国家级课题

“我国素质教育背景下的双语教学理论与实践研究”课题组

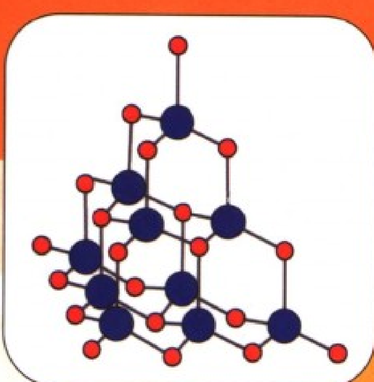
推荐用书

CHEMISTRY

BASIC

初中化学英文课本

（中文注释）



[英]B·厄尔　L D R·威尔福德 著

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本书引进自英国经GCSE（普通中学证书）审定的教材，根据我国现行初中教学大纲整理汇编而成。本书形式新颖、程度适中、实例丰富、图片精美，符合我国教育改革的方向，特别有利于一般学生学习，是一本值得推荐的双语教学范本。

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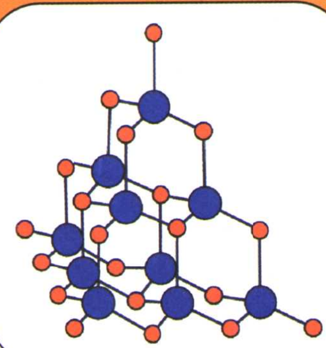

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Foreword

The 21st century will be a special one for China. The past century witnessed a series of great changes in the country of a 5000-year civilization. China has changed from a closed, backward, despised monarchical nation into an open, dynamic and respectable socialist state with strong comprehensive strength. However, the 20th century left behind only a newly-decorated stage for the Chinese people, and their historical task is to stage a really splendid life drama in the 21st century.

China in the 21st century cannot develop without being closely linked with the international environment. In today's world there is a trend of integration of science, economy, and culture, which are promoting each other, learning from each other, and blending each other. China's entry into WTO, her hosting the 2008 Olympic Games and the 2010 World Expo, and her increasing use of the Internet all require that the whole nation, especially the adolescents, should enhance their foreign language ability. It will be of great significance to carry out bilingual teaching research and practice in some regions with advanced education system. *Bilingual Pedagogy and Practice for Capacity Education in China* — a National Education Science Project for the Tenth Five-Year Plan — is a comprehensive research project including the development of the textbook series.

Generally speaking, in the Chinese language context, bilingual teaching refers to the practice that all non-linguistic subjects are instructed totally or partly in a foreign language. This sort of teaching demands new textbooks and new approaches to learning. Thus, all teachers face great challenges in terms of their language ability, subject expertise, teaching skills and methodology. The aim of bilingual teaching is not merely language acquisition, for language is a tool of thinking, and the command of a new language means the command of a new way of thinking. And the change of thought pattern will lead to a better communication and a better understanding between different races, different nations and also different cultures. Strictly speaking, bilingual teaching should go for the multiple objectives of languages, disciplines and thought patterns.

The natural science textbooks by the British JOHN MURRY Press are quite novel, both in the content and in the style, and has a wide coverage with proper levels according to the educational reforming in China. The series of textbooks are also supervised by GCSE (General Certificate of Secondary Education of Britain). These are all characteristics beneficial to students' learning. Our compilers of the series have made careful adaptation and necessary explanation in line with the status quo of education in China. The layout of the series, with necessary notes of special terms at the end of each section, can not only meet the needs of different students, but also make easy reading. The series is a worthwhile model among bilingual textbooks. We hope the users of the textbooks will kindly give us their valuable comments and suggestions so as to contribute to the development of bilingual teaching.

Professor Qian Yuanwei
Head of *Bilingual Pedagogy and Practice for Capacity Education in China*
(A National Education Science Project for the Tenth Five-Year Plan)
Fundamental Educational Office
Shanghai Teachers' University
April 5, 2003

序　言

21世纪对于中国来说，将是一个不寻常的100年。过去的100年是我们这个具有5000年文明史的国家变化极为剧烈的时期。从一个闭关自守的、落后的、被世人看不起的君主国家演变为开放的、充满活力和具有不可忽视的综合国力的新型社会主义国家。然而，20世纪留给国人的还只是一个装饰一新的大舞台，在这一舞台上演出一台绚丽的生活秀是身处21世纪的人们不可推卸的历史重任。

21世纪中国的发展离不开国际大背景，当今世界正在涌动着一体化大潮，科学的、经济的、乃至文化的各个领域，正在互相推动，互相借鉴，互相交融。中国进入WTO，申奥成功，申博成功，国际互联网的广泛运用……都迫切需要全面提高国民，尤其是青少年一代的外语能力。在具备基本条件的若干教育发达地区，率先展开双语教学的实践研究具有前瞻性的重要意义。教育科学“十五”国家课题《我国素质教育背景下的双语教学理论与实践研究》是一项全面的行动研究，其中包括课程教材研发。

