New Zealand Pool Industry Association Inc, PO Box 17069 Greenlane 1546 – email executive@poolguild.org.nz

TEST PAPER 2.

GLOSSARY OF TERMS & UNITS OF MEASUREMENT

By signing this document (below) **I signify that have read this PAPER thoroughly and believe I have a good understanding of the Terms used in swimming pool industry and understand the Units of measurement which will be in common usage in my role in the New Zealand swimming pool industry.**
I will keep this PAPER for reference material

Your Name _____ Membership Number _____ *If a NZPIA Member*

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GLOSSARY OF TERMS used and, useful **UNITS OF MEASUREMENT**

Introduction:

This PAPER is a ***reference guide*** which you will find necessary to refer to often throughout the course.

Just for the record, "Hyper-Thymesia" is the word for a highly superior auto-biographical **memory** (HSAM).
So ***Unless you have a 100% memory,*** *it is not possible to retain the full implications of all the terms used* until they are discussed in more detail throughout the latter parts of our course. So read on.

As we briefly discuss these common terms it will enhance your understanding and awareness of the course and therefore understanding and awareness of the correct procedures and functions of a home swimming pool.

Glossary of Terms:

ACID: A chemical used to lower the pH of pool water by neutralising the alkalis (see alkalis also). The most commonly used acids in home pools are Hydrochloric or Muriatic acids, (liquid acids) or Sodium Bisulphate (dry acids).

ACID DEMAND: The amount of acid needed in a pool to lower the pH to the desired level, ideally for the most efficient overall usage.

ALGAE: Tiny plant-like organisms, introduced to the pool by wind and rain which, if not eliminated, will grow at a rapid rate to discolour the pool water and interior finishes.

ALGAE SPORES: These are the microscopic cells of the algae, which can be transferred from one place to another.

ALGICIDE: A chemical used to either prevent algae growth, or to kill algae growth in pool water.

ALKALI: A chemical used to raise the pH and total alkalinity of pool water. The most common alkalis are Soda Ash and Sodium Bicarbonate.

BACKWASHING: The term used to clean a filter by reversing the flow of water through the filter medium to remove the dirt and accumulated debris.

BACTERIA: Microscopic and disease bearing organisms introduced to the pool by swimmers, wind blown dirt and debris, etc.

BAQUACIL: A liquid disinfectant, which doesn't contain any chlorine and is not compatible with chlorine, which is used in conjunction with a shock treatment called Baquashock.

BASE: See Alkali.

BUFFER: Also called pH buffer of pH stabilizer. An alkaline chemical used to raise the pH and total alkalinity of pool water. The correct total alkalinity helps to maintain or "buffer" the pH in the desired range.

CALCIUM HYPOCHLORITE: A granulated powder type of chlorine, usually 65% in strength and carried in a calcium base.

CARTRIDGE FILTER: A swimming pool filter medium that uses a polyester/cotton, concertina like cartridge, (similar to a motorcar's air filter) to cleanse the pool water.

CHLORINATION: The term used for the adding of chlorine in whatever form to the pool water.

CHLORINATORS: Usually termed automatic chlorinators when in fact most are chlorine "dosers". There are three main types of chlorine dosers used to add chlorine to pool water:

> Floating dispensers, that allows chlorine usually in tablet form (usually Trichloroisocyanurate, or "Tri-Chlor")to dissolve in the main body of pool water.
>
> In-line Tri-Chlor feeder or Liquid Chlorine injector which introduces chlorine into the return line of the pool plumbing system and
>
> Salt chlorination system which uses a 12-volt electrolytic cell placed in the return line plumbing system to convert salt (Sodium Chloride) that has been added to the pool water effectively into a chemical (Sodium Hypocholite) with similar traits to granular chlorine (Calcium hypochlorite). Electrolysis of saline water generates Sodium Chloride and Sodium Hydroxide in equal quantities. Sodium Hydroxide (Caustic Soda) has a pH of 14, so regular pH adjustments are required when a Saline Chlorinator is used.

