

SAA LECTURE No E1

PHYSICS AND THE DIVER



BOYLE'S LAW

For a fixed mass of gas at a constant temperature (T) the pressure (P) is inversely proportional to the volume (V).

e.g. A diver requiring 1 litre of air at the surface will need 3 litres at 20 metres.

PRESSURE

A force measured in bars.

Absolute pressure = gauge pressure + 1 bar.

10 metres = 1 bar gauge = 2 bars absolute

20 metres = 2 bar gauge = 3 bars absolute

30 metres = 3 bar gauge = 4 bars absolute

40 metres = 4 bar gauge = 5 bars absolute

50 metres = 5 bar gauge = 6 bars absolute

CONSTANT-VOLUME-LAW

If the volume of a fixed mass of gas is held constant, the pressure is directly proportional to the temperature.

An increase in temperature increases the pressure and vice versa.

CHARLE'S LAW

A fixed mass of gas at a constant pressure, the volume is directly proportional to the temperature.

Constant – Volume Law and Charles' Law: If a gas is heated, it will either increase in pressure if the volume is constrained or increase in volume.

DALTON'S LAW

In a mixture of gases, the pressure exerted by one of the gases is the same as it would exert if it alone occupied the same volume.

As you dive deeper the percentages of gases in a cylinder will remain the same. It is the partial pressure of the gas that increases.

PARTIAL PRESSURE

Oxygen greater than 1.6 bar partial pressure can lead to O₂ toxicity.

Dives greater than 30 metres will expose a diver to nitrogen narcoses, however some may be affected at shallower depths.

Carbon Monoxide and Carbon Dioxide are toxic if the purity of the air in a **SAA** set maximum dept for air diving to 50 metres.

HENRY'S LAW

At a constant temperature the amount of gas that dissolves in a liquid with which it is in contact is proportional to the partial pressure of that gas.

ARCHIMEDES PRINCIPLE

Any object immersed in water will receive an up thrust equal to the volume of the water it displaces.

Object weighs less than the water displaced it will float.

Object weighs more than the water displaced it will sink.

Object weighs the same as the water displaced it will be neutrally buoyant.

SENSES

Vision:

Objects appear 33% larger and 25% closer than they really are, this is due to refraction.

Colour is filtered out according to depth.

RED	4-5 METRES
ORANGES	8 METRES
YELLOWS	11 METRES
GREENS	19 METRES
BLUES	23 METRES
GREYS	31 METRES

Artificial light can restore the balance of colour.

SAA LECTURE No E1

PHYSICS AND THE DIVER



- Touch:** Can be restricted by diver's dress
- Smell:** None
- Sound:** Travels 4-5 times faster in water than in air and is amplified.
Difficult to determine direction sound originates

AIR CONSUMPTION

It is essential that a diver can calculate the air requirements for a dive.

This should be part of every diver's dive plan.

Example: Divers air consumption rate is 25litres/minute.

Dive to 20 metres for 20 minutes.

Using the formula: $\text{Air consumption per minute} \times \text{Absolute pressure} = \text{Air consumption per minute.}$

This calculation is possible – $25\text{l/min} \times 3 \text{ Bar Absolute} = 75\text{l/min}$

Using the formula: $\text{Air consumption per minute} \times \text{Dive duration} = \text{Air requirements in litres.}$

This calculation is possible – $75\text{l/min} \times 20 \text{ mins} = 1500 \text{ litres.}$

GUIDELINES

Never hold breath under water

Never dive with a cold or nose/ear congestion

Deeper you dive – less buoyant you become

The deeper you dive – the more air you use

Ascent rate 10 metres per minute