PENANG SANGAM HIGH SCHOOL
YEAR 12 PHYSICS
WEEK 20-21

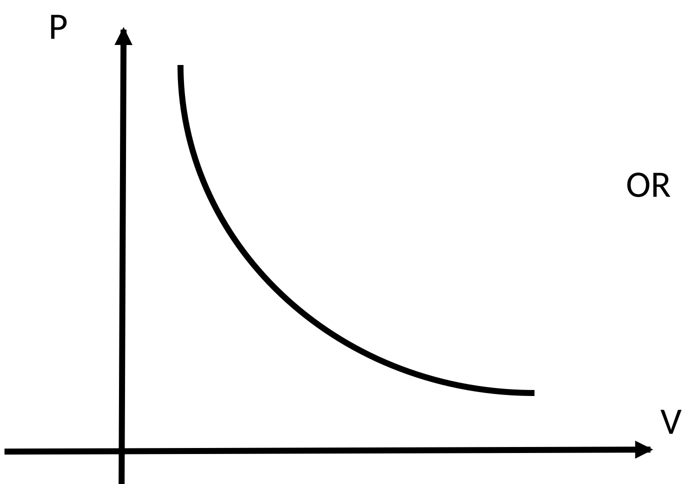
Strand	HEAT ENERGY
Sub Strand	Kinetic theory of gases
Content Learning Outcome	At the end of the lesson students should be able to • Demonstrate understanding, by explanation and solving problems of the physical phenomena, concepts, principles and relationships involved in Fluid statics.

KINETIC THEORY OF GASES

1. Gases consist of small particles that are always moving
2. The size of these particles are very small
3. The forces of attraction between these particles is very very small.
4. **The pressure of the gas is due to the collision of these particles with themselves and the walls of the container.**
5. The kinetic energy of these particles is directly proportional to the temperature.

BOYLES LAW

Pressure of a gas is inversely proportional to its volume provided its temperature is kept constant.



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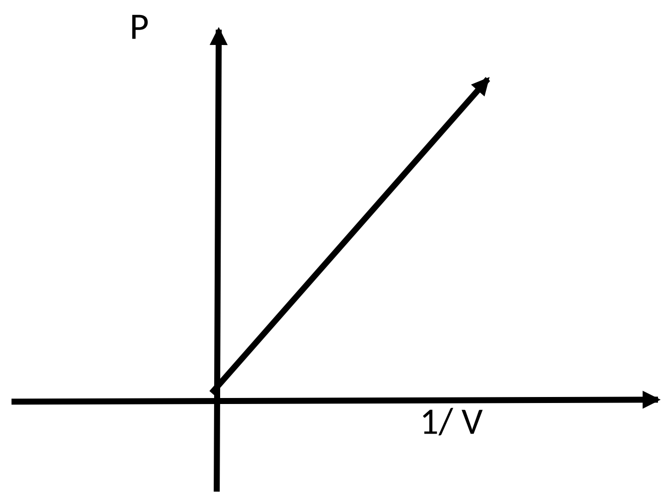


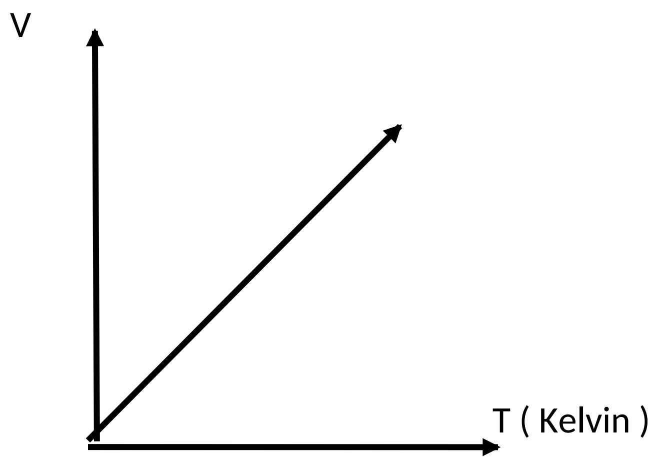
Explanation using kinetic theory

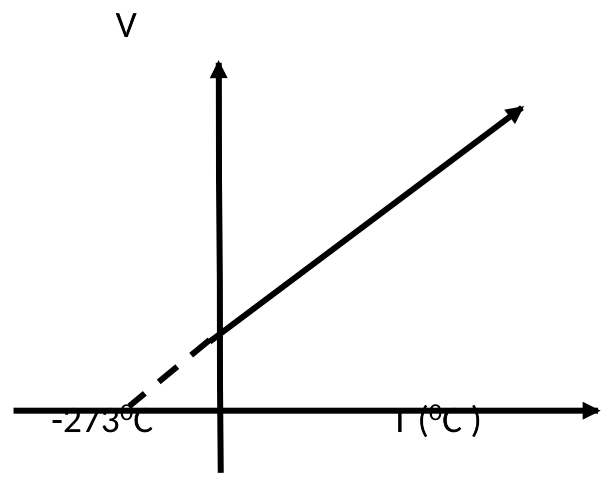
When the volume of a gas is decreased the number of collisions of the particles with themselves and the walls of the container increases therefore the pressure increases.

