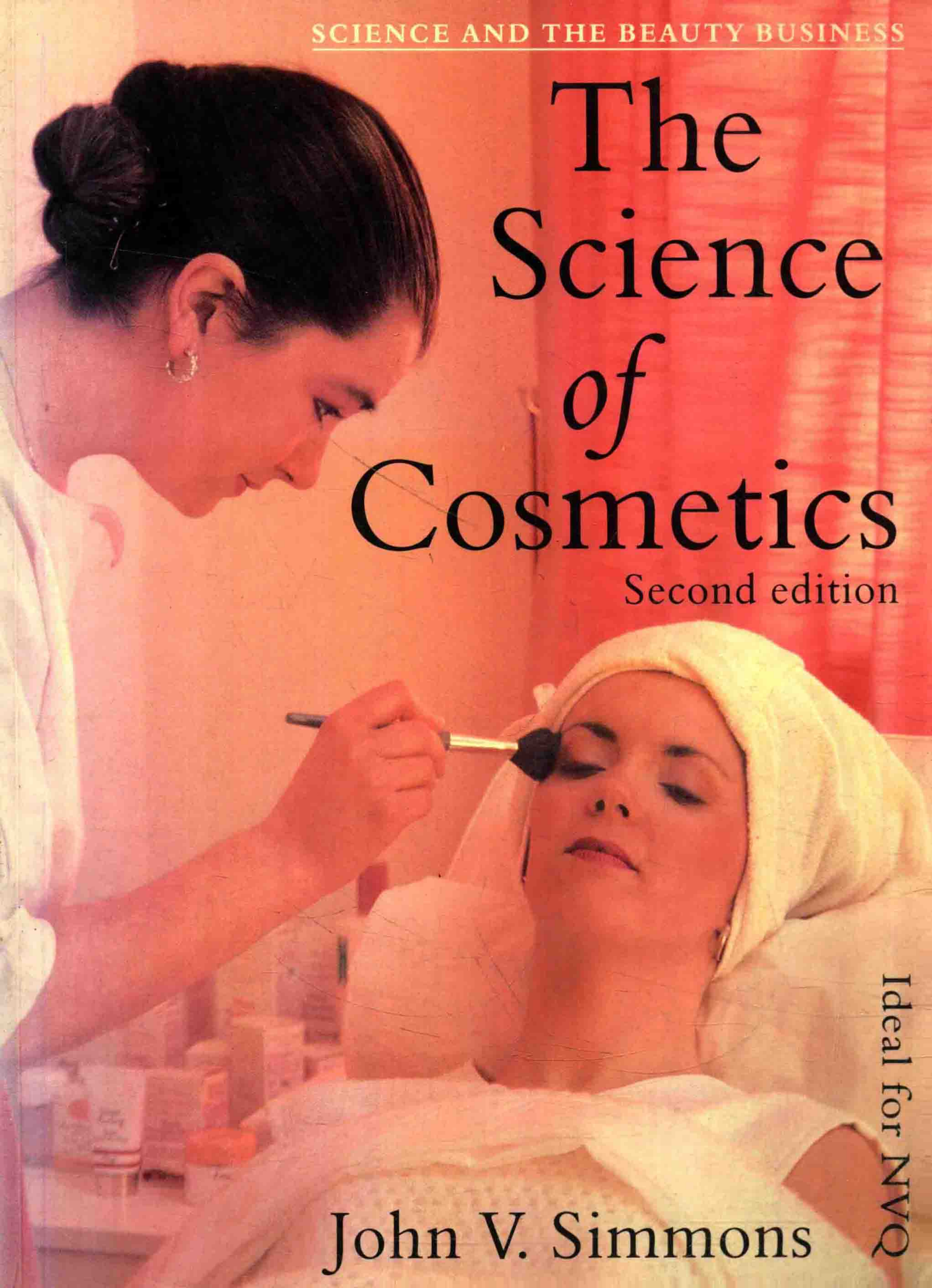
SCIENCE AND THE BEAUTY BUSINESS

The Science *of* Cosmetics

Second edition



Ideal for NVQ

John V. Simmons

Science and the Beauty Business

The Science of Cosmetics:

Second Edition

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Science and the Beauty Business —
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Preface

The scientific principles of Beauty Therapy divide quite naturally into two distinct areas: the science of cosmetics and toiletries which is the subject of this volume, and the science of the salon and its equipment which is dealt with in a companion volume – *The Beauty Salon and its Equipment.*

Together, the two volumes are primarily intended for students of Beauty Therapy studying for the major examinations offered by BTEC, the City and Guilds of London Institute and the professional beauty therapy organisations including those preparing for National Vocational Qualifications at all levels.

