



Senior Science
Lifestyle Chemistry

New Revised Edition

David Heffernan

S
Science Press

Contents

Use the table of contents to record your progress through this book. As you complete each topic, write the date completed, then tick one of the three remaining columns to guide your revision for later. The column headers use the following codes:

?? = Don't understand this very well at all.

RR = Need to revise this.

OK = Know this.

Topic	Page	Date completed	??	RR	OK
Introduction	1				
Verbs To Watch	1				
1 Chemicals Used at Home	2				
2 Solutions, Suspensions and Colloids	4				
3 Surface Tension	6				
4 Surfactants and Emulsions	8				
5 Soaps and Detergents	11				
6 The Skin	14				
7 Perspiration and its Control	16				
8 Skin Care	19				
9 Solvents	21				
10 External Medications	23				
11 Digestive System	25				
12 Getting Drugs on Target	27				
13 Pills and Poisons	30				
Topic Test	32				
Answers	34				

© Science Press 2010

First published 2003

Revised edition 2010

Science Press

Private Bag 23

Marrickville NSW 2204 Australia

Tel: (02) 9516 1122 Fax: (02) 9550 1915

Email: sales@sciencepress.com.au

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of Science Press. ABN 98 000 073 861

Introduction

Each book in the *Surfing* series contains a summary, with occasional more detailed sections, of all the mandatory sections of the syllabus, along with questions and answers. It is envisaged this book will be useful in class for both initial understanding and revision, while the more traditional textbook can remain at home for more detailed analysis.

All types of questions — multiple choice, short response, structured response and free response — are provided. Questions are written in exam style and use the verbs specified by the Board of Studies so that you will become familiar with the concepts of the topic and answering questions in the required way.

Answers to all questions are included.

A topic test at the end of the book contains an extensive set of summary questions, including multiple choice and free response questions. These cover every aspect of the topic, and are useful for revision and exam practice. Marking guidelines are supplied where appropriate.

Verbs To Watch

When you are answering questions in this book, your textbook or any examinations, make sure you answer what the question is asking. To do this you will have to know what each of the terms below means — they dictate what sort of an answer is required. It is essential that you learn their meanings as required by the Board of Studies. Your exam answers will be marked according to what these terms indicate your answer should be saying.

account, account for	State reasons for, report on, give an account of, narrate a series of events or transactions.
analyse	Identify components and the relationships among them, draw out and relate implications.
apply	Use, utilise, employ in a particular situation.
appreciate	Make a judgement about the value of something.
assess	Make a judgement of value, quality, outcomes, results or size.
calculate	Determine from given facts, figures or information.

clarify	Make clear or plain.
classify	Arrange into classes, groups or categories.
compare	Show how things are similar or different.
construct	Make, build, put together items or arguments.
contrast	Show how things are different or opposite.
critically (analyse/evaluate)	Add a degree of level of accuracy, depth, knowledge and understanding, logic, questioning, reflection and quality to an analysis or evaluation.
deduce	Draw conclusions.
define	State the meaning of and identify essential qualities.
demonstrate	Show by example.
describe	Provide characteristics and features.
discuss	Identify issues and provide points for and against.
distinguish	Recognise or note/indicate as being distinct or different from, note difference between things.
evaluate	Make a judgement based on criteria.
examine	Inquire into.
explain	Relate cause and effect, make the relationship between things evident, provide why and/or how.
extract	Choose relevant and/or appropriate details.
extrapolate	Infer from what is known.
identify	Recognise and name.
interpret	Draw meaning from.
investigate	Plan, inquire into and draw conclusions about.
justify	Support an argument or conclusion.
outline	Sketch in general terms; indicate the main features.
predict	Suggest what may happen based on available information.
propose	Put forward (a point of view, idea, argument, suggestion etc.) for consideration or action.
recall	Present remembered ideas, facts or experiences.
recommend	Provide reasons in favour.
recount	Retell a series of events.
summarise	Express concisely the relevant details.
synthesise	Put together various elements to make a whole

1 Chemicals Used at Home

The foods that we eat and the substances that we squirt or rub on our bodies are made of chemicals. How we use these substances and how our bodies respond to them depends on the physical and chemical properties of these substances. Many common consumer products that are used daily for food and drink, for entertainment, for hygiene or to maintain health, are mixtures. A **mixture** is a number of substances existing together that can be separated by physical means. In a mixture the proportion of each substance can vary as they are not chemically bonded together.