一般而言，在我国语言环境下，双语教学是指在非语言学科课程中使用部分或全部外国语的教学。这种教学，在学生的学习资料、学习方式等方面，提出了新的要求；而教师的语言与学科底蕴、教学技能、教学方法等也将面临全新的严峻挑战。双语教学目标并非单纯的是语言，语言是思维的工具，掌握一门新的语言也就是掌握了新的思维方式，而思维方式的改变必将导致不同民族、不同国家乃至不同文化之间的沟通和理解。规范地讲，双语教学应研究语言、学科知识、思维等多元目标。

英国JOHN MURRY出版公司出版的自然科学教材无论在内容上，还是在形式上都比较新颖，面广且深度适中，正符合我国教育改革的方向，特别有利于一般学生学习。这套教材是GCSE的审定教材，GCSE是英国General Certificate of Secondary Education （普通中学证书）的简称。本书整理者又根据我国的教学背景作了合理的编排调整和注释，这种编排顾及了不同层次学生的需求；又对专业知识、专业术语作了必要的注释，均列在每小节末，便于阅读。这是一套值得去试一试的双语教学范本。希望使用本书的师生提出宝贵意见，让我们共同为双语教学的健康发展而努力。

“十五”国家课题《我国素质教育背景下的双语教学理论与实践研究》课题负责人钱源伟
2003年4月5日　于上海师范大学基础教育处

Preface to the reader

This textbook has been written to help you in your study of chemistry to GCSE. Although you will be following a GCSE specification for only one particular examination group, this book contains the material needed by all the groups. For this reason it is not expected that you will need to study or learn everything in this textbook.

The different chapters in this book are split up into short topics. At the end of many of these topics are questions to test whether you have understood what you have read. At the end of each chapter there are larger study questions. Try to answer as many of the questions as you can as you come across them because asking and answering questions is at the heart of your study of chemistry.

A selection of examination questions, selected from examination papers published by the different examination groups, is included at the end of the book. In many cases they are designed to test your ability to apply your chemical knowledge. The questions may provide certain facts and ask you to make an interpretation of them. In such cases, the factual information may not be covered in the text.

To help draw attention to the more important words, scientific terms are printed in bold the first time they are used. There are also checklists at the end of each chapter summarising the important points covered.

This textbook will provide you with the information you need for your particular specification. We hope you enjoy using this book.

B Earl & LDR Wilford

We use coloured strips at the edges of pages to define different areas of chemistry:

- 'starter' chapters – basic principles
- physical chemistry
- inorganic chemistry
- organic chemistry and the living world.

International hazard warning symbols

You will need to be familiar with these symbols when undertaking practical experiments in the laboratory.

Corrosive.
These substances attack or destroy living tissues, including eyes and skin.

Harmful.
These substances are similar to toxic substances but less dangerous.

Irritant.
These substances are not corrosive but can cause reddening or blistering of the skin.

Oxidising.
These substances provide oxygen which allows other materials to burn more fiercely.

Toxic.
These substances can cause death.

Highly flammable.
These substances can easily catch fire.