CHLORINE: The most commonly used chemical to kill algae and bacteria in pool water. Available in granular (aka Cal Hypo) or liquid forms

CHLORINE DEMAND: The amount of chlorine needed to kill all the pollutants in pool water.

CHLORINE RESIDUAL: Also called free available chlorine (FAC) which is the amount of chlorine left after the chlorine demand has been met, to kill any future contaminates that may be introduced to the pool water.

CHLOROMINE: Free chlorine is used up by combining with ammonia to make a chloromine (OCL) which is an ineffective form of chlorine that will cause eye, nose and throat irritations to bathers. Chloramine is 1/25,000 strength of FAC so is useless at sterilizing the pool.

CLARITY: The "clearness" of pool water. It should at least be possible to read heads or tails on a twenty-cent coin in 1.5-meter-deep pool water.

CONDITIONER: See Stabilizer.

COPING: The walking surface immediately surrounds the pool.

CORROSION: (See Langelier Index) If LSI is negative no potential to scale exists and the pool water will dissolve $CaCO_3$ – obviously which is damaging to plaster finishes.

CYANURIC ACID: Usually called Stabiliser or Conditioner. A granular powder which when dissolved and introduced to the pool water in the correct levels will reduce the amount of chlorine lost to the suns rays by occupying the uppermost level of the pool water.

DI-ATOM-ACE-OUS EARTH: (Hyphenated for clarity) Most easily referred to as D.E. and used as the filter medium in D.E. filters. D.E. is a naturally occurring fossil, which lived millions of years ago in huge colonies like coral. It is mined and crushed into a fine powder, which forms a layer on the filter elements to trap the minute specks of dirt and debris. Some areas will not allow DE filters due to the contamination of waste water systems.

DRY ACID: See Acid.

FILTRATION: The process of passing the pool water through a filter medium to remove the minute particles of dirt, debris and bacteria.

FILTER SEPTUM: See Septum.

FLOCCULANT: (aka FLOC) May be a dry powder or liquid form chemical (Aluminium Sulphate - aka "Floc") used to combine the negatively charged groups of suspended matter to the positive, thus making them large enough to be removed by the filter, or heavy enough to sink to the bottom of the pool for removal by vacuuming.

HAIR & LINT STRAINER OR POT: Used to trap the solids that can pass through the skimmer-box basket yet still block or reduce the pumping ability of the pump impeller.

HARDNESS: The level of dissolved solids in the pool water, which are mostly made up of Calcium Carbonate, and Magnesium expressed as mg/1. If the hardness of a concrete pool water is too low, the pool will try to gain calcium from the plaster finish – so the remedy for that is to "up" the available calcium by adding calcium chloride to the water. Then maintaining the hardness leve as recomended saves the pool-wall finish from damage
Residential swimming pools are recommended to have between 200 ppm and 400 ppm (200 - 400 mg/Liter) hardness. In the USA, a hardness level of 500ppm (500 mg/Liter) is often recommended for plastered concrete pools, but 300 is more common in New Zealand

HOCL (Hypochlorous Acid – pH range of 3.0 to 6.0) the component of chlorine that is most effective at sterilizing pool water, killing both Algae and Bacteria most efficiently at a pH of 7.6. (See OCL or Chloramine) HOCL Chlorine becomes **insignificant at pH over 8.0** when 85% of the chlorine present is OCL or combined chloramines.

HYDROCHLORIC ACID: See Acid.

HYDROSTATIC VALVE; This valve is commonly a spring loaded plug, or weighted loose fitting (but watertight) drain cover situated in the main drain, designed to open if the water pressure under the pool is greater than the water pressure from within the pool, particularly if the pool is being emptied without the relief of pressure via this valve, an empty fiberglass pool, or even a sprated concrete pool, can be forced to catastrophically pop out of the ground like a big boat.

IMPELLER: A veined disc which spins on the pump motor shaft to create water velocity in the pump to force the water out through an orifice into the filteration of the system.