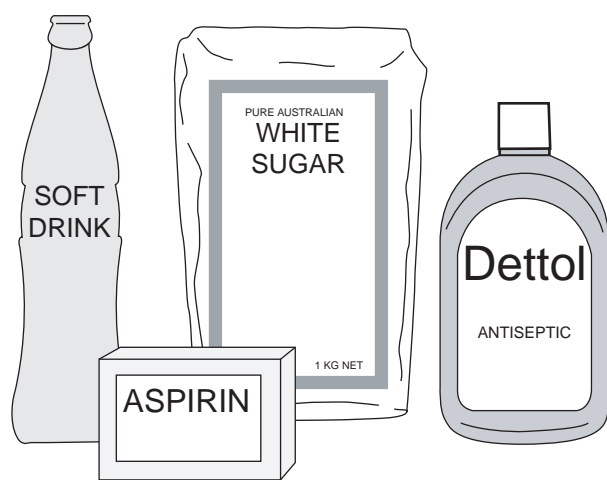


Figure 1. Chemicals used at home

Mixtures Used at Home

Food is composed of substances such as carbohydrates, protein, fats and oils, vitamins, minerals, water, acids, bases, alcohols, esters and many others. A meat pie is a mixture of proteins, fats and salt encased in a mixture of carbohydrates and fats. A cup of tea is a mixture of water, caffeine, sugar while the milk that is added is a mixture of water, fats and proteins.

Mixtures we use during entertainment include those applied to our skin and hair. Cosmetics such as lipstick are a mixture of oils, waxes and colorants. Decorations will be mixtures of paper, plastic, metals and colorants. Drinks contain substances such as water, carbon dioxide, flavourings and colorants.

Mixtures that are used for body hygiene include soap, shampoo, deodorant, toothpaste, cleansing creams and lotions. Antiperspirants that are used under the arms include chemicals to close the sweat glands, others to kill bacteria, fragrances to mask bad smells and a propellant. Toothpaste contains soaps, abrasives, glycerol to retain moisture, thickeners, stabilisers, sweeteners, flavourings, colorants and water!

Mixtures are used to help maintain health including those we have listed for body hygiene. Other mixtures assist in maintaining a hygienic environment such as toilet cleaners, disinfectants and insecticides. Thus an antiseptic such as Dettol contains chemicals to kill bacteria, colorants, fragrances and water. Other mixtures include the medicines we must sometimes take. Aspirin tablets contain aspirin, but also have starch as a filler, binders and preservatives.

Table 1 Chemicals and what they do

Type of chemical	What it does	Precautions when using
Surfactant cleaner	Removes dirt and grease from clothing and grease and food from crockery etc.	Some people develop dermatitis from use of detergents
Degreaser	Removes grease from metal engine parts of cars and trucks	Dangerous to inhale. Flammable
	Removes fats from ovens and blocked drains	Highly caustic
Lubricant	Allows metal parts in cars and engines to move smoothly past each other	Flammable
Pesticide	Insecticides kill insect pests, herbicides kill weeds, etc.	Toxic
Solvent	Chemicals that dissolve other chemicals. We use turps to clean paint brushes and dissolve soluble aspirin in water	Some are flammable
Metal cleaner	Removes tarnish from metals such as chrome on cars or silverware in the home.	Chemicals used may be toxic
Body hygiene chemicals	We treat pimples with acne creams, body odour with deodorants and mouth odour with toothpaste	Sprays are dangerous to inhale
Cosmetics	Perfumes make us smell nice, hair spray keeps our hair in place, lipstick colours the lips	Sprays are dangerous to inhale
Pharmaceuticals	Drugs and medicines are used to treat illness and help maintain our health	All pharmaceuticals are dangerous when not used according to instructions. They are sometimes dangerous when used with other pharmaceuticals

For You to Do

- Identify which of the following chemicals forms part of our food.
(A) Carbohydrate
(B) Aspirin
(C) Kerosene
(D) Insecticide
- Which of the following chemicals is used for personal hygiene?
(A) Herbicide
(B) Methylated spirits
(C) Water
(D) Coffee
- Identify which of the following chemicals is most often used during entertainment.
(A) Insecticide
(B) Plastics
(C) Antibiotic
(D) Kerosene
- Which of the following chemicals is a pharmaceutical?
(A) Kerosene
(B) Contraceptives
(C) Methylated spirits
(D) Water
- In which group below can we classify water?
(A) Degreaser
(B) Surfactant cleaner
(C) Pesticide
(D) Solvent
- It often takes a long time for a chemical idea to be converted into a useful product. Some are listed in the table below.

Table 2 From idea to product

Innovation	Conception	Final product	Year taken
Antibiotics	1910	1940	30
Cellophane	1900	1912	12
Cisplatin (treat cancer)	1964	1972	8
Instant coffee	1934	1956	22
Nylon	1927	1939	12
Photography	1782	1838	56
Roll-on deodorant	1948	1955	15

- Identify the discovery that took longest to develop. Explain why it may have taken so long.
- Some medicines took much longer to develop than others. Suggest why this may be so.
- Classify each innovation as used for food, hygiene, entertainment, medicine, clothing or packaging.