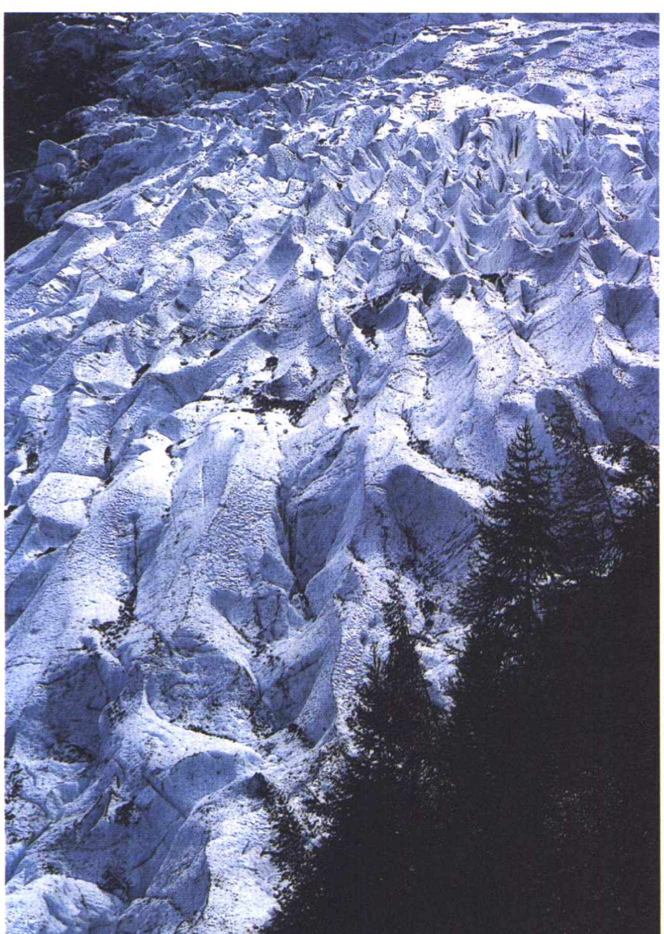
Contents

5 Metal extraction and chemical reactivity

6 Atmosphere

1 All about matter

Chemistry is about what **matter** is like and how it behaves, and our explanations and predictions of its behaviour.[1] What is matter? This word is used to cover all the substances[2] and materials from which the physical universe[3] is composed. There are many millions of different substances known, and all of them can be categorised as solids,[4] liquids[5] or gases[6] (Figure 1.1). These are what we call the **three states of matter**.[7]



a solid

b liquid

c gas

Figure 1.1 Water in three different states.

Solids, liquids and gases

A **solid**, at a given temperature,[8] has a definite volume[9] and shape which may be affected by changes in temperature. Solids usually increase slightly in size when heated (**expansion**)[10] (Figure 1.2) and usually decrease[11] in size if cooled[12] (**contraction**).[13]

A **liquid**, at a given temperature, has a fixed volume and will take up the shape of any container[14] into which it is poured. Like a solid, a liquid's volume is slightly affected by changes in temperature.[15]

A **gas**, at a given temperature, has neither a definite shape nor a definite volume. It will take up the shape of any container into which it is placed and will spread out evenly within it.[16] Unlike those of solids and liquids, the volumes of gases are affected quite markedly by changes in temperature.

Liquids and gases, unlike solids, are relatively **compressible**.[17] This means that their volume can be reduced by the application of pressure.[18] Gases are much more compressible than liquids.

Figure 1.2 Without expansion gaps between the rails, the track would buckle in hot weather.

Words and phrases 单词和短语

1 Chemistry is about ... of its behaviour. 译：化学是一门关于什么是物质及其变化，以及我们对这种变化怎样解释和预测的科学。
2 substance /ˈsʌbstəns/ n. 物质
3 physical universe 物质世界
4 solid /ˈsɒlɪd/ n. 固体
5 liquid /ˈlɪkwɪd/ n. 液体
6 gas /gæs/ n. 气体
7 three states of matter 物质的三态
8 at a given temperature 在某个特定的温度下
9 volume /ˈvɒljuːm/ n. 体积 definite volume 一定的体积
10 expansion /ɪksˈpænʃən/ n. 膨胀
11 decrease /diːˈkriːs/ v. 减小
12 cool /kuːl/ v. 冷却
13 contraction /kənˈtrækʃən/ n. 收缩
14 container /kənˈteɪnə/ n. 容器
15 Like a solid, a liquid's volume ... in temperature. 译：像固体一样，液体的体积仅轻微地受温度变化的影响。
16 It will take ... within it. 译：它将会占据任何形状的容器，并会在容器中均衡地散布开来。
17 compressible /kəmˈpresɪbl/ a. 可压缩的
18 pressure /ˈpreʃə/ n. 压力

The kinetic theory of matter

The **kinetic theory**[1] helps to explain the way in which matter behaves. The evidence is consistent with[2] the idea that all matter is made up of tiny **particles**.[3] This theory explains the physical properties[4] of matter in terms of the movement of its constituent particles.

The main points of the theory are:

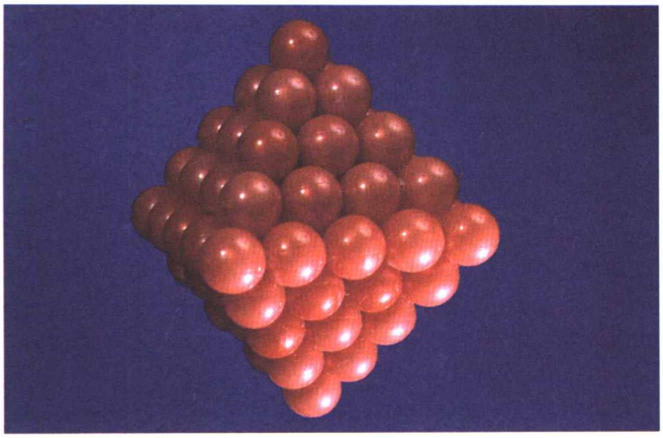
- all matter is made up of tiny, moving particles, invisible to the naked eye.[5] Different substances have different types of particles (atoms, molecules or ions) which have different sizes
- the particles move all the time. The higher the temperature, the faster they move on average[6]
- heavier particles move more slowly than lighter ones at a given temperature.

The kinetic theory can be used as a scientific model[7] to explain how the arrangement of particles[8] relates to the properties of the three states of matter.