The content is however deliberately not limited by the examination syllabuses. Instead it examines the scientific principles of all aspects of the beauty industry and as such it will be valuable to all who seek a good general insight into the subject.

Cosmetics & toiletries

Cosmetics are products to be applied to improve the appearance and instil a feeling of self-confidence – to LOOK GOOD, SMELL GOOD and FEEL GOOD.

There are actually two groups of products, *cosmetics* and *toiletries*. Until recently the two terms were ill-defined. Some products were called cosmetics, some were toiletries and others could be either. Legislation has now clarified the matter:

Cosmetics – are skin care and decorative products; that is, skin creams and lotions and make-up.

Toiletries – are cleansing products and 'active' products such as anti-perspirants and depilatories.

There remains, however, a 'grey' area in distinguishing between certain active cosmetics and pharmaceuticals. To be effective some products must actually affect the *physiology* of the part of the body to which they are applied. This brings them rather close to being products applied for a medicinal purpose.

The sequence of the book

The early chapters consider the theoretical and practical aspects of the formulation of cosmetics and toiletries. Next there follow chapters on the skin and skin care products, the hands, the feet and the nails, the hair and hair care products, and the teeth. Finally the book deals with perfumery, product safety and the packaging of products.

The formulations

Although it is by no means an exhaustive 'recipe book', many formulations for products are given. Mostly, they have been selected from the technical literature. They have been chosen with two main considerations in mind:

1 that they are representative of the particular type of product – though it is unlikely that they will exactly copy any market brand;
2 that, as far as possible, the raw materials used are obtainable from the usual laboratory suppliers, although this is not always possible and certain materials will have to be obtained from specialist suppliers or even from the manufacturers.

The legal considerations

As far as possible, the suggested formulations comply with the current legislation regarding cosmetics and toiletries as laid down in the *EEC Cosmetics Directive* of 1972 and enacted in the UK by the *Cosmetic Product Regulations* of 1978 which are part of the Consumer Protection Act of 1961.

This legislation is under constant review and is frequently updated, so the intending manufacturer must ascertain the legal position current at the time regarding the materials and methods it is intended to use. The current 'complete edition' of the legislation is the Cosmetic Products (Safety) Regulations 1989. This has been amended each year since. He must also appreciate that the manufacturers and suppliers of raw materials ACCEPT NO RESPONSIBILITY for the way in which their materials are used.

When innovative materials and formulations are introduced it is customary for the innovators to *patent* their ideas. If it is intended to manufacture any published formulation *for sale*, the manufacturer must ascertain the patent situation regarding that formulation.

Acknowledgements

I wish to express my gratitude to my many friends and colleagues in the Cosmetics Industry and in the Beauty Profession, and in particular to fellow members of the Society of Cosmetic Scientists who have both knowingly and unknowingly contributed to the content of this Volume. I also offer my most grateful thanks to beauty therapist Teresa Zajac for her tremendous assistance in preparing and checking the text and the illustrations.

JOHN V. SIMMONS

Contents

1 Weighing & Measuring in Laboratory & Salon

Metric system – Système International; conversion between metric and Imperial; weighing and measuring in the beauty salon; weighing and measuring equipment in the laboratory; density and relative density; temperature

Weights and measures

In the quest for beauty, health and fitness, people are made to feel constantly aware of their personal weight and measurements.

It has been customary in the United Kingdom and much of the English-speaking world to use the Imperial System of weights and measures – stones and pounds, feet and inches. In the modern international world we should however be using the international metric system, *Système International* or SI for short.

Science has used the metric system for many years, but in the UK we have been most reluctant to use it, either in industry or in our everyday lives.