When the volume of a gas is increased the number of collisions of the particles with themselves and the walls of the container decreases therefore the pressure decreases.

CHARLES LAW

Volume of a gas is directly proportional to temperature provided its pressure is kept constant





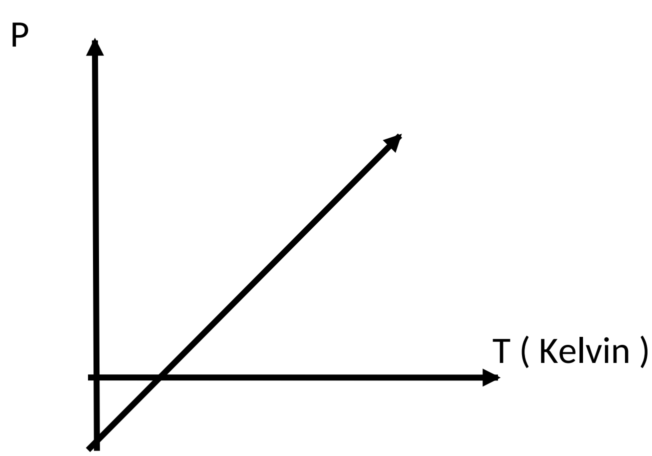
Explanation using kinetic theory

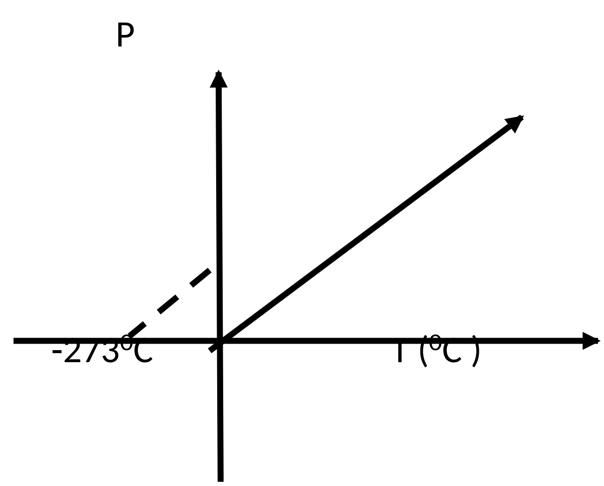
When the temperature of a gas is increased the particles gain energy move faster and occupy more space therefore the volume increases.

When the temperature of a gas is decreased the particles lose energy move slower and occupy less space therefore the volume decreases.

PRESSURE LAW

Pressure of a gas is directly proportional to temperature provided its volume is kept constant.





Explanation using kinetic theory

When the temperature of a gas increases the particles gain energy move faster and the number of collisions of the particles with themselves and the walls of the container increases therefore the pressure increases.

When the temperature of a gas decreases the particles lose energy move slower and the number of collisions of the particles with themselves and the walls of the container decreases therefore the pressure decreases.

Combined gas laws

In reality none of the factors can be kept constant so we have the combined gas law.

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

- If any of the variables is said to be constant or not mentioned in the formula just cross it out form the main formal and use the other terms in the formula.
- The temperature substituted must always be in Kelvin
- K = ^{0}C + 273

1. 100 cm^3 of air is At a pressure of 200,000 Pascal's. Find the new volume if the pressure is 45,000 Pascals.

2. A certain mass of oxygen has a volume of $5m^3$ at a temperature of 27^0C. what will be the volume at a temperature of 77^0C.

3. At the beginging of a trip a driver adjusts the pressure of the tires to 2.81 x 10^5 Pa when the temperature is 28^0 C. After the trip the driver finds out the pressure in the tire is 3.1 x 10^5 Pa. find the temperature of the air at this instant.

4. A certain mass of gas has a volume of 250ml at a pressure of 280 kPa at a temperature of 57^0 C. find the new volume of the air if the pressure is increased to 350 kPa and temperature also increased to 120 ^0C.