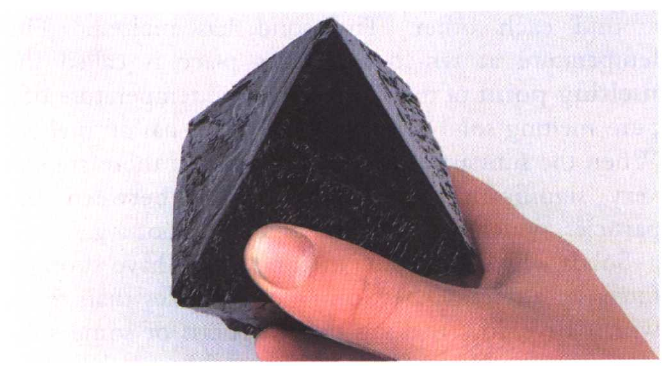
Explaining the states of matter

In a solid the particles attract one another. There are attractive forces[9] between the particles which hold them close together. The particles have little freedom of movement and can only vibrate about a fixed position.[10] They are arranged in a regular manner, which explains why many solids form crystals.[11]

It is possible to model such crystals by using spheres to represent the particles (Figure 1.3a).[12] If the spheres are built up in a regular way then the shape compares very closely with that of a part of a chrome alum[13] crystal (Figure 1.3b).



a A model of a chrome alum crystal.



b An actual chrome alum crystal.

Figure 1.3

Figure 1.4 A modern X-ray crystallography instrument, used for studying crystal structure.

Studies using X-ray crystallography[14] (Figure 1.4) have confirmed[15] how the particles are arranged in crystal structures. When crystals of a pure substance

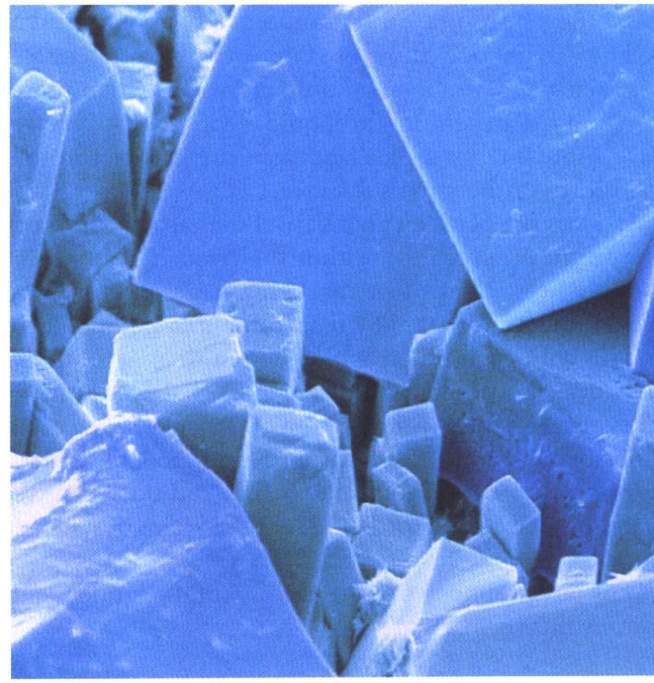


Figure 1.5 Sodium chloride crystals.

form under a given set of conditions, the particles present are always packed in the same way. [16] However, the particles may be packed in different ways in crystals of different substances. For example, common salt (sodium chloride)[17] has its particles arranged to give cubic crystals[18]as shown in Figure 1.5.

In a liquid the particles are still close together but

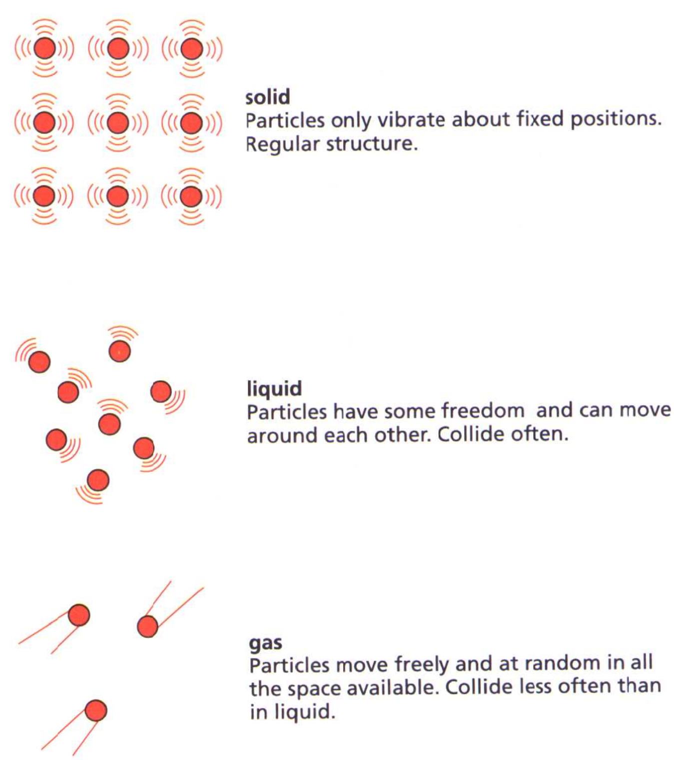


Figure 1.6 The arrangement of particles in solids, liquids and gases.