SI tables for length, volume and weight

Length – standard unit, the **metre.**
10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)

Volume – standard unit, the **decimetre cubed** or **litre.**
1000 centimetres cubed (cm^3) or millilitres (ml), = 1 decimetre cubed (dm^3) or litre (l)

Weight – standard unit, the **gram.**
1000 milligrams (mg) = 1 gram (g)
1000 grams (g) = 1 kilogram (kg)

Conversions between SI and imperial units

Until one is familiar with the 'size' of metric units, it is useful to compare them with Imperial units. Here are some typical conversions:

For *length:*	1 inch	= 2.54 centimetres
	1 centimetre	= 0.39 inches
	1 metre	= 39.4 inches

Very approximately, an inch is about 2½ centimetres and a metre is 3 inches more than a yard.

For *volume:*	1 fluid ounce	= 28.4 centimetres cubed
	1 pint	= 568 centimetres cubed
	1 litre	= 1.76 pints

Approximately, a fluid ounce can be compared with 30 centimetres cubed and a litre is 1¾ pints.

For *weight:*	1 pound	=	454 grams
	1 kilogram	=	2.2 pounds
	1 ounce	=	28.4 grams
	1 stone	=	6.35 kilograms

Approximately, 30 grams are equivalent to an ounce and a stone is 6⅓ kilograms.

Weighing and measuring in the beauty salon

Ideally, the personal measurements of clients should be taken and recorded in *metric* units. For this purpose measuring tapes, height gauges and personal scales are all available, calibrated in metric units. Frequently they show Imperial units as well, so it is easy to compare measurements in the two systems (see figures 1.1, 1.2, 1.3 and 1.4).

