Unit One

LESSON 1

1.1 物理学专业英语的特点

1.1.1 物理学专业英语简介

从体裁上讲，英语主要有文学文体、政论文体、应用文体和科技文体四大类，物理学专业英语属于科技英语文体的一部分。

物理学专业英语把英语和物理学专业知识紧密结合起来，用专业语言来说明客观存在的事物或事实。专业英语的叙述要求客观、真实、明确、简洁，并大量使用科学术语和符号，也经常借用图表和插图来说明专业内容。这就决定了专业英语的文体风格：概念准确、表达正式、陈述客观、逻辑性强、专业性强、严谨周密、行文简练、重点突出、句式严整、少有变化、常用前置性陈述，即在句中将主要信息尽量前置，通过主语传递主要信息。

专业英语的语言特点表现在词汇、句法和修辞三个方面。

1.1.2 物理学专业英语的词汇特点

1. 纯科技词汇

所谓纯科技词汇是指那些只用于某个专业或学科的专门词汇或术语，如 hydroxide(氢氧化物)、diode(二极管)、isotope(同位素)等。随着物理学及其相关领域的发展，新学科、新分支的产生，这样的词汇层出不穷，其词义精确而狭窄，针对性极强。除少数术语是新造的词外，绝大多数术语都是在原有旧词的基础上，靠借用、加前后缀或合成等手段构成，其中尤以合成这种手段最为常见。专业英语中很多新术语都是用这几种手段组成的。阅读专业性强的文献，就要首先了解该领域的专门词汇和术语。

2. 通用科技词汇

通用科技词汇即不同专业都要经常使用的那些词汇，数量较大，如表示时间、空间、方位、方向、尺寸、形状、面积、体积等方面的词汇以及一批要求固定介词的形容词和动词。如 accumulate，accuracy，capital，cell，charge，current，load，intense，motion，operation，potential，pressure，react，reflection，resistance，revolution，tendency 等词汇均属于多门学科使用的半专业词汇。这类词的使用范围比纯科技词汇广、出现频率高，但在不同的专业里有较为稳定的词义。如 power 一词在物理学中的词义为"电""电力"、"动力"、"电源"、"功率"等，在数学中的词义为"乘方"、"功效"、"幂"等。

3. 派生词汇

派生词指在已有的词汇上加前、后缀，或以词根生成，或以构词成分形成的新词。这种词汇在物理学专业文献中占有很大的比重。例如，由前缀 hydro-，hyper-，hypo-和 inter-构成的词条在物理学专业英语中就非常多；以表示学科的后缀-logy，-ics 和表示行为、性质、状态等的后缀-tion，-sion，-ance，-ence，-ment 构成的词汇在专业英语文献中俯拾皆是。

前缀的特点：加前缀构成的新词只改变词义，不改变词类。

intergalactic　银河间的　inter＋galactic

submicroscopic　亚微观的　sub＋microscopic

另外，前缀有固定的意义。如：

multi-表示“多”　multimedia 多媒体

hyper-表示“超级”　hyperelastic 超弹性的

后缀的特点：加后缀构成的新词可能改变也可能不改变词义，但一定改变词类。

infinity　无穷远(名词)＝infinite＋y(infinite 是形容词)

quantization　量子化(名词)＝quantize＋ation(quantize 是动词)

有些词加后缀后，语音或拼写可能发生变化。

electrification＝electrify＋cation

accelerator＝accelerate＋or

4. 复合词汇

所谓复合词，就是指两个或两个以上的词组合在一起构建的新词。一般来说，复合词分为复合名词、复合动词、复合形容词、复合形容动词和复合副词。有些词已经在词义上发生了变化，从意思上看不出复合的痕迹，但是从词形上仍然能够看出最初复合的痕迹。复合词常以连字符“-”连接两单词构成，或采用短语构成，但有的则去掉连字符形成一个单一的词。

以下是物理学中的一些加连字符复合词的例子：

by-pass 旁路，cathode-ray tube 阴极射线管，change-over switch 换向开关，current-carrying conductor 载流导体，digital-to-analogue conversion 数模转换，fine-adjustment 微调、细调，flat-bottomed flask 平底烧瓶，fly-back 回扫，full-wave rectifier 全波整流器，half-wave rectification 半波整流，infra-red ray 红外线，inverse-square law 平方反比定律，ion-pair 离子偶、离子对，push-button switch 按钮开关

值得一提的是，专业英语中-proof 使用的比较多，它是一个构词成分，意思是“防……的，能抗……的”，“完全地或成功地抵制……的；不能穿透……的”。这个构词成分能构成许多有用的单词。例如：

a water-proof material　防水材料

a bullet-proof glass　防弹玻璃

a sound-proof room　隔音室

a bomb-proof shelter　防空洞

a fire-proof material　防火材料，耐火材料

a fail-proof method　万无一失的方法

a fool-proof instrument　操作十分简便的仪器

此外还有 acid-proof 抗酸的、耐酸的，corrosion-proof 抗腐蚀的、防腐蚀的，mar-proof 耐磨损的，ozone-proof 耐臭氧的等。