they move around in a random way[19] and often collide[20] with one another. The forces of attraction[21] between the particles in a liquid are weaker than those in a solid. Particles in the liquid form of a substance have more energy on average than the particles in the solid form of the same substance.

In a gas the particles are relatively far apart. They are free to move anywhere within the container in which they are held. They move randomly at very high velocities,[22] much more rapidly than those in a liquid. They collide with each other, but less often than in a liquid, and they also collide with the walls of the container. They exert virtually no forces of attraction on each other because they are relatively far apart. Such forces, however, are very significant. If they did not exist we could not have solids or liquids (see Changes of state, p. 4).

The arrangement of particles in solids, liquids and gases is shown in Figure 1.6.

Questions

1 When a metal such as copper is heated it expands. Explain what happens to the metal particles as the solid metal expands.

2 Use your research skills on the Internet to find out about the technique of X-ray crystallography and how this technique can be used to determine the crystalline structure of solid substances such as sodium chloride.

Words and phrases 单词和短语

1 kinetic theory 分子运动理论

2 be consistent with 与……一致

3 particle /'pɑːtɪkl/ n. 微粒

4 physical property 物理性质

5 naked eye 肉眼

6 The higher the temperature, the faster they move on average. 译：温度越高，他们平均移动得也越快。

7 scientific model 科学模型

8 the arrangement of particles 粒子的排布

9 attractive force 吸引力 There are ... close together. 本句中 hold 的意思是结合

10 vibrate /vaɪ'breɪt/ v. 振动 The particles have little ... fixed position. 译：粒子几乎没有运动自由，它们只能在一定的位置上振动。

11 crystal /'krɪstl/ n. 晶体

12 sphere /sfɪə/ n. 球体 It is possible ... the particles. 译：我们可以用小球表示粒子将晶体做成模型。

13 chrome alum 明矾(铬矾)

14 X-ray crystallography X射线晶体学

15 confirm 证实

16 When crystals of ... in the same way. 本句中 pack 作为动词，意为排列组成

17 sodium chloride 氯化钠

18 cubic crystal 立方晶体，是晶体结构形状的一种

19 in a random way 以随机的方式

20 collide /kə'laɪd/ v. 碰撞

21 forces of attraction between the particles 微粒间的吸引力

22 velocity /vɪ'lɒsɪtɪ/ n. 速度

Changes of state

The kinetic theory model can be used to explain how a substance changes from one state to another. If a solid is heated the particles vibrate faster as they gain energy. This makes them 'push' their neighbouring particles further away from themselves. This causes an increase in the volume of the solid and the solid expands. Expansion has taken place.

Eventually, the heat energy causes the forces of attraction to weaken. The regular pattern of the structure breaks down.[1] The particles can now move around each other. The solid has melted.[2] The temperature at which this takes place is called the **melting point** of the substance[3]. The temperature of a pure melting solid will not rise until it has all melted. When the substance has become a liquid there are still very significant forces of attraction between the particles, which is why it is a liquid and not a gas.

Solids which have high melting points have stronger forces of attraction between their particles than those which have low melting points. A list of some substances with their corresponding melting and boiling points is shown in Table 1.1.

Table 1.1

Substance	Melting point/°C	Boiling point/°C
Aluminium	661	2467
Ethanol	−117	79
Magnesium oxide	2827	3627
Mercury	−30	357
Methane	−182	−164
Oxygen	−218	−183
Sodium chloride	801	1413
Sulphur	113	445
Water	0	100

If the liquid is heated the particles will move around even faster as their average energy increases. Some particles at the surface of the liquid have enough energy to overcome the forces of attraction between themselves and the other particles in the liquid and they escape to form a gas. The liquid begins to **evaporate**[4] as a gas is formed.

Eventually, a temperature is reached at which the particles are trying to escape from the liquid so quickly that bubbles of gas actually start to form inside the bulk of the liquid.[5] This temperature is called the **boiling point**[6] of the substance. At the boiling point the pressure of the gas created above the liquid equals that in the air – **atmospheric pressure**.[7]

Liquids with high boiling points have stronger forces between their particles than liquids with low boiling points.