IONISATION: The process of splitting up a substance (usuall copper, silver) dissolved in water into equal numbers of negatively and positively charged ions by the use of an electric current. Due to the low output these devices are banned in many places as primary sterilisation

IONIC STERILIZER: A device using two copper and silver alloy electrodes to pass a current, which will create in water, copper and silver ions. The copper ions kill the algae growth while the silver ions kill the bacteria. (See IONISATION, above)

LANGELIER INDEX: The Langelier Saturation index (LSI – developed by Wilfred "Bill" Langelier, Professor of Chemistry, University Southern California, 1936)

The Langelier index is a "balance model" derived from the theoretical concept of saturation in water pipes and provides an indicator of *the degree* of saturation of water with respect to calcium carbonate using pH as a main variable. The "perfect" result is 0 (Zero) or no bias of either side. Zero is perfectly balanced water; saturated with the perfect amount of calcium carbonate and has a stable pH.

Being the universal solvent, if water is out of balance, it will naturally try to find its own balance and equilibrium, because it wants to be at 0.00 LSI. For instance, if there is not enough calcium, **water will dissolve and extract it from the most readily available source**. Usually in pools, that means the cement in the plaster or pebble finish.

The LSI is universally interpreted as the pH change required bringing water to equilibrium.

The LSI is not ***widely used by pool builders*** as the results require a change in pH to achieve "balance" whereas in the residential swimming industry, ***we know that a constant pH of 7.6 is necessary to maintain satisfactory sterilization levels***, so other factors such as Calcium Hardness must be changed rather than the pH...

LEAF BASKET: The relatively course strainer basket that is usually situated in the skimmer-box to trap the larger leaves and debris before they can enter the pump.

MAIN DRAIN: A pot-shaped suction point with a grill covering the top and usually embedded in the deepest area of the pool floor, which is used to drain or circulate water from the deepest point. It is connected to the filtration system pump with PVC pipes – often incorporating the skimmer-box. It is essential that any Main Drain cover in the pool fits tightly, is actively fixed and in good condition, as a dangerous suction hazard to swimmers is involved.

Many Main Drains incorporate a hydrostatic relief valve. Current legislation in many countries (Including New Zealand) require a minimum of two conjoined separate Main Drains in tandem, to avoid suction entrapment possibility (i.e. if one is accidentally -or purposely- blocked by a swimmer, the suction lets go as the tandem drain takes over)

MURIATIC ACID: See Acid.

ORTHOTOLIDINE (aka OTO): A commonly used test kit reagent RED in colour for measuring chlorine residual. It is not the most accurate reagent for free chlorine because it will also measure combined chlorine if not read instantly – like, within two to three minurtes of taking the sample. It is also a recognised Carcinogen (i.e. can cause cancer) if the fumes are breathed in or if skin contact is made in its pure form. For this reason, they are not often encountered, being replaced by DPD test kits. DPD stands for **N,N Diethyl-1,4 Phenylenediamine Sulfate** – hence the more commonly used acronym.

PH: A logarithmic (non-lineal) measurement scale from 0 -14 used to measure the acid (pH 1) or alkali (pH 14) levels of pool water. The neutral point is 7.0 although it is recommended for pool water to be in the range 7.2 to 7.8 and optimally 7.6, but still acceptable between the previous values.

The logarithmic nature of the scale is similar in concept to the Richter Magnitude Scale – i.e. each gradient is 10 times the previous one. So if the pH is 7.0 (neutral), and the pH rises to 8.0 (Alkaline) it is "quite a bit more Alkaline" than 7.0 The scale is misleading to chemically uneducated pool owners, so perhaps should be shown as 7,000 – 8,000 etc. to illustrate larger difference between tests. As accurate home pool balance is essential, pH 7.6 means what it says.

pH BUFFER: An alkaline chemical (Sodium Bicarbonate) added to pool water to increase the total alkalinity, which in turn (in combination with Calcium Chloride) will buffer the pH from rapid changes. It can also be used to increase a low pH although ieffective over pH 8.3.

PHENOL RED: The most commonly used reagent for residential Pool Water Test Kits testing pH.

RECIRCULATION RATE: This is a measure of the time a filtration system takes to turn over a pool's entire water volume in a given period. I.e. a recirculation rate of 4/24 = four total recirculation of the pool's water volume in 24 Hrs.