以下是一些无连字符复合词的例子：

joulemeter 焦耳计，kilowatt 千瓦特、千瓦，loudspeaker 扬声器，output 输出，ratemeter 率计、率表，supersaturation 过饱和

5. 混成词

混成词指由最少两个词语或词语的一部分结合而成的词语，该新词语的意义和读音集组成部分而成。一般而言，混成词是新词，诸如 motel 汽车旅馆（motor＋hotel）、smog 烟雾（smoke＋fog），brunch 早午餐（breakfast＋lunch）和 cyborg 生化人（普遍代指 cybernetic organism 自动化生物）等混成词。

以下是一些物理学中混成词的例子：

potentiometer（potential＋meter）	分压器，电位器，电势差计，电位差计
radioisotope（radioactive＋isotope）	放射性同位素
radionuclide（radioactive＋nuclide）	放射性核素
radiotherapy（radioactive＋therapy）	放射疗法
sonometer（sonic＋meter）	弦音计
spectrometer（spectrum＋meter）	光谱仪、分光计
thermocouple（thermal＋couple）	温差电偶、热电偶
telesat（telecommunication＋satellite）	通信卫星

6. 缩略词

缩略词的构成有两种：将英语中较长的单词取其首部或者主干构成与原来单词同义的短单词，称为压缩或省略；将组成词汇的短语的各个单词的首字母拼接为一个字符串，称为缩写。

1）压缩或省略

一些单词比较长，难于记忆和拼写，通过压缩或省略的方法把它们压缩成一个短小的单词，或者仅仅取其头部，或仅取关键音节。

maths（mathematics）数学，lab（laboratory）实验室，plane（airplane）飞机，ft（foot/feet）英尺，cpd（compound）化合物

2）缩写

利用词的第一个字母代表一个词构成的缩略词，就叫做首字母缩略词。常见的有以下三类。

① 通常情况下以小写字母出现，并且已经作为常规词汇。

m（metre）公尺，cm（centimeter）厘米，g（gram）克，fm（frequency modulation）调频

scr（silicon-controlled rectifier）可控硅整流器，p. s.i.（pounds per square inch）磅每平方英寸，radar（radio detecting and ranging 无线电探测与定位）雷达，laser（light amplification by stimulated emission of radiation 受激发射光放大器）激光

② 以大写字母出现，有的具有主体发音音节，有的仅为字母缩写。

TV（television）电视，CD（compact disk）激光唱盘，CAD（computer-assisted design）计

算机辅助设计，IT(information technology)信息技术，IDD(international direct dial)国际直拨电话，PVC(polyvinyl chloride)聚氯乙烯，FRP(fiber glass reinforced plastic)玻璃钢，DNA(deoxyribonucleic acid)脱氧核糖核酸，F(fluorine)氟，U(uranium)铀，CATV(cable television)有线电视，CD-ROM(compact disk-read-only memory)光盘只读存储器(也就是光驱)，GHG(greenhouse gas)温室气体

③ 有的缩略词还可以和其他词连用，如：

E-mail (electric mail)电子邮件，H-bomb (hydrogen bomb) 氢弹，CO_2 (carbon dioxide) 二氧化碳

7. 骈词

专业英语中有不少骈词，它们由同义词、近义词构成，两词前后顺序基本固定，中间由and连接，在语气、语调及语义方面有特殊的修辞效果。一般有以下三类：

1) 头韵类

如 effective and efficient, integral and indispensable, part and parcel, queries and questions 等。

It is clear that idealized model method provides an *effective and efficient* answer to a number of complex problems. 很明显，理想模型方法是解决许多复杂问题的一种快速高效的办法。

During the last twenty years, holography has become an *integral and indispensable* part of physics. 在最近二十年中，全息技术成为物理学不可或缺的部分。

Mechanics is *part and parcel* of physics. 力学是物理学的组成部分。

If there are *queries and questions* with laser, do not hesitate to contact us. 若对激光器有疑问，请立即和我们联系。

2) 尾韵类

如 first and most (foremost), wear and tear 等。

Calculus is the *first and most* common method of solving problems in physics. 微积分方法是最首要、最常用的解决物理问题的方法。

First and foremost, we should tackle the problem of energy sources. 首先，我们应该解决能源问题。

The *first and most* important step for learning university physics is to have a good command of calculus. 对大学物理学习来说，第一也是最重要的一步是学好微积分。

Regular maintenance of instruments reduces much needless *wear and tear*. 定期维护仪器可以大大减少不必要的磨损。

3) 无韵类

如 each and every, leaps and bounds, pure and simple, trial and error, ways and means 等。

This type of product manufacturing control ensures that consistent rare earth quality is achieved for *each and every* lot delivered to the labs. 这种产品制造控制方法，会保证发往实验室的每批稀土质量是稳定的。

Since the quantum was put forward, it has grown by *leaps and bounds* into a remarkably prosperous branch of physics. 自量子理论提出以来，它迅速发展为一个非常繁盛的物理学分支。

The operating error was due to carelessness *pure and simple*. 操作失误纯粹归因于粗心大意。

In general, the design procedure is not straightforward and will require *trial and error*. 一般来说，设计过程不是一帆风顺的，而需要反复的试验。