When a gas is cooled the average energy of the particles decreases and the particles move closer together. The forces of attraction between the particles now become significant and cause the gas to **condense**[8] into a liquid. When a liquid is cooled it **freezes**[9] to form a solid. In each of these changes energy is given out.[10]

Changes of state are examples of **physical changes**.[11] Whenever a physical change of state occurs, the temperature remains constant during the change (see Heating and cooling curves,[12] opposite). During a physical change no new substance is formed.

An unusual state of matter

Liquid crystals[13] are an unusual state of matter (Figure 1.7). These substances look like liquids, flow like liquids but have some order in the arrangement of the particles, and so in some ways[14] they behave like crystals.

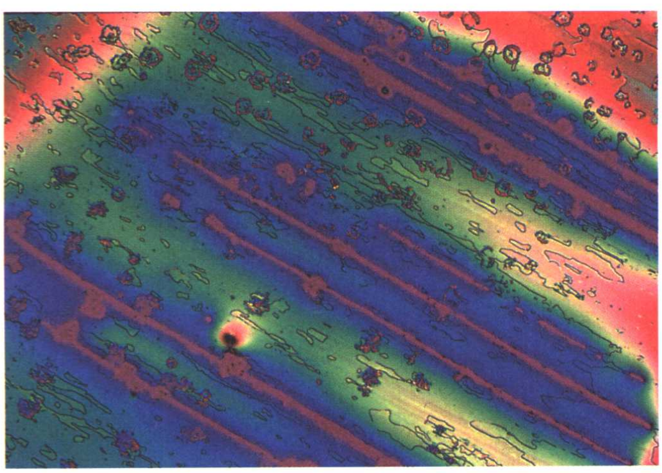


Figure 1.7 A polarised light micrograph of liquid crystals

Liquid crystals are now part of our everyday life. They are widely used in displays for digital watches,[15] calculators and lap-top computer displays[16] (Figure 1.8), and in portable televisions.[17] They are also useful in thermometers[18] because liquid crystals change colour as the temperature rises and falls.

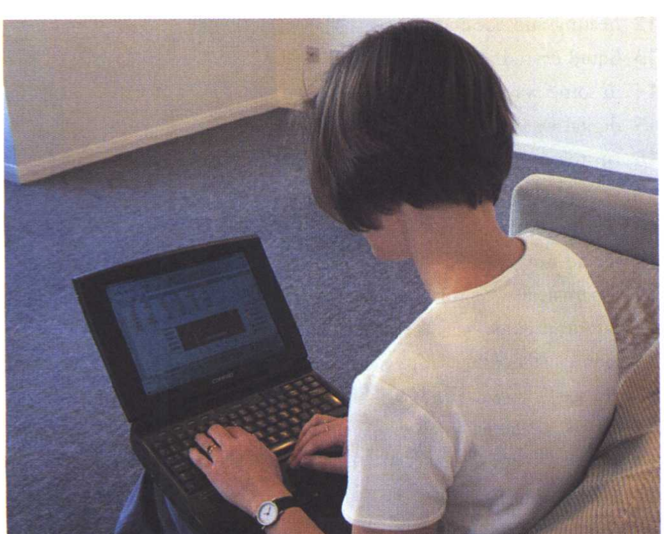


Figure 1.8 Liquid crystals are used in this computer display.

An unusual change of state

There are a few substances that when they are heated change directly from a solid to a gas without ever becoming a liquid. This rapid spreading out[19] of the particles is called **sublimation**.[20] Cooling causes a change from a gas directly back to a solid. Examples of substances that behave in this way are carbon dioxide[21] (Figure 1.9) and iodine.[22]

$$\text{solid} \xrightleftharpoons{\text{sublimation}} \text{gas}$$

Figure 1.9 Dry ice (solid carbon dioxide) sublimes on heating and can be used to create special effects on stage.

sublimation

Carbon dioxide is a white solid called dry ice[23] at temperatures below −78 °C. When heated to just above −78 °C it changes into carbon dioxide gas. The changes of state are summarised in Figure 1.10.

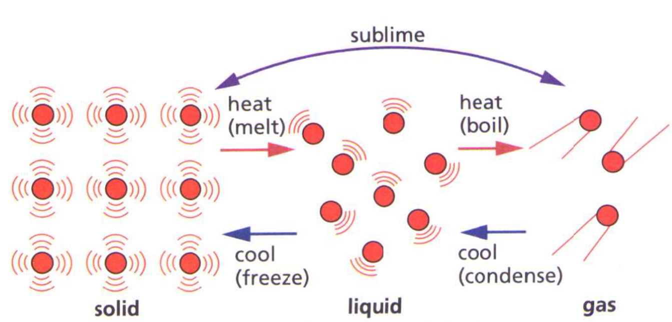


Figure 1.10 Summary of the changes of state.