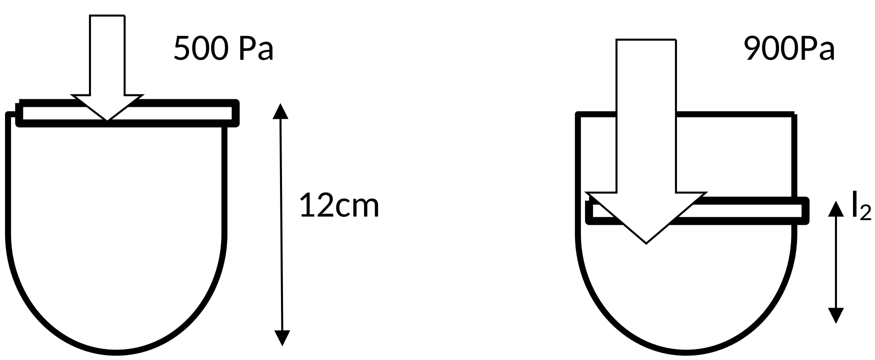
5. A gas is at a pressure of 300pascals and occupies a volume of $20cm^3$. Find the new volume if the pressure is increased to 700 pascals.

6. A gas has a volume of $0.4m^3$ at a temperature of 45^0C. find the new volume at a temperature of 120^0C.

7. The pressure of a gas is 1 atmosphere at a temperature of 35^0C. find the new pressure at a temperature of 89^0C.

8. A gas occupies a volume of $0.4cm^3$ at a temperature of 47^0C and pressure of 500P. find the new volume if the pressure is 250P and temperature is 160^0C.

9. Given below are two tubes containing gas.



a. Find the length of the gas occupied by the gas in the second diagram
b. How far inward has the plunger moved.

10. Write boyles laws as a formula.

11. Write Charles law as a formula

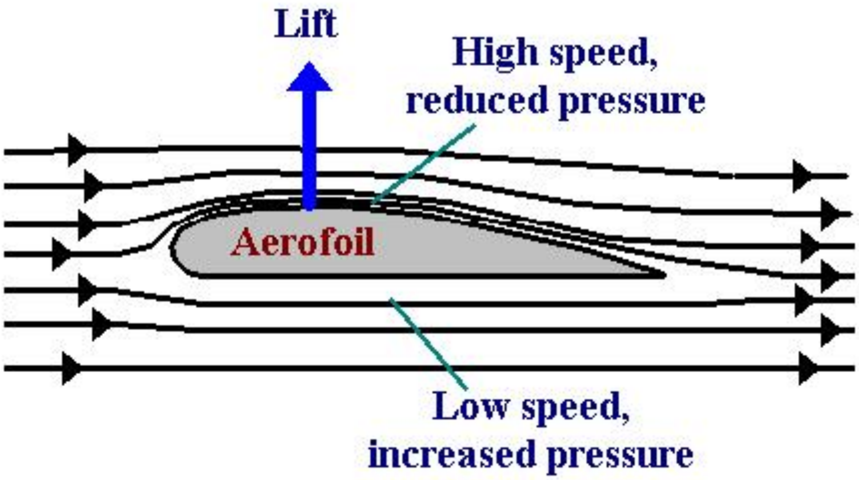
12. Write the pressure law as a formula.

Bernoulli's Principal

Faster moving air exerts less pressure. Or we can say slower moving air exerts more pressure

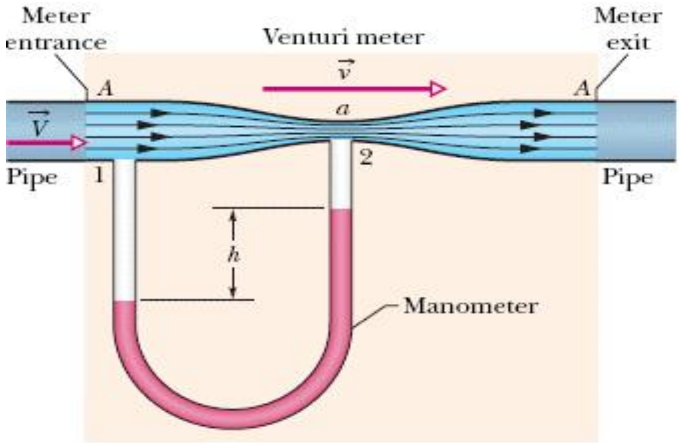
Applications

1. Aero plane wings
   The design of the shapes of the wings called as aerofoil is shaped so that the air travelling over the wings is moving faster than the air moving beneath the wings. This results in the pressure at the bottom of the wing to be greater than the pressure at the top of the wings. This causes a net upwards force called the lift which helps the plane to take off.