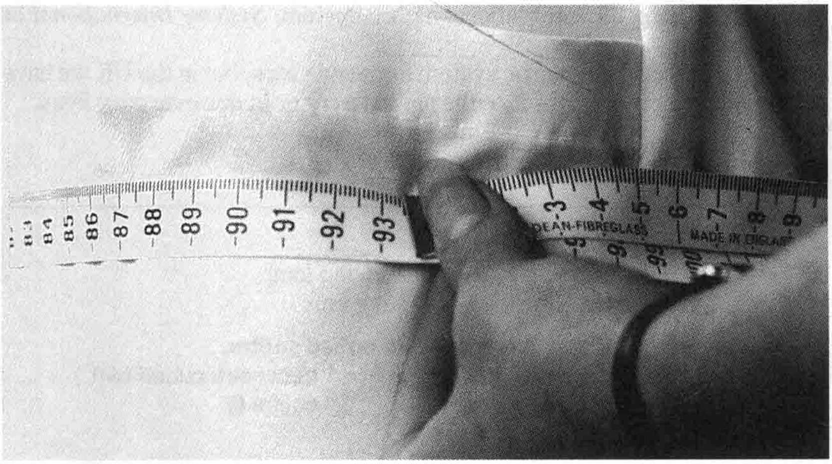

Figure 1.1 Using a metric tape to take personal measurements

Figure 1.2 A personal height gauge

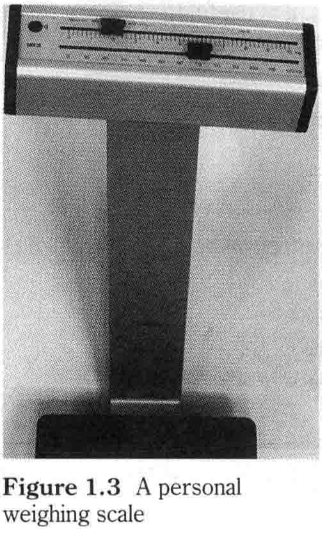

Figure 1.3 A personal weighing scale

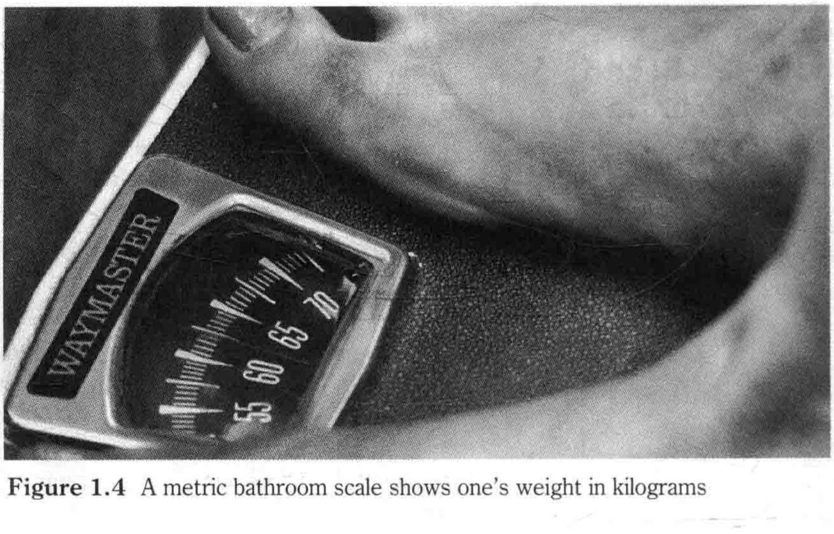

Figure 1.4 A metric bathroom scale shows one's weight in kilograms

In practice, though, you will find that metric units will mean little to most of your clients. An amazing 50 kilograms is barely 8 stone. Even the winner of a beauty contest might be alarmed to know her 'vital statistics' are 91, 61, 91 – the centimetre equivalent of 36, 26, 36!

Weighing and measuring in the laboratory

For most purposes in the laboratory, such as the making of samples of cosmetics, weighing may be done on a simple laboratory balance such as the 'sliding mass' type so long as it is accurate to within 0.1 g (see figure 1.5).

For more accurate weighings where small amounts of materials are required, a modern electric or electronic balance is desirable (see figure 1.6).

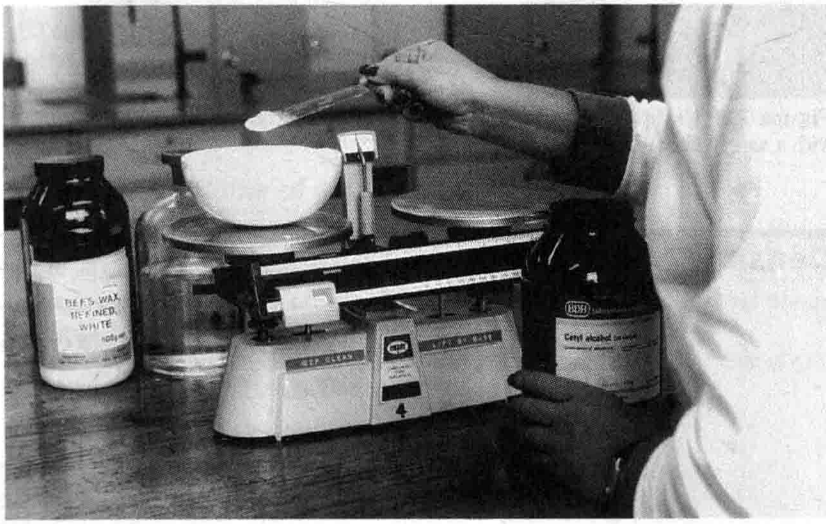

Figure 1.5 Using a sliding mass balance to weigh materials for a sample of a cosmetic

Figure 1.6 An electronic top-pan balance

Such a balance is accurate to within 0.01 g or even 0.001 g. Remember that a balance is an expensive precision instrument and should be treated with great care.

Materials should always be weighed in a container and *never* directly on to the balance pan. To take account of the weight of the container, a '*tare*' facility is very useful. This enables you to place the empty container on the balance and reset the scale to zero before weighing the material. Do not forget to reset this facility for each container.

In most cases the measuring of volumes of liquids can be done in *measuring cylinders*. These are accurate enough for larger quantities (see figure 1.7). To dispense small volumes of liquids more accurately, a suitable *pipette* or even a *burette* could be used (see figures 1.8 and 1.9). Always remember to use a pipette filler. Never suck up liquid into it by mouth.

Note that the liquid surface in a measuring device is *not* level, but curves where it meets the glass. This curved surface is called a *meniscus*. When reading a volume of liquid, the *bottom* of the curve is adjusted to the line on the scale (see figure 1.10).