The object of studying thermodynamic processes was to work out *ways and means* of improvements of the efficiency of heat engines. 研究热力学过程的目的是为了找出改进热机效率的各种方法。

8. 专业词汇的隐喻

隐喻是把某种比喻意义从一个事物传给另一事物，即在两个本质不同的事物之间进行的暗含比较，是以相似和联想为基础的。

在物理领域，隐喻已经成为十分重要的形象思维手段和认知工具，词汇中充斥着大量的隐喻。原子结构理论的创立者丹麦物理学家 Henrik David Bohr（玻尔）把肉眼看不见的原子的内部结构想象成一个“太阳系”，称为 miniature solar system（微型太阳系），从大的宏观概念直至小的微观概念。与这种视微观世界为宏观世界的放大化隐喻相对应，专业词汇中也存在视宏观世界为微观世界的缩小化隐喻，如天文学家创造了 light-year（光年）这一术语作为计算星球之间距离的单位，用 crab nebula（蟹状云）来指称银河系中的某一强大射电源。当科学家发现了新的事物及其特点、规律时，他们在很多情况下不会任意杜撰或“发明”新的词汇来表示新概念，而是在原有词汇的基础上给新的概念和知识命名。这其中相当一部分是隐喻，即概念与概念之间的类比。

从已知到未知，从具体到抽象，由此及彼，相互类推，就会形成一条“隐喻链”。同一词语应用在不同学科中建构了一系列的科学概念名称，展现出隐喻思维的线索。例如从 wave（波）类推到 sound wave（声波），再到 light wave（光波）；到了电子时代，又有了 radio wave（无线电波），electromagnetic wave（电磁波），microwave（微波），ultrasonic wave（超声波）以及 long/medium/short wave（长/中/短波），及其到了量子时代的 matter wave（物质波）等。这些概念的建构一脉相承，都建立在同一喻体之上。

1.2 专业英语阅读

1.2.1 Introduction（引言）

We begin our study of the physical universe by examining objects in motion. The study of motion, whose measurement, more than 400 years ago gave birth to physics, is called kinematics.

Much of our understanding of nature comes from observing the motion of objects. In this chapter we will develop a description for the motion of a single point as it moves through space. Although a point is a geometrical concept quite different from everyday objects such as footballs and automobiles, we shall see that the actual motion of many objects is most easily described as the motion of a single point (the “center of mass”), plus the rotation of the object about that point. Postponing a discussion of rotation, let us begin here with a description of a single point as it moves through space.

1.2.2 Space and Time(时间与空间)

Kinematics is concerned with two basic questions, "Where?" and "When?". Though the questions are simple, the answers are potentially quite complicated if we inquire about phenomena outside our ordinary daily experiences. For example, the physics of very high speeds, or of events involving intergalactic distances or submicroscopic dimensions, is quite different from our common-sense ideas. We will discuss these interesting subjects in later chapters. For the present we shall adopt the space and time of Newton—those concepts we gradually developed as a result of our everyday experiences.

Space is assumed to be continuously uniform and isotropic. These two terms mean that space has no "graininess" and that whatever its properties may be, they are independent of any particular direction or location. In the words of Isaac Newton, "Absolute space, in its own nature, without relation to anything external, remains always similar and unmovable." Every object in the universe exists at a particular location in space, and an object may change its location by moving through space as time goes on. We specify the location of a particular point in space by its relation to a frame of reference.

Time, according to Newton, is also absolute in the sense that it "flows on" at a uniform rate . We cannot speed it up or slow it down in any way, in Newton's words, "Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration." Time is assumed to be continuous and ever advancing, as might be indicated by a clock.

Space and time are wholly independent of each other, though it is recognized that all physical objects must exist simultaneously in both space and time.

Remarkably, many of these traditional ideas turn out to be naive and inconsistent with experimental evidence. The world is just different from the picture we form from our common-sense, intuitive ideas. Space and time, by themselves, are concepts that are difficult (or perhaps impossible) to define in terms of anything simpler. However, we can measure space and time in unambiguous ways. We define certain operations by which we obtain numerical measurements of these quantities using rulers and clocks, based upon standard units of space and time.

For many years, our standard of time was based on astronomical observations of the earth's rotation. Because of the variations in the earth's rotation, in 1967 the 13th General Conference on Weights and Measures, attended by 38 nations, adopted an atomic standard for time.

Similarly, our former standard of length was the distance between two marks on platinum-iridium bar kept at Sevres, France. In 1960, the fundamental length standard was redefined in terms of the wavelength of light emitted during a transition between two atomic energy levels.

The standard units of time and length may be described as follows:

An interval of time. The fundamental unit is the **second** (s), which by international agreement is defined as the duration of 9 192 631 770 periods of radiation corresponding to the transition between the two lowest energy levels in the atomic isotope cesium 133.

An interval of length. The fundamental unit is the **meter** (m), which is defined independently of the time interval. Before 1983, by international agreement the meter was defined as exactly 1 650 763.73 wavelengths of the orange light emitted from the isotope krypton 86. In November 1983, the length standard was defined as the distance that light travels in a vacuum in 1/299 792 458 second.