RESIDUAL CHLORINE: See Chlorine Residual.

SAND FILTER: A pool water filter tank that uses especially graded silica sand in a pressure vessel to a depth of at least 300mm. The filtration media is normally .45 to .55 mm – or also known as pool grade #20 silica sand and in the UK 14/24 Mesh Size.
Becoming more common is crushed and graded recycled glass alcohol bottles (Beer being common), which product is more effective than silica sand, as the glass components will not wear away as quickly as the silica sand, giving the customer a longer period of time between media changes.

SCALE: A precipitation of excess Calcium Carbonate which deposits on pool walls and floors, causing a sand paper-like finish. LSI +.5 and greater - See LANGELIER INDEX.

SEPTUM: This is the term used to describe the whole of the cloth covered elements or grades that are held together with a manifold system for the purpose of trapping a layer of Diatomaceous Earth as the filter medium in a D.E. filter system.

SHOCK TREATMENT: This is a large dose of chlorine or other chemical added to the pool water to kill algae growth. For chlorine it will be at least 5 times the normal daily dose, or enough to bring the chlorine level up to at least 10mg/l. This treatment should not be confused with superchlorination, which is a regular (weekly of fortnightly) dosage of 2.5 to 3 times the normal daily dose for 'prevention' of algae and neutralising pool "nasties".

SKIMMER-BOX: See PAPER 1. A skimming device placed on one side of the pool as the main suction point, which can be used for vacuuming and skimming large debris and leaves to catch them before they enter the filtration system.

SKIMMER TYPES: There have been advances in skimmer design over the past four decades, from the 1960's Hayward W102, 1970's WA72, SP5000 and so on but no major differences developed in most skimmer types until the introduction of the Aquagenie Skimmer/Feeder in 1987. Being a proprietary product, the Aquagenie is not widely used but you may find them installed since 1994 in Cascade swimming pools.

SLURRY: The term used for a mixture of fine powders or solids and water to make a mixture, which is easily poured, but sually referred to when adding a mixture of D.E. to a filtration system.

SODA ASH: (Sodium Carbonate) A strong alkali powder used for raising the pH but not suitable for raising total alkalinity.

SODIUM BICARBONATE: See pH Buffer.

SODIUM BISULPHATE: Aka Dry Acid, Sodium Bisulphate has a pH of 1.4 (obviously Acidic) so is used to lower pH more safely without using liquid acids as hydrochloric acid - but must still be handled with care or exposed to skin.

SODIUM HYPOCHLORITE: Liquid chlorine approx. 12.5% strength. (+-)

SODIUM TRI-CHLORO-ISO-CYAN-URATE: Aka TRICHLOR: (Hyphenated to assist your pronounciation) Sodium Trichloroisocyanurate is normally found in tablet form – sold as stabilised chlorine It has a pH (acidic) of 1.0 to 2.0 pH, yet leaves no residue. See Stabilised Chlorine.

STABILISED CHLORINE: Chlorine granular composition which contains isocyanuric acid (stabiliser) which if added to the correct levels will reduce the loss of chlorine to the sun's ultra-violet rays. It is recommended to alternate with regular chlorine to prevent the stabilizer level from becoming too high – i.e. a maximum of 50 ppm is usually recommended. In a dry climate, high levels of cyanuric acid require dumping 50% of the pool water and refilling to dilute the cyanuric levels, so has to be monitored but heavy rainfall typical of New Zealand tends to dilute pools.

STABILISER: (aka conditioner, cyanuric acid) A chemical which when added to a pool's water in the correct levels (25 to 60 mg/1) will reduce the loss of chlorine to the sun's ultraviolet rays. The chemical is Isocyanuric acid.

STABILISING: (aka conditioning) the act of adding stabiliser to a pool's water to reduce the loss of chlorine due to sunlight.

STAINS: A variety of discolorations to a pool interior surfaces caused by minerals such as iron and copper, or from pitting caused by the addition of too much acid or too little alkalinity, from scale mixed with impurities, or from wind blown materials which in particular leave 'tide marks'. Temporarrily raising the chlorine level, or adding hydrochloric acid will usually remove stains.