Viscous liquids such as oils or glycerol are not easy to measure by volume. Even if you succeed in pouring the correct quantity into a measuring cylinder, you will have great difficulty pouring it all out again. It is much better to *weigh* such liquids directly into the mixing vessel.

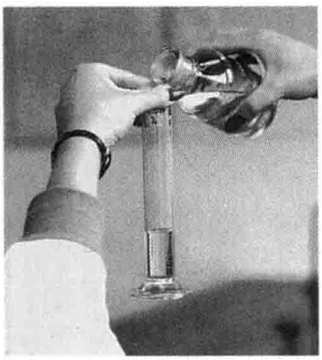

Figure 1.7 How to use a measuring cylinder

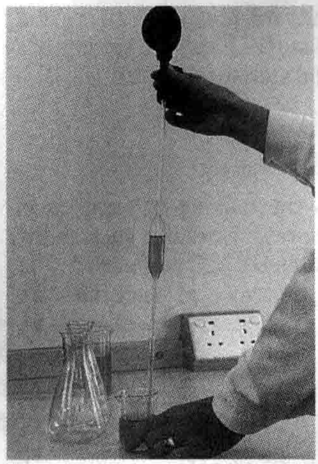

Figure 1.8 Using a pipette with a safety filter

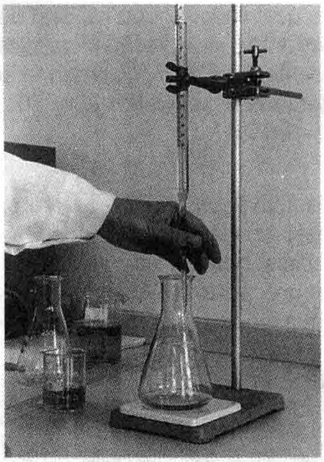

Figure 1.9 Using a burette

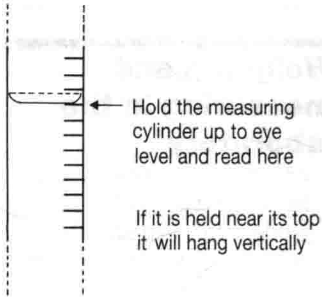

Figure 1.10 Reading the level of liquid in a measuring cylinder

Density

In the 'recipe' or *formulation* for a cosmetic product it is usual to show the relative quantity of each raw material in *parts by weight* out of 100.

Formulation for a traditional cold cream

White beeswax – 16.0	Borax – 0.8
Mineral oil – 50.0	Water – 33.2

The beeswax and borax are solids. They can be weighed out. The water and mineral oil are liquids, so it might be more convenient to measure them by volume.

To find the volume of a certain weight of a substance we need to know its *density*. Density is the relationship between the weight or *mass* of a substance and its volume: that is, whether a substance is 'light' like air or 'heavy' like lead.

Density is the mass in grams of 1 cm^3 of a substance.

To find the density of a substance, weigh a sample of it and find its volume. Then:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} \ \text{g/cm}^3$$

For example, to find the density of the rectangular block of iron shown in figure 1.11:

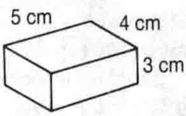

Figure 1.11 Finding the density of an iron block

Volume	= 5 cm × 4 cm × 3 cm
	= 60 cm^3
Weight	= 470 g
Density	$= \frac{470}{60}$
Density of iron	= 7.83 g/cm^3

Density of liquids

The density of a liquid may be found by carefully measuring out, say, a 100 cm^3 sample and weighing it. Here are some useful examples:

100 cm^3 of WATER weighs 100 g.

The *density of water* is, therefore, $\frac{100}{100}$ or 1 g/cm^3.

100 cm^3 of MINERAL OIL weighs 86 g.

The *density* of *mineral oil* is $\frac{86}{100}$ or 0.86 g/cm^3.

100 cm^3 of ALCOHOL weighs 80 g

The *density of alcohol* is $\frac{80}{100}$ or 0.80 g/cm^3.

Finding the volume of a liquid in a formulation

Water is easy. Because its density is 1 g/cm^3, each gram of water is also 1 cm^3. So if the formulation requires a certain number of grams of water, just measure out that number of cm^3. To make a 100 g sample of the cold cream requires 33.2 g – that is, 33.2 cm^3 of water.