- A wide range of chemicals are used in our everyday life (Table 1). Match each of the uses listed on the right with the chemicals listed on the left.

(i) surfactant cleaner	(a) a fungicide is used to remove mould from the bathroom
(ii) degreaser	(b) silver trays are cleaned of tarnish
(iii) lubricant	(c) cordial is mixed with water before drinking
(iv) pesticide	(d) kerosene is used to clean oil from tools
(v) solvent	(e) mouthwash is used to remove bad breath
(vi) metal cleaner	(f) washing powder
(vii) body hygiene chemicals	(g) an antacid is used to settle an upset stomach
(viii) cosmetic	(h) engine oil in a car
(ix) pharmaceutical	(i) a person takes an aspirin to treat a headache
	(j) oven-cleaner removes fat from an oven's walls
	(k) a person powders their nose
- For each of the items in Figure 1 classify it as used for food, hygiene, entertainment or maintenance of our health.
- A wide variety of chemicals are found in laundry detergents: detergent (surfactant), builders, corrosion inhibitors, enzymes, bleaches, whitening agents and fragrances are some. Use your textbook and other sources to find out what each component of the mixture does and identify an example of a chemical used for that purpose.
- Chemicals can be classified in a variety of ways. Using your textbook, discuss three different ways that we can classify pesticides.

2 Solutions, Suspensions and Colloids

A wide range of consumer products occur as solutions, colloids and suspensions.

Solutions are mixtures that have the same properties throughout and cannot be filtered. Solutions are ions or molecules spread throughout a solvent, e.g. sugar mixed with water, alcohol in water (wine).

Suspensions are mixtures with the same properties throughout but with particles large enough that they can be filtered and which will settle out to form layers relatively quickly. The particles are clumps of molecules spread throughout the solvent and are big enough to be seen with a microscope, e.g. clay in water.

Colloids are mixtures with the same properties throughout but with particles too small to be filtered and which will not settle out to form layers relatively quickly. A famous colloid was formed in 1857 when Michael Faraday (1791–1867) dispersed gold in water. This colloid is still in the London Museum and has not settled out. The particles are small clumps of atoms, ions or molecules that have a diameter of 1 nm to 10 μm and are too small to be seen with a microscope. Although a colloid may sometime look clear like a solution, you can see a beam of light when shone through it. This is because the particles are big enough to scatter the light. Table 3 lists a number of colloids.

A number of colloids are common in foods (Figure 2). **Foams** include soap suds, whipped cream or egg-whites, carpet shampoo, and the froth that comes from fire extinguishers. Foam is a gas-in-liquid colloid. The foam from beaten or whisked egg-whites is used to lighten the texture of cakes and in meringues. The beating adds bubbles of air to the egg to form a gas-in-liquid colloid.

Emulsions are liquid-in-liquid colloids. A common example is ordinary homogenised milk where tiny butterfat globules are spread (dispersed) throughout water — an oil-in-water emulsion. The milk is forced through small openings to break up the larger fat globules in the milk that comes straight from the cow. Cosmetics such as moisturisers and lotions are emulsions of either oils-in-water or water-in-oil. Oil-in-water cosmetics produce a cooling effect as the water evaporates, leaving behind a layer of oils on the skin. Water-in-oil cosmetics allow the oil to reach the skin more quickly but have no cooling effect. The perfume used to make them attractive is usually dissolved in the oil of the cosmetic.

Vinaigrette is an emulsion of oil and vinegar (water makes up most of the vinegar) that is used as a salad dressing. The oil helps smooth the tartness of the vinegar. To create the emulsion the oil and water must be shaken or stirred so the oil breaks up into separate droplets. In some vinaigrettes you have to shake the bottle each time it is used as the oil and vinegar have reformed separate layers. In other vinaigrettes chemicals called **emulsifiers** are added to stop the droplets from joining together again.

Vinaigrette made with two parts oil and one part vinegar, using ground mustard as emulsifier, will produce an oil-in-water emulsion. If the oil-to-water ratio is increased to three-to-one then a water-in-oil emulsion will result.