Heating and cooling curves

The graph shown in Figure 1.11 was drawn by plotting the temperature of water as it was heated steadily from −15°C to 110°C. You can see from the curve that changes of state have taken place. When the temperature was first measured only ice was present. After a short space of time the curve flattens,[24] showing that even though heat energy is being put in, the temperature remains constant.

In ice the particles of water are close together and are attracted to one another. For ice to melt the particles must obtain sufficient energy to overcome the forces of attraction between the water particles to allow relative movement to take place. This is where the heat energy is going.[25]

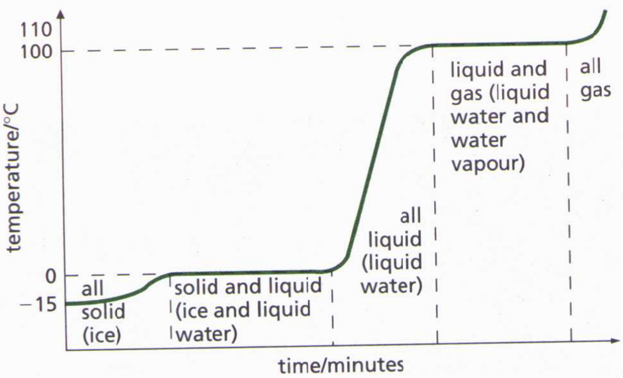


Figure 1.11 Graph of temperature against time for the change from ice at −15 °C to water to steam.

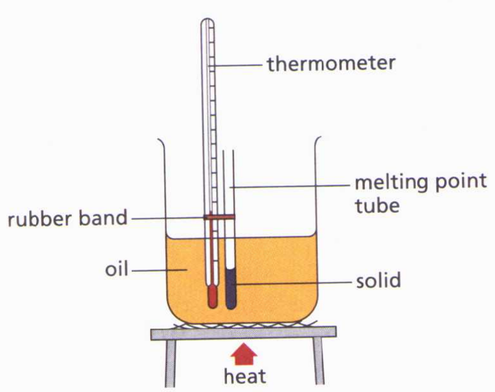


Figure 1.12 Apparatus shown here if heated slowly can be used to find the melting point of a substance such as the solid in the melting point tube.

The temperature will begin to rise again only after all the ice has melted. Generally, the heating curve for a pure solid always stops rising at its melting point and gives rise to a sharp melting point.[26] The addition or presence of impurities[27] lowers the melting point. You can try to find the melting point of a substance using the apparatus[28] shown in Figure 1.12.

In the same way, if you want to boil a liquid such as water you have to give it some extra energy. This can be seen on the graph (Figure 1.11) where the curve levels out at 100 °C – the boiling point of water.

The reverse processes of condensing and freezing occur on cooling. This time, however, energy is given out when the gas condenses to the liquid and the liquid freezes to give the solid.

Questions

1 Write down as many uses as you can for liquid crystals.

2 Why do gases expand more than solids for the same increase in temperature?

3 Ice on a car windscreen will disappear as you drive along, even without the heater on. Explain why this happens.

4 When salt is placed on ice the ice melts. Explain why this happens.

5 Draw and label the graph you would expect to produce if water at 100 °C was allowed to cool to a temperature of −5 °C.

Words and phrases 单词和短语

1 break down 毁掉，终止
2 melt /melt/ v. 熔化
3 melting point 熔点 The temperature at which ... of the substance. 译：发生这一变化(熔化)的温度称为这一物质的熔点。
4 evaporate /ɪ'væpəreɪt/ v. 蒸发
5 bubbles of gas actually start to form inside the bulk of the liquid 气泡真正开始从液体内部产生。
6 boiling point 沸点
7 atmospheric pressure 大气压
8 condense /kən'dens/ v. 凝结，冷凝
9 freeze /friːz/ v. 凝固
10 give out 释放
11 physical changes 物理变化
12 heating and cooling curves 加热和冷却曲线
13 liquid crystal 液晶
14 in some ways 在某些方面
15 digital watch 数字手表
16 lap-top computer display 便携式电脑显示器
17 portable television 手提电视
18 thermometer 温度计，体温计
19 spread out 展开
20 sublimation /ˌsʌblɪ'meɪʃən/ n. 升华
21 carbon dioxide 二氧化碳
22 iodine /'aɪədiːn/ n. 碘
23 dry ice 干冰，即固体二氧化碳的俗名。
24 flatten /'flætn/ v. 变平
25 This is ... is going. 本句中is going意为损耗，消失
26 a sharp melting point 明显的熔点
27 impurity /ɪm'pjʊərɪtɪ/ n. 杂质，非纯净物
28 apparatus /æpə'reɪtəs/ n. 仪器，装置

Diffusion – evidence for moving particles

When you walk past a cosmetics counter[1] in a department store you can usually smell[2] the perfumes.[3] For this to happen[4] gas particles must be leaving open perfume bottles and be spreading out through the air in the store. This spreading out of a gas is called **diffusion**[5] and it takes place in a haphazard[6] and random way.