Certain older units of length are still occasionally used.

$$1 \text{ angstrom}(\text{Å}) = 10^{-10}\text{ m} \quad 1 \text{ micron } (\mu \text{ or } \mu\text{m}) = 10^{-6}\text{ m}$$

Glossary

universe	宇宙	object	物体
measurement	测量	kinematics	运动学
motion of objects	物体的运动	center of mass	质心
space and time	时空	phenomena	现象
intergalactic	银河间的	submicroscopic	亚微观的
dimension	尺度	subject	研究的对象
uniform	均匀的	isotropic	各向同性的
continuously	连续地	graininess	颗粒性
direction	方向	location	位置
specify	规定	frame of reference	参考系
simultaneously	同时地	inconsistent with	与……不一致
define/definition	定义	meridian	子午线
general conference on weights and measures	国际计量大会	atomic standard	原子标准
former standard of length	长度原标准	platinum-iridium	铂铱合金
transition	跃迁	atomic energy level	原子能级
isotope cesium	铯同位素	krypton	氪
vacuum	真空	angstrom	埃

1.3 专业英语常用表达法-1 常用工具

toolbox 工具箱	nail hammer 羊角锤、拔钉锤
handsaw 手锯	sledge hammer 大锤、双手锤
ball-pane hammer 球头锤	pick 镐
ball hammer 圆头锤	double-bladed axe 双刃斧
axe hammer 斧锤	cutting nippers 剪钳、老虎钳

nipper pliers 尖嘴钳，剪丝钳	tape measure 卷尺
crowbar 铁锹、撬杠	scissors 剪刀
nail 铁钉	wrench，spanner 扳手
coping saw 弓形锯	adjustable spanner 活动扳手
chisel 凿子	double offset ring spanner 梅花扳手
hand plane 刨子	inner hexagon spanner 内六角扳手
screw 螺丝钉	pipe spanner 管子扳手
screwdriver 螺丝刀	connection cover cutting pliers 剥线剪钳
gimlet 手钻	
scoop 铲子	wire-cutting pliers 克丝钳
triangle 三角板	insulated pliers 绝缘钳
protractor 量角器	metal wire pliers 剪线钳
curved ruler 曲尺	electric drill 电钻
adjustable triangle 可调节三角板	hollow drill 空心钻
T-square 丁字尺	percussion drill 冲击钻
angle square 角尺	electric（solding）iron 电烙铁
drafting machine 平移角尺	stopwatch 秒表、跑表、停表
dividers 两脚规	

LESSON 2

2.1 物理学专业英语的名词化结构

2.1.1 名词化

物理学专业英语的两个显著特点就是广泛使用名词化结构和大量使用被动语态。名词化是指词性作用的名词性转化，比如起名词作用的非谓语动词和与动词同根或同形的名词，也包括一些形容词来源的名词。这些词可以起到名词的作用，也可以表达谓语动词或形容词所表达的内容，常伴有修饰成分或附加成分，可构成短语。名词化结构指的是大量使用名词和名词词组，即在其他功能和题材的文章里用动词、形容词等词类充当某种语法成分，而在专业英语里往往会转化为由名词充当这种语法成分。

专业英语的“科学性”和“说理性”是名词化大量存在的理据。因为这种结构既可减少句子或分句的出现，又能包容大量的信息，并能反映科学内容的严肃性和客观性。下面就是一个名词化的例子：

(1) We can assume a freely falling body moves in one dimension under constant acceleration if we neglect air resistance.

在专业英语中则通常说成

(2) The motion of a freely falling body can be assumed to be motion in one dimension under constant acceleration by negligence of air resistance.

在这组例子中，名词化发生在两个地方。首先例(1)中的谓语动词转化为(2)中的名词主语，其次，例(1)中的状语从句的谓语动词 neglect 转化为名词结构介词短语来充当状语。经过名词化处理的例(2)由含有两个主谓结构的复合句变成了只含一个主谓结构的简单句，从而使句子的结构更加精练严谨，也由于使用抽象名词替代原来的人称代词做主语而使句子的语体更加正式。

2.1.2 名词化的分类

动词的名词化具有四种形式：

1) 动作名词

在四种形式中，动作名词的名词性最强，而动词性最弱。动作名词用于一般性地叙述一个事实或概念，指出动作和技术的特点，而不强调动作本身的进行过程和时间。

Analysis of projectile motion is surprisingly simple if the following three assumptions are made.

2) 动词性名词

动词性名词的名词性稍弱一些，而动词性略强。用于把概念和动作过程联系起来的描述，时间性也不强。

The *analyzing* of projectile motion is surprisingly simple if the following three assumptions are made.

3) 动名词

动名词的动词性更强一些。在强调动作过程，概括地叙述一般行为，而不是特定行为，并且时间性也不强时，就可以使用动名词。

Analyzing projectile motion is surprisingly simple if the following three assumptions are made.