The mineral oil is not quite so easy. Each gram is *not* 1 cm^3. The cold cream requires 50 g of mineral oil. Let us work out its volume.

$$\text{If Density} = \frac{\text{Mass (Weight)}}{\text{Volume}}$$

by transposing

$$\text{Volume} = \frac{\text{Weight}}{\text{Density}}$$

So if we divide the required weight of a liquid by its density we get its volume. The density of mineral oil is 0.86 g/cm^3 and we require 50 g:

$$\frac{50}{0.86} = 58$$

We must measure out 58 cm^3 of mineral oil. But remember mineral oil is a *viscous* liquid – it is not very 'runny'. In practice it is much easier to *weigh* it into the mixing vessel rather than measure it by volume.

Alcohol is frequently used in cosmetic products. Being free flowing it is more convenient to measure it by volume than weigh it. Again we must be aware that each gram is *not* 1 cm^3.

In this simple formulation for a hair setting lotion, the setting agent, polyvinyl pyrrolidone is dissolved in a mixture of alcohol and water.

Formulation for a hair setting lotion

Polyvinyl pyrrolidone	– 2.0
Alcohol	– 48.0
Water	– 50.0

We require 48 g of alcohol. Its density is 0.80 g/cm^3 so we divide the weight by the density:

$$\frac{48}{0.80} = 60$$

We must measure out 60 cm^3 of alcohol.

Relative density or specific gravity

For liquids the term *relative density* is frequently used instead of density. Relative density is the density of a liquid compared with that of water. In effect, it is the number of times a liquid is 'heavier' than water. Water is 'as heavy as itself'! Its relative density is 1.

To find the relative density of a liquid, weigh a sample of the liquid then weigh an equal volume of water.

$$\text{Relative density} = \frac{\text{Weight of sample of liquid}}{\text{Weight of equal volume of water}}$$

An example:

> 100 cm^3 of alcohol weighs 80 g
>
> 100 cm^3 of water weighs 100 g
>
> Relative density of alcohol $= \frac{80}{100}$ or 0.80

Relative density is numerically the same as density but it is just a number. It has no units.

Hydrometer

A simple way to measure the relative density of a liquid is to use a floating device called a *hydrometer.* This floats to a greater or lesser depth in a liquid, depending on its relative density. The reading is taken at the point on the scale at liquid surface level (see figures 1.12 and 1.13).

Remember to handle a hydrometer carefully. It is made of glass. It is very fragile and good ones are quite expensive.

The main use made of relative density measurements is to check the strength of solutions. A solution of a particular substance of a certain strength always has the same relative density.

Solutions of *hydrogen peroxide* are used a great deal by hairdressers and to some extent by beauty therapists. It is vitally important that the correct strength of solution is used.

Table 1.1 shows how the percentage strength, the 'volume strength' and the relative density are related.

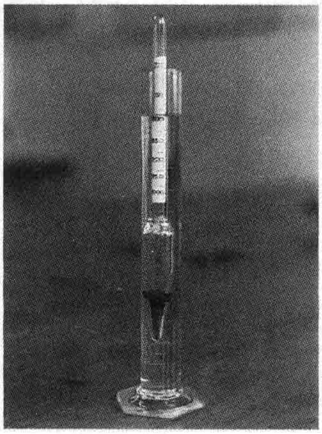

Figure 1.12 Using a hydrometer to measure the relative density of a liquid

Table 1.1 Relative Density of Hydrogen Peroxide Solutions

% Strength	*'Volume Strength'*	*Relative Density*
3%	10 volume	1.010
6%	20 volume	1.020
9%	30 volume	1.030
12%	40 volume	1.040
18%	60 volume	1.060
30%	100 volume	1.100

↑ Note the coincidence ↑

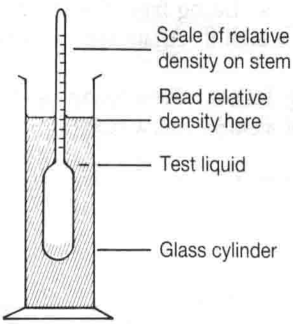

Figure 1.13 Reading a hydrometer