SUPERCHLORINATION: Often confused with a "one off" Shock Treatment to rid the pool of excess Algae but is NOT the same! This is a monthly dose of chlorine 2.5 to 3 times the normal daily dose performed on a regular basis in the hot months or if the pool is heavily used. It is normally added at the end of the day or on the Sunday evening and will increase the free chlorine level to around 5 mg/1 (5ppm) which is usually sufficient to 'burn out' chloramines and resistant types of algae which in turn 'prevents' the growth of unsightly algae.

TELESCOPIC HANDLE: An extendible pole, to attach accessories such as pool Brush, Vacuum Head and Leaf Rake.

TOTAL ALKALINITY: This measure is the total or reserve number of alkaline materials present in the pool water. A correct total alkalinity will buffer the pH from rapid changes and is **essential in the overall balance of pool water in marble or cement type interior finishes**. Depending on the hardness of the pool water the total alkalinity can range from 60 to 150 mg/1 although 70 to 120 mg/1 is the most common.

T.D.S. (Total Dissolved Solids): The total amount of dissolved salts such as sodium, calcium, chlorides and sulphates in the pool water. As a general rule providing that salt or liquid chlorine are not used in the pool the recommended maximum level is 1500 mg/1.

VACUUM HEAD: A weighted plastic brush or flat molded plastic body with wheels. Usually, a flat or round base into which a flexible hose (Vacuum Hose) attached to suck the heavy materials and dirt from the bottom of the pool.

VACUUM HOSE: See Vacuum Head.

VACUUM PLATE: A tight fitting circular PVC plate with a central hole for the Vac Hose to fit into, designed to sit in the skimmer-box above the leaf-basket to allow the vacuum hose to fit for vacuuming purposes. Also can used for drawing water from the bottom of the pool to lower the water leve (as needed).

WIER: Aka Skimmer Weir – Skimmer Flap: A bottom-hinged floating flap designed to float just under the surface of the water as it enters the skimmer-box under suction of the filtratiop system. This action causes the floating dirt and debris and surface water to be drawn into the skimmer box. When the filtration suction stops, the detritus in the skimmer box will not be able to re-enter the swimming pool.

WINTERISING: A special chemical treatment for pool water to minimize the treatment of a pool over winter or periods of non-use.

Addendum: FOR YOUR INFORMATION

USING THE METRIC SYSTEM AND MATHS TO DETERMINE POOL SIZES

The traditional way of measuring chemicals in pool water was PPM (Parts Per Million)

This has been superceded by the metric system

The metric system is also known as the S.I. or "System International" system of Units. It has been in use for some time, but you may not be fully aware of the terms in use.

As far as we (the swimming pool industry) is concerned, we don't need much more than knowing the ratio of X – Y (i.e. X being the pool chemical in suspension) to Y (being the volume of water)

Keeping it simple…

Weight of substance added to one unit volume of water to give one *part per million (ppm)*

Remember this: 1 ppm = 1 milliliter per liter (ml/L)
ONE Part per Million = (equals) ONE Milliliter per liter (aka 0.001)

Regardless of how frequently or what system you use to add **chlorine** to the water, the **chlorine** level **should** stay between 1.0 and 3.0 **parts per million** (**ppm**) to maintain a healthy **pool**. Anything higher **will** make you to run the risk of red eyes and swimmer's itch.

So – for example - to maintain the ratio of chlorine in the pool at 2 mh/l, and as the pool water quantity will vary depending on the cubic capacity of the pool, gradual dosing is required until the correct ratio is achieved.

Determining the cubic capacity of a pool is mentioned elsewhere in this discussion, but basically it's the pool length TIMES the pool width TIMES the pool depth (X means TIMES - L X W X D) with many variations due to pool shape etc, but keeping it simple, a 4.0m x 8.0 m pool of 1.5 m depth = 4 x 8 = 32 x 1.5 = 48 cubic meters of water, and 2 ml/l is 48 x 2 = .096 liters(+-)

The metric (S.I.) system is relatively easy to learn and use in everyday life because it is a decimal system based on the number ten which makes calculations much simpler and all units derived from the basic units have a conversion factor of one.

e.g.:	1 joule =	=1 Newton x 1 meter
	(Work done)	= (Force) x (Distance)

Derivatives"

Kilojoule	One Thousand joules
Megajoule	One Million joules

etc.