4) 动词不定式

动词不定式的名词性最弱，动词性最强。通常用动词不定式表达某一次有时间性的特定动作或过程。

Projectile motion of the ball needs *to be analyzed* now if the following three assumptions are made.

2.1.3 名词化结构的构成

名词化结构的应用使得整个句子的结构便于写作修辞，也使得词句负载信息的容量增加。经常使用的名词化结构有：

1) 名词(行为名词)＋介词＋名词

在此结构中，若"介词＋名词"构成的介词短语在逻辑上是行为名词的动作对象或动作的发出者，行为名词的含义在深层中转换或变异，使原来的名词变为动词，构成了动宾或主谓的关系。

The acceleration of the car is due to the force applied on it. 车的加速是由于外力的作用。

此句的 The acceleration of the car＝The car accelerates.

In the case of all freely falling bodies, gravity is essential in *the change of the velocity*. 所有做自由落体运动的物体,速度的改变都离不开重力。

其中 the change of the velocity=the velocity changes.

2) 介词+名词(行为名词)

在此结构中,行为名词的动作意义相对完整,与句中的其他部分之间存在着一定的逻辑关系,能起到时间状语、原因状语、条件状语和让步状语等作用。

A rigid body can change its position *by translation or rotation*. 刚体位置的改变可以通过平移或转动实现。

3) 谓语动词+行为名词(+介词短语)

此结构可以将宾语(介词宾语)转换成谓语。

Kepler's laws have *found application for* the exploration of the planets. 开普勒定律已经被用来探索行星。

此句可改变为 People have applied Kepler's laws to explore the planets.

此结构中谓语动词 find 含义空泛,只起语法作用,翻译时可以不译。类似的动词有:do,keep,have,make,take,pay,show,perform,offer 等。又如:

Friction *offers resistance to* the movement of the block. 摩擦力阻碍木块的运动。句中 offer 几乎不表示什么意义,只起连接作用。此句可以改为:Friction resists the movement of the block.

4) 与动词构成固定搭配

名词化结构与动词构成固定搭配的常用形式为:动词+动词名词化结构+介词名词化结构。这种搭配大量地以一个动词短语的形式出现,约定俗成。例如:

make use of 利用,do research for 研究,lay emphasis on 强调,pay attention to 注意,等等。

5) 行为名词+短语/从句

在此结构中行为名词可以译成动词,与后面的成分一起构成汉语的动宾结构。

I have a *doubt* whether the instrument works well. 我怀疑这仪器是否运行良好。

此句可以改换成 I doubt whether the instrument works well or not.

6) 名词+名词(行为名词)

在此结构中,名词在表层结构上是前置定语,但在翻译过程中,其深层结构的内在含义可以译成动宾词组,行为名词转换成谓语。如:

heat conduction 导热,rust prevention 防锈,performance examination 性能检验

2.1.4 名词化的功能

名词化具有可以使语篇简洁、客观、量化、正式、严密等多种功能。

1) 简洁功能

简洁明了是物理学专业英语的重要特点之一,要求以精练的语言传达大量的信息,而名词化的使用可以使句子省去一些不必要的词语,使得结构紧凑,具有较强的可读性。例如:

Kepler's laws had been developed. For this reason, Newton could discover his laws of motion.

以上两句可用名词化结构分别表达为 the development of Kepler's laws 和 for Newton to discover his laws of motion。

若再把这两个名词化结构按句法要求组织起来，则是：

The development of Kepler's laws makes it possible for Newton to discover his laws of motion.

所以，利用名词化结构，不仅可把两个句子合二为一，使语言更简洁、更精练，而且可把更多的信息结构融合成逻辑关系明确的整体。

2）客观功能

英语中用动词体现过程，动词须有参与者，有时还须有补语。而名词化则使本来由动词体现的过程转而由名词体现，这个过程变成另一过程的参与者，与旧过程相关的参与者就可以省略掉，从而使表达显得客观、真实，避免主观因素和主观色彩。

If we substitute some rolling friction for sliding friction, we can considerably reduce the friction.

改用名词化结构后可以去掉句子的主语 we，提高了客观的程度。

The substitution of some rolling friction for sliding friction results in a very considerable reduction in friction.

3）量化功能

专业英语有时需要使用表示数量的词来表示某人做了多少事情或某物占有多少分量等，但是动词和形容词是不能被量化的，这时名词化就成了可采取的有效手段。例如：

Last year 17 major changes and improvements were made toward making the lab even more perfect.

这个句子使用了数字加动词 change 和 improve 的名词化形式，使表达准确、严谨。如果采用 Last year we changed 17 major things and improved the lab even more perfect. 则显得不够严谨，数量的概念不是很强。

4）正式功能

专业英语要求使用较为正式的语言，适当使用一些名词化结构，可以增加语篇的正式程度。

The engineers are confident about the motion of the "Shenzhou" spaceship from the very beginning.