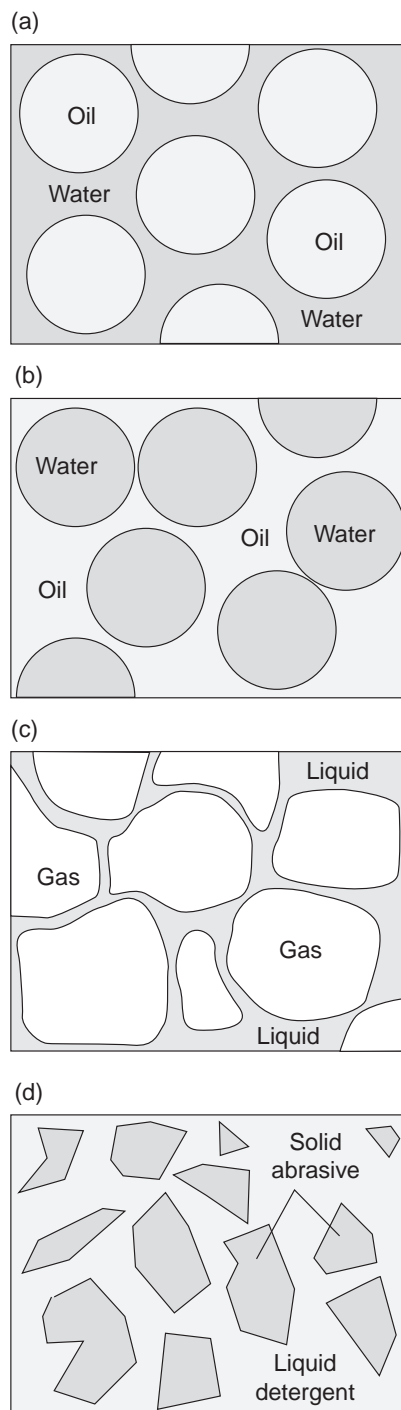


Figure 2. Types of colloid (a) Oil-in-water such as milk, (b) water-in-oil such as mayonnaise, (c) gas-in-liquid such as foam, (d) solid-in-liquid such as toothpaste.

Table 3 Colloids

Type of colloid	Common name	Examples
Solid-in-solid		Coloured gemstones, some alloys
Solid-in-liquid		Paint, toothpaste, printing ink, clay in water
Solid-in-gas	Aerosol	Smoke, airborne bacteria
Liquid-in-solid	Gel	Gelatin, jelly, butter, cheese, opal and pearl
Liquid-in-liquid	Emulsion	Homogenised milk (oil-in-water), salad dressing (oil-in-water), mayonnaise (oil-in-water), cosmetics (either), detergent (oil-in-water)
Liquid-in-gas	Aerosol	Fog, hairspray, mist
Gas-in-solid		Popcorn, insulating foam (eg. polystyrene), marshmallow, pumice
Gas-in-liquid	Foam	Whipped cream, fire-extinguisher foam
Gas-in-gas		Does not exist

Some emulsifiers are much better than others. Egg yolk, for example, is such a good emulsifier that stable oil-in-water emulsions can be produced that contain up to 75 per cent oil. Egg whites are used as the emulsifier in mayonnaise which is made of three-parts oil to one part vinegar. Mayonnaise has a smoother texture which many people find pleasing.

For You to Do

- 1 A beam of light is shone onto a beaker containing a clear liquid. Most of the light passes straight through, but the liquid scatters some of the light in many directions. Which of the following is the most likely substance present in the beaker?
(A) A sugar solution.
(B) A suspension of muddy water.
(C) A colloid such a diluted milk.
(D) A colloid such as mayonnaise.
- 2 When a liquid is filtered a solid deposit is left on the filter paper. Which of the following is the most likely substance present in the beaker?
(A) A solution.
(B) A suspension.
(C) A colloid.
(D) None of the above.

- 3 Which type of colloid is a frothy shampoo?
(A) Gas-in-liquid.
(B) Oil-in-water.
(C) Water-in-oil.
(D) Liquid-in-liquid.
- 4 Which class of material is added to some colloids to prevent the different parts from separating?
(A) Foam.
(B) Emulsion.
(C) Gel.
(D) Emulsifier.
- 5 Which of the following is an example of a suspension?
(A) Sand storm.
(B) Mayonnaise.
(C) Soft drink.
(D) Concrete.
- 6 Use Table 3 to classify the following colloids.
(a) Cream (a mixture of oils/fats and water).
(b) The 'head' on beer.
(c) Clouds.
- 7 Using Figure 2 as a guide, draw diagrams to illustrate the following colloids.
(a) Liquid-in-gas such as hairspray mist.
(b) Liquid-in-solid such as butter.
(c) Gas-in-solid such as marshmallow.
- 8 Some cosmetics applied to the skin are colloids such as oil-in-water or water-in-oil. Outline the advantages of applying cosmetics that are colloidal to the skin.
- 9 Some foods are emulsions of oil-in-water. Identify such a food and outline the advantage of a mixture being in that form.
- 10 Describe how you can produce a stable colloid of one of the following.
(a) Beaten or whisked eggs.
(b) Salad dressing (oil/vinegar).
(c) Mayonnaise.
- 11 Use your experimental work in the laboratory to answer the following questions.
(a) Describe how to prepare an emulsion.
(b) Describe how you made the emulsion stable.
(c) Compare the properties of the stable emulsion to those of a solution and suspension.
- 12 Use diagrams to show the relative sizes of the particles found in solutions, colloids and suspension.

NOTES