attention

Exercise C

Fill in the blanks with the English translation of the Chinese given in the brackets. You should add something where necessary to make them grammatically correct.

1. A given downward pull on the loose end of the cord will lift

_____ (两倍) the weight at W.

2. If we increase the force _____ (四倍), we increase the acceleration _____(四倍).
3. The total area of the factory is _____ (六倍) that factory.
4. This pipe is _____ (长四分之一) that pipe.
5. Mercury _____ (是十四倍) water.
6. Since the forces acting upon the two gear wheels are equal, the torque will, for the larger gear wheel, _____ (大三倍) the small one.

Exercise D

Fill in the blanks with suitable words.

Whenever we try to move anything we encounter a (1) which we call friction. Friction can be found (2) pushing a book on a table. Friction is ever present, and in all types of machines it causes a (3) of force. But friction is not always a (4). We could not walk or run if it were (5) for friction. (6) friction we could not drive an automobile on a level road or up a hill. A railroad locomotive depends on the friction (7) the rails and the driving wheels to pull the train. Force could not be (8) by means of belting and pulleys without friction. Friction can be classified (9) such kinds as starting friction, sliding friction or rolling friction. Sliding friction can be reduced by keeping the sliding surfaces (10).

2. Guided Writing

Definition (I)

Definitions are a very important writing skill for science students to know. They are frequently used by scientists, engineers and technicians to define ideas, concepts, laws, substances or objects in scientific writings.

A definition usually has two parts. The first part is the class or category consisting of items which can be grouped together because of their resemblance or characteristics. The second part is the trait of the defined item which distinguishes it from other members of the class. Take for example the definition of the word "lever": "A lever is a bar that is used for lifting or moving something heavy or stiff." Here the first part is "a bar"that tells you which class the lever belongs to. The fact that "it is used for lifting or moving something heavy or stiff" differentiates the lever from any other bars. It is the second part.

Stage 1

Fill in the blanks with the given words so as to complete each statement as a definition.

a generator　　a motor　　a compressor