这个句子中，使用动词 move 的名词化形式 motion，使整个句子显得很正式。如果改成 The engineers are confident how the "Shenzhou" spaceship moves...则正式程度大为降低。

5）严密功能

由于名词化结构中大量使用抽象名词，因此可以借助于抽象思维的逻辑性和概念化使科技文章的表达更确切，更严密。此外，在使用上，句子信息结构最复杂、最重要的部分往往是名词化结构。

We begin our *study of* the physical universe by examining objects *in motion*. The *study of* motion, whose measurement, more than 400 years ago *gave birth to* physics, is called kinematics. Much of our *understanding of* nature comes from observing *the motion of* objects.

2.2 专业英语阅读

2.2.1 Vectors(矢量)

Many quantities in physics have magnitude and direction. **Vectors** are quantities with magnitude and direction. Examples include velocity, acceleration, momentum, and force. Quantities with magnitude but no associated direction—for example, distance and speed—are called **scalars.**

A vector is represented graphically by an arrow drawn in the same direction as that of the vector, and with a length that is proportional to the magnitude of the vector. When the magnitude of a vector is given, its unit must also be given.

Two vectors are defined to be equal if they have the same magnitude and the same direction. Graphically, this means that they have the same length and are parallel to each other. A consequence of the definition is that moving a vector so that it remains parallel to itself does not change it. Vectors do not depend on the coordinate system used to represent them (except for position vectors, which are introduced later).

2.2.2 Properties of Vectors(矢量的性质)

In comparing vectors and performing other mathematical operations such as addition and subtraction, we may translate vectors anywhere in the coordinate space for convenience. We must be careful, however, to preserve their magnitudes and directions with respect to the axes.

Vector Addition(矢量加法)

Two vectors are added graphically by placing the tail of one, $\boldsymbol{B}$, at the head of the other, $\boldsymbol{A}$(Fig. 2-1). The resultant (or net) vector, $\boldsymbol{C}=\boldsymbol{A}+\boldsymbol{B}$, extends from the tail of $\boldsymbol{A}$ to the head of $\boldsymbol{B}$. This is the so-called **head-to-tail method.**

An equivalent way of adding vectors, called the **parallelogram method**, is to move $\boldsymbol{B}$ so that it is tail-to-tail with $\boldsymbol{A}$. The diagonal of the parallelogram formed by $\boldsymbol{A}$ and $\boldsymbol{B}$ then equals the resultant vector $\boldsymbol{C}$, as shown in Fig. 2-2.

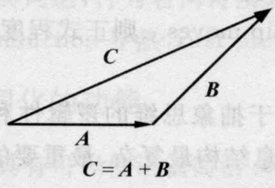

Fig. 2-1 Head-to-tail method of vector addition

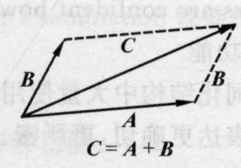

Fig. 2-2 Parallelogram method of vector addition

The vectors have the mathematical property of "obeying the **commutative law** in addition".

$$\boldsymbol{A}+\boldsymbol{B}=\boldsymbol{B}+\boldsymbol{A} \tag{2-1}$$

Vector Subtraction（矢量减法）

We subtract vector $\boldsymbol{B}$ from vector $\boldsymbol{A}$ by adding $-\boldsymbol{B}$ to $\boldsymbol{A}$. The result is shown in Fig. 2-3. Note that vector addition or subtraction can be done only when vectors are in the same unit.

Scalar Product (Dot Product)（标积/点积）

The scalar product of any two vectors is defined as a scalar quantity equal to the product of the magnitudes of the two vectors $\boldsymbol{A}$ and $\boldsymbol{B}$ and the cosine of the angle ϕ that is included between the directions of $\boldsymbol{A}$ and $\boldsymbol{B}$.

That is, the scalar product (or dot product) of $\boldsymbol{A}$ and $\boldsymbol{B}$ is defined by the relation

$$\boldsymbol{A} \cdot \boldsymbol{B} = AB\cos\phi \tag{2-2}$$

where ϕ is the angle between $\boldsymbol{A}$ and $\boldsymbol{B}$ as in Fig. 2-4. A is the magnitude of $\boldsymbol{A}$, and B is the magnitude of $\boldsymbol{B}$, Note that $\boldsymbol{A}$ and $\boldsymbol{B}$ need not have the same unit.

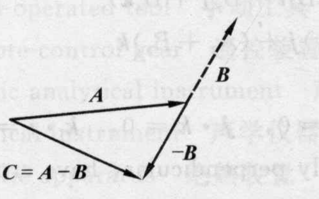

Fig. 2-3 Vector subtraction

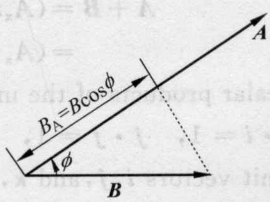

Fig. 2-4

Cross Product (Vector Product)（叉积/矢积）

The cross product of two vectors $\boldsymbol{A}$ and $\boldsymbol{B}$ is defined to be a vector $\boldsymbol{C}=\boldsymbol{A}\times\boldsymbol{B}$ whose magnitude equals the area of the parallelogram formed by the two vectors, as in Fig. 2-5 (a). The vector $\boldsymbol{C}$ is perpendicular to the plane containing $\boldsymbol{A}$ and $\boldsymbol{B}$ in the direction given by the right-hand rule, that is, as your right-hand fingers curl from the direction of $\boldsymbol{A}$ toward the direction of $\boldsymbol{B}$, the direction of $\boldsymbol{A}\times\boldsymbol{B}$ is given by your thumb (Fig. 2-5(b)). If ϕ is the angle between the two vectors and $\boldsymbol{n}$ is the unit vector that is perpendicular to each in the direction of $\boldsymbol{C}$, the cross product of $\boldsymbol{A}$ and $\boldsymbol{B}$ is

$$\boldsymbol{C} = \boldsymbol{A}\times\boldsymbol{B} = (AB\sin\phi)\boldsymbol{n} \tag{2-3}$$

