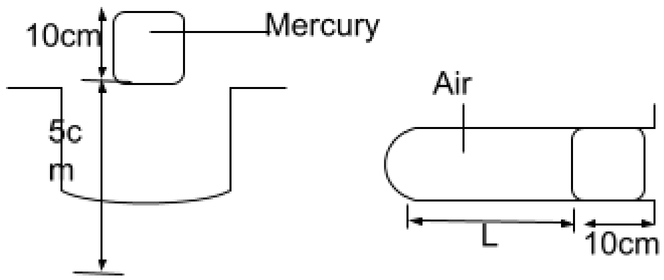
GAS LAWS

1. (a) State Boyle's law

(b