All gases diffuse to fill the space available to them. As you can see from Figure 1.13, after a day the brown–red fumes[7] of gaseous bromine have spread evenly throughout both gas jars from the liquid present in the lower gas jar.

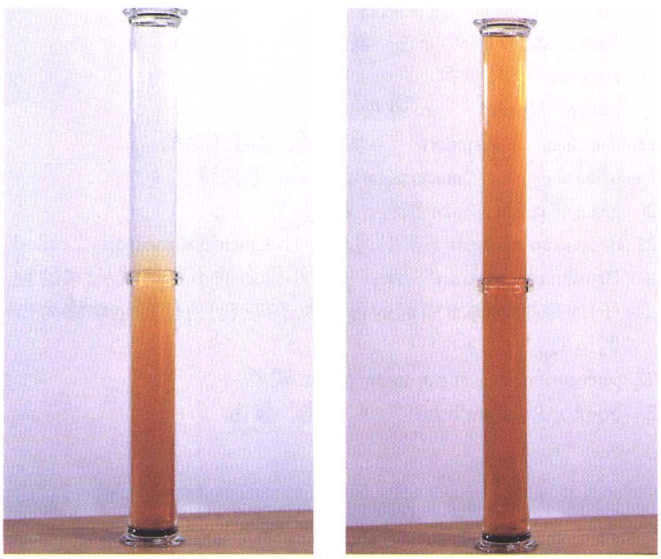


Figure 1.13 After 24 hours the bromine fumes have diffused throughout both gas jars.

Gases diffuse at different rates. If one piece of cotton wool[8] is soaked[9] in concentrated ammonia solution[10] and another is soaked in concentrated hydrochloric acid[11] and these are put at opposite ends of a dry glass tube,[12] then after a few minutes a white cloud[13] of ammonium chloride appears (Figure 1.14). This shows the position at which the two gases meet and react. The white cloud forms in the position shown because the ammonia particles are lighter than the hydrogen chloride particles (released from the hydrochloric acid) and so move faster. Generally, light particles move faster than heavier ones at a given temperature.

Diffusion also takes place in liquids (Figure 1.15) but it is a much slower process than in gases. This is because the particles of a liquid move much more slowly.

When diffusion takes place between a liquid and a gas it is known as **intimate mixing**.[14] The kinetic theory can be used to explain this process. It states[15] that collisions are taking place between particles in a liquid or a gas and that there is sufficient space between the

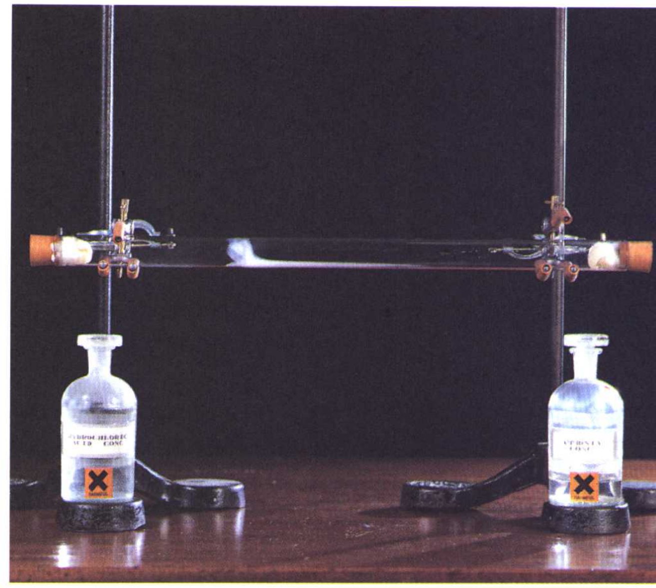
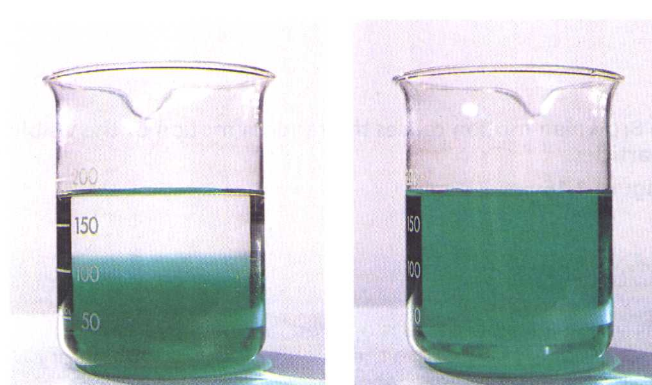


Figure 1.14 Hydrochloric acid (left) and ammonia (right) diffuse at different rates.



a b

Figure 1.15 Diffusion within nickel(II) sulphate solution can take days to reach the stage shown on the right.