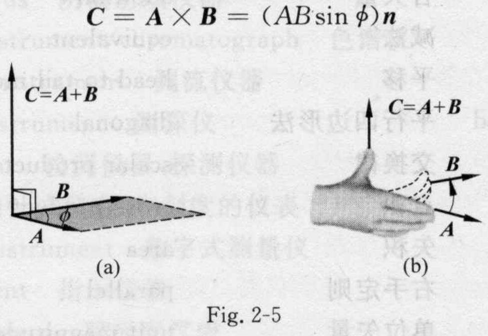

Fig. 2-5

If $\boldsymbol{A}$ and $\boldsymbol{B}$ are parallel, $\boldsymbol{A}\times\boldsymbol{B}$ is a zero vector.

2.2.3 Unit Vectors(单位矢量)

A **unit vector** is a *dimensionless* vector with unit magnitude. Unit vectors that point in the positive x, y, and z directions are convenient for expressing vectors in terms of their rectangular components. They are usually written as $\boldsymbol{i}$, $\boldsymbol{j}$ and $\boldsymbol{k}$, (or $\boldsymbol{i}$, $\boldsymbol{j}$, and $\boldsymbol{k}$) respectively (Fig. 2-6). For example, the vector $A_x\boldsymbol{i}$ has a magnitude $|A_x|$ and points in the positive x direction if A_x is positive (or the negative x direction if A_x is negative). A general vector $\boldsymbol{A}$ can be written as the sum of three vectors, each of which is parallel to a coordinate axis

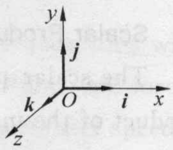

Fig. 2-6

$$\boldsymbol{A} = A_x\boldsymbol{i} + A_y\boldsymbol{j} + A_z\boldsymbol{k} \tag{2-4}$$

The addition of two vectors $\boldsymbol{A}$ and $\boldsymbol{B}$ can be written in terms of unit vectors as

$$\begin{aligned}\boldsymbol{A}+\boldsymbol{B} &= (A_x\boldsymbol{i}+A_y\boldsymbol{j}+A_z\boldsymbol{k})+(B_x\boldsymbol{i}+B_y\boldsymbol{j}+B_z\boldsymbol{k}) \\ &= (A_x+B_x)\boldsymbol{i}+(A_y+B_y)\boldsymbol{j}+(A_z+B_z)\boldsymbol{k}\end{aligned} \tag{2-5}$$

The scalar products of the unit vectors are

$$\boldsymbol{i}\cdot\boldsymbol{i}=1,\quad \boldsymbol{j}\cdot\boldsymbol{j}=1,\quad \boldsymbol{k}\cdot\boldsymbol{k}=1,\quad \boldsymbol{i}\cdot\boldsymbol{j}=0,\quad \boldsymbol{j}\cdot\boldsymbol{k}=0,\quad \boldsymbol{k}\cdot\boldsymbol{i}=0 \tag{2-6}$$

The unit vectors $\boldsymbol{i}$, $\boldsymbol{j}$, and $\boldsymbol{k}$, which are mutually perpendicular, have cross products given by

$$\boldsymbol{i}\times\boldsymbol{j}=\boldsymbol{k},\quad \boldsymbol{j}\times\boldsymbol{k}=\boldsymbol{i},\quad \text{and} \quad \boldsymbol{k}\times\boldsymbol{i}=\boldsymbol{j} \tag{2-7}$$

$$\boldsymbol{i}\times\boldsymbol{i}=\boldsymbol{j}\times\boldsymbol{j}=\boldsymbol{k}\times\boldsymbol{k}=\boldsymbol{0} \tag{2-8}$$

Glossary

vector	矢量	magnitude	大小
velocity	速度	acceleration	加速度
momentum	动量	scalar	标量
proportional to	正比于	parallel	平行
position vector	位置矢量	coordinate system	坐标系
resultant/net vector	合矢量	addition	加法
subtraction	减法	equivalent	等价的
translate	平移	head-to-tail method	三角形法
parallelogram method	平行四边形法	diagonal	对角线
commutative law	交换律	scalar product	标积
dot product	点积	cross product	叉积
vector product	矢积	area	面积
right-hand rule	右手定则	parallel	平行
unit vector	单位矢量	unit magnitude	单位大小
dimensionless	无量纲的	respectively	分别地