(Replaces horsepower and foot/pounds of torque)

Themetric system has seven base units from which the remaining units can be derived.

QUANTITY	BASE UNIT	SYMBOL
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electrical current	ampere	A
Temperature)	Kelvin	K
Luminous intensity	candela	cod
Amount of substance	mole	mol

Note: We will not need to use all of these.

From the above base units, we can derive more units to suit special requirements e.g. The derived unit for measuring an area (m2) is made up from the base unit of length (m) Some derived units come from the names of scientists and engineers and their symbols are always capitals for this reason. Further units are:

QUANTITY	UNIT	SYMBOL
Area	Square meter (derived)	m2
Volume	Cubic meter "	m3
Velocity	Meter/second "	m/s
	Kilometer	km
Density	Kg/cubic meter "	kg/m3
Force	Newton "	N = kg m/s
Energy	Joule "	J = Nm
Power	Watt "	W = J/s
Pressure	Pascal "	Pa = N/my
Fluid volume	Litre	l
Mass	Tonne (1,000kg)	t
Time	Hour-minute	h - min
Area	Hectare (10,000m2)	ha
Temperature	Degree Celsius	0c

CONVERSION TABLE

MULTIPLES

It is not necessary to memorise all metric prefixes although the most common prefixes should be known. e.g. mega, kilo, milli, micro and deci.

MULTIPLYING FACTOR		PREFIX	SYMBOL
1,000,000	= 10^6	mega	M
1,000	= 10^3	kilo	k
100	= 10^2	hecto	h
10	= 10^1	deka	da
1/10 or 0.1	= 10^{-1}	deci	d
1/100 or 0.01	= 10^{-2}	centi	c
1/100 or 0.001	= 10^{-3}	milli	m

1/1,000,000 or 0.000,001 = 10^{-6} micro u

We may determine therefore from the above chart that 1,000 mm = 1m
1,000 m = 1km

We should remember that when measuring dimensions, we must be practical. e.g. Use the appropriate tool for the job. For swimming pool dimensions, use a 30m long flexible fibre reinforced tape, and carry an 8m steel tape with you. If we were to measure a pool Length x Width X Depth with just an 8m tape it would be impractical to measure the volume to three decimal points.

LENGTH: We know from our charts that the standard metric unit of length is the meter, and this was determined by a standard meter bar as determined by the Society Francaise' in Paris although now more accurately defined in terms of radiation wavelengths from a Krypton atom. (Named after Superman's Home Planet)

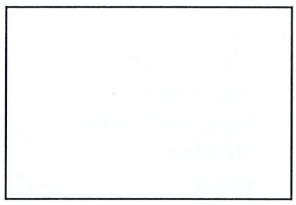
Remember, 1 meter (1m) = 1,000 millimeters (1,000mm)

AREA: Areas are measured in square units like square meters (m^2) or square mm (mm^2)

(1) Squares and Rectangles.

A rectangle is a four-sided figure with all four internal angles an equal 90^0

A square is a rectangle with four equal sides.



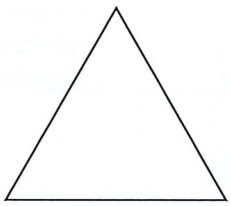
Area of a square = Length of side x Length of side

Area of a rectangle = Length of side x Width

e.g. L = 6m = Length
B = 4m = Width

Area = L x B
= 6 x 4 therefore the area = $24m^2$

(2) Triangles



A triangle is a figure having 3 sides or 3 internal angles.

A right-angled triangle is a triangle where one internal angle = 90^0.