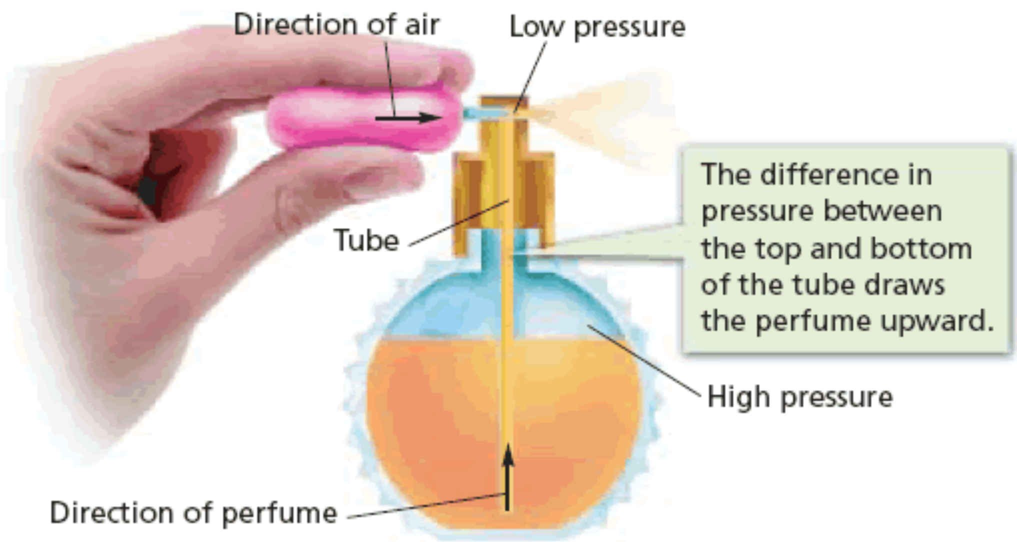


2. **The venturi meter**

   This is an instrument for measuring the drop in pressure that takes place as the speed of the air increases.



3. **Atomizer**



When the rubber at the top is squeezed the air at the top moves faster. At the top pressure becomes less compared to the bottom where the pressure is more. This pushes the perfume or liquid to the top of the tube. The air stream then breaks the liquid into small drops, and the liquid or the perfume comes out as a fine mist.

Viscosity

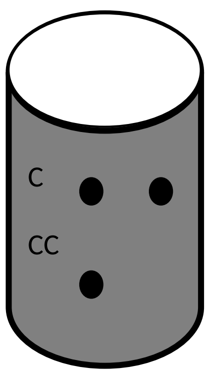
Every fluid posses different amounts of resistance against deformation. In common terms we can say how thick the fluid is. The thicker the fluid the more the viscosity. Ie water is more viscose than air.

There are two ways to view viscosity

a. Kinematic viscosity- the time it takes to watch a fluid pour out of a container **.Units for measurement are stokes, poise, square centimeters per second, square meters per second.**

Dynamic viscosity- internal friction of a fluid, how easily it can deform. **Is also called absolute viscosity. Measures the resistance of a liquid to flow, in other words internal friction of a fluid or how easily it can deform under stress. Units for measurement pascal – seconds**

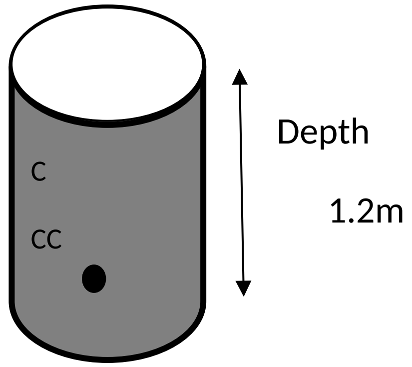
LIQUID PRESSURE



1. Pressure in a liquid increases with depth (pressure at A is smaller than at C
2. Pressure at one depth is equal (pressure at A is equal to pressure at B)
3. Pressure at a particular depth is given by the formula

$$P = \rho g d$$

P is the pressure in pascals Pa, ρ is the density of the liquid in kg/m^3, and d is the depth in m.



1. Find the pressure at C where the density of the liquid is 800 kg/m^3.

2. A diver swims 30m below the surface of the sea. Find the pressure exerted on B if the density of sea water is 1030 kg/m^3.

Atmospheric pressure

Atmospheric pressure is the pressure of the atmosphere and at sea level it is 1 atmosphere. At different heights above sea level it changes. At the top of a hill it is less.

There are many units of pressure

1 atmosphere ie 1 atm = 101.3 x 10^3 Pa

1 atmosphere = 760mm of mercury (76 cm of mercury)

1 atmosphere = 1.01 bar

Gauge pressure is the pressure measured by a gauge or an instrument. This device measures the pressure relative to the atmospheric pressure i.e calibrated against the atmospheric pressure.

Total pressure is also called absolute pressure.

$$P_{TOTAL} = P_{GUAGE} + P_{ATMOSPHERE}$$

Use atmospheric pressure as 101300Pascals

1. The gauge pressure at a depth is 30,000 pascals. Find the total pressure at that depth

2. A diver is swimming at a depth of 50m below the surface of the sea. The density of sea water is 1030kg/m^3.Find

   a. The gauge pressure

   b. The total pressure