2.3 专业英语常用表达法-2 仪器设备

apparatus 装置、设备、器械
appliance 器具、电器
device 装置
equipment 设备
facilities 设备、用具
gear 用具，装置
instrument 仪器、仪表
machine 机器、机械
machinery 机器设备、机械
mechanism 机械装置
plant 成套机械、装置
realia 教具、教学用品
set （成套）设备、仪器
tool 工具
unit 装置、组件、元件
a battery supply set 电池供电设备
a device for regulating temperature 控制温度的装置
a hand-operated tool 手动工具
a remote-control gear 遥控装置
acoustic analytical instrument 声分析仪
acoustical instrument 声学仪器
adiabatic apparatus 绝热装置
adjusting instrument 调节仪器、调节装置
all-purpose instrument 多用工具、万能仪表
altitude instrument 高度仪
an air-conditioning equipment for 供……用的空调设备
an instrument for measuring the spectra 测量光谱的仪器
arc-suppressing apparatus 灭弧装置
beat measuring apparatus 拍频测试仪
bolometer 辐射热测定器
bolometric instrument 辐射热量计
calorimeter 量热计
cathode ray apparatus 阴极射线仪器
chromatographic instrument/chromatograph 色谱仪
current-measuring instrument 测流仪器
depth-measuring instrument 测深仪
detecting instrument 检测仪器、探测仪器
dial instrument 指针式仪表、有刻度的仪表
digital measuring instrument 数字式测量仪
displaying instrument 指示仪器
double-scale instrument 双标度仪表
double-range instrument 双量程仪表
dynamometer 功率计、电力测功仪、测力计、动力计
echo-sounding instrument 回声探测仪

eddy current instrument 涡流仪器
educational instrument 教学仪器
electric instrument 电工测量仪表、电表
electrical appliance 电器用具
electroacoustical instrument 电声(测试)仪器
electromagnetic acoustical instrument 电磁声学仪器
electronic measuring instrument 电子测量仪器
electronic test instrument 电子试验(测试)仪器
electrostatic acoustical instrument 静电声学仪器
electrostatic instrument 静电式仪表
electrostatic measuring instrument 静电式电表、静电式测量仪
electrothermic instrument 热电式仪表
fine measuring instrument 精密测量仪器、精密量具
first-order instrument 一阶仪器
flow instrument 流量计
humidity-measuring instrument 湿度测量仪
instructional instruments 教学仪器
insulation test instrument 绝缘(电阻)测试仪器
laboratory apparatus 实验仪器(装置)
laboratory instrument 实验室仪表
laser distance-measuring instrument/laser range finder 激光测距仪
level instrument 位面计、水平仪
levelling instrument 水准器、水平尺、测平仪
measuring instrument 测量仪表、测量仪器
metrologic instrument 计量仪器
needle instrument 指针型仪器
optical instrument 光学仪器
photomicrographic apparatus 显微照相装置
portable instrument 便携式仪器
power plant/unit 动力装置/机组
precise instrument 精密仪器
radio instrument 无线电仪器
research instrument 试验设备、研究设备
resistance instrument 电阻式仪表
scientific apparatus/instrument 科学仪器/仪表
scientific experiment package 科学实验装置
sensing instrument 灵敏仪表、灵敏元件
spraying apparatus 喷雾器
supersonic thickness meter gauge 超声测厚仪

surveying instrument　测量仪器、测绘仪器

test instrument　试验工具、测试设备

testing instrument　试验仪器

the latest research equipment　最新研究设备

visual instrument　目视仪器

X-ray diffraction instrument　X 射线衍射仪

LESSON 3

3.1　物理学专业英语的语法特点

3.1.1　常用的动词时态

专业英语在时态运用上有限，尽管英语的动词有 16 种时态，但在专业英语中常见的只有四种：一般现在时、一般过去时、现在完成时和一般将来时。

1）一般现在时

在物理学英语文献资料中用得最多的时态是一般现在时，用以表述无时间性的科学定义、定理、公式、现象、过程等。究其原因可能是科学家和物理工作者都想表明他们所说的、所写的都是真理性的，都不受时间的限制。即使是叙述一个已完成的实验，或者是叙述一个将要做的实验，也大都使用一般现在时，意在表明其他人在任何时候都可以重复这样的实验而得到同样的结果。主要有以下三种用法。

(1) 表示一般叙述过程。如：

As the electrons move, the surface charge density increases until the magnitude of the internal field equals that of the external field, giving a net field of zero inside the conductor.

If we now imagine the surface to shrink to zero like a collapsing balloon, until it essentially encloses a point, the charge at the point must be zero.

(2) 叙述客观事实或科学定理。如：

A good electrical conductor contains charges (electrons) that are not bound to any atom and are free to move about within the material.

The electric field is zero everywhere inside the conductor.

Work done on a particle equals the change in its kinetic energy.

(3) 表达通常或习惯发生的行为。如：

Much of our understanding of nature comes from observing the motion of objects.

The solutions of kinematic equations are usually obtained quite easily in a direct fashion using integral calculus.

2）一般过去时

在提到以前叙述过的事情、叙述物理学发展史时，经常使用过去时态。如：

The result is the same as Eq. (7-1), which was calculated directly from Coulomb's law.