In the example of a triange 600mm wide by 40mm high, it can be easily seen that right-angled triangle is half a rectangle in area, so this example would be expressed as follows:

Area = ½ x 60 x 40 = $1200m^2$

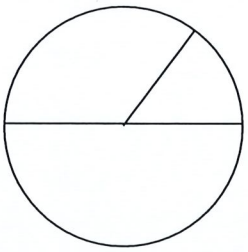
This equation applies to all triangles.

(3) Circle:

A circle is a figure whose boundary (circumference) is a constant distance from a fixed point (centre).

Any line which passes through the centre and touches the circumference at each end is a diameter.

A diameter = twice the radius.



The symbol Pi is a constant and may be remembered as 3.14 or $\frac{22}{7}$

The area of a circle is Pi $\frac{D^2}{}$ - or PiR^2 (Pi x RADIUS Squared)

VOLUME

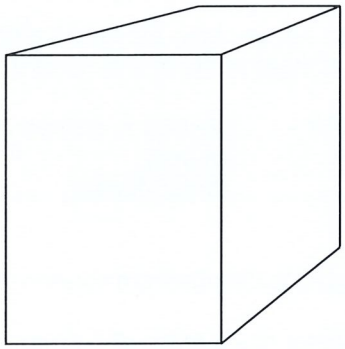
Volumes are measured in cubic units such as cubic metres (m3) or cubic millimetres (mm3). In addition, liquid volumes can be expressed in kilolitres and litres.

(1) Rectangular Solids

A rectangle may be divided into a number of squares each of length 1 unit.
A rectangular solid may be divided up into a number of cubes of side length 1 unit.

The volume of a rectangular solid – length x width x height

Therefore a retangular solid of L = 60mm
W = 40mm
H = 100mm



Would be 60 x 40 x 100 = 240,000mm^2

(2) Cylinders:

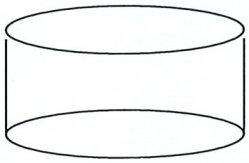
Cylinder Dia = 70mm Height = 100mm – what is the volume?

Example: Area of base $= \frac{\text{Pi x } D^2}{4}$

$= \text{Pi x } \frac{70 \text{ x } 70}{4}$

$= \frac{22}{7} \text{ x } \frac{70 \text{ x } 70}{4}$

$= 3850 \text{ mm}^2$



Volume $= 100 \text{ x } 3850$

$= 385\,000 \text{ mm}^3$

(3) Cones:

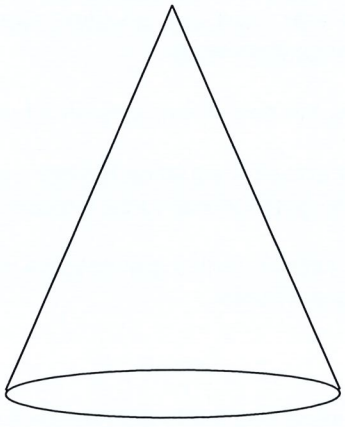
Cone base Dia = 70mm Height = 120mm – what is the volume?

Example: Area of base $= \frac{\text{Pi x } D^2}{4}$

$= \text{Pi x } \frac{70 \text{ x } 70}{4}$

Volume $= 3850 \text{ x } \frac{120}{3}$

$= 154\,000 \text{ mm}^3$



(4) Tanks with Sloping Floors.

This case is often encountered in swimming pools.

The volume of a tank with a sloping floor = Surface Area x Average Depth

Example: Length 10m x Depth (Shallow = 1m deep = 2m) Average = 1.5m x Width = 5m

Volume = 10m x 5m x 1.5m = 75 m^3

MASS AND WEIGHT

In the SI (metric) system the unit of mass is the kilogram. This is the mass of a solid cylinder that is kept by the International Bureau of Weights and Measures.

Mass-Weight Relationship.

The mass is the quantity of matter in a body and is constant no matter where it is measured.

The weight is the force with which a body is drawn towards the centre of the earth and will vary slightly according to the gravitational pull at different spots on the earth's surface.

For our purposes we will not be using the term weight, but if necessary, we will refer to the "gravitational force" extended by the mass of liquid contained in a vessel. This force will be expressed in Newtons

DENSITY:	Density is defined as the quantity of mass per unit of volume	
e.g.	Density	= Mass/volume
	Water density	= 1 tone/m3 (1,000kg/m3)
		= 1kg/1

We can use this last figure to change from volume to mass or vice versa of water.

REMEMBER 1 litre of water has a mass of 1 kilogram within a specified temperature range.
It is necessary to specify the temperature because liquids and solids can change in volume with temperature. e.g. freezing expands water while boiling water contracts.

SPECIFIC GRAVITY: The specific gravity is the ratio of the density of a particular substance over water at a given temperature. Therefore it is a measure of how heavy or dense a particular substance is as compared to water:

e.g.	
The specific gravity of water	= Density of water/Density of water
	= 1
The S.G. of concrete	= 2.4

Any substance therefore that is less dense or has a specific gravity which is less than 1, will float in water. Specific gravities that are over 1 will sink in water. Remember a steel ship doesn't sink because the air it contains PLUS the steel, are less dense than water.

FORCE: Force is the power that acts on a body to change or try to change its position direction or speed.

The mathematical equation for force is mass x acceleration.
Therefore, gravitational force = mass x acceleration due to gravity

The acceleration rate of earth's gravitational pull is equal to 9.8 m/sec/sec or 9.8 m/sec^2. Therefore the gravitational force of one kilogram mass

= 1kg mass x 9.8 m/sec^2
= 9.8 Newtons

A Newton is the force needed to accelerate a mass of 1kg. 1m per second per second.

i.e. 1 Newton = 1kg m/sec^2

For larger units we use the kilonewton. 1kN = 1,000N
If we were to lift a mass of water of 1 tonne or 1000kg or 10001 or 1m3 (all the same) from a single point, there would be a gravitational force of 9,800N
PRESSURE: If our same cubic metre of water is placed in a cubic metre container and placed on a level surface, the gravitational force will be spread over the base area of the container.

This means that the container base will exert pressure onto the level surface.
The container base is exerting the waters gravitational force onto the level surface as pressure, whilst the level surface is exerting an equal and opposite upward pressure on the under side of the base to prevent it from moving up or down.

Pressure is defined: Force per unit area.
P = F/A
A pressure unit is the Pascal = Pa
A Pascal is a force of 1 Newton/1m^2

1Pascal = 1 N/m^2
1 kiloPascal = 1,000 Pa
= 1 kPa

The pressure at the base of the container = F/A

P = 9,800N/1m^2
= 9,800Pa (or N/m^2)
= 9.8kPa.

Therefore the pressure of a column of water 1m high is 9.8 kPa, so it follows that the pressure will increase with the height of the Column even if the base dimensions increase.
The pressure only increases with height or head of liquid.

ELECTRICAL CURRENT:

The flow rate of electricity is the current.

The metric unit is the Ampere
The force that causes electricity to flow is electromotive force
The metric unit is the volt.
The resistance is the power of a material to oppose the electrical flow through it.
The metric unit is the ohm.

TEMPERATURE: When used in scientific work the temperature is expressed in Kelvins (K) whereas in everyday use it is expressed in Celsius. (^{0}C) The freezing point of water is 0^{0}C and the boiling point is 100^{0}C.

CONCENTRATIONS: We calculate concentrations and dosage rates by first determining the volume of water.

With the volume ascertained we have two formulas :

1) Concentration (mg/1) = Amount of chemical (mg)/Amount of water e.g. The concentration of 1kg chemical added to 10 m3 is Concentration (mg/1) = Mass of chemical mg/litres of water

= 1kg x 1,000g x 1,000mg/10m3 x 1,0001
= 1,000,000/10,000
= 100mg/1

2) Chemical (mg) = Concentration mg/1 x Water 1
e.g. The amount of chemical required to obtain a concentration of 100mg/1 in 10m3 of water is :

Chemical (mg)
= Concentration mg/1 x water 1
= 100mg/1 x 10m3 x 1,0001
= 100 x 10 x 1,000
= 1,000,000mg
= 1,000g
= 1kg

NOTE: Concentrations expressed in parts per million (ppm) are the same as mg/1 because 1mg = 1ppm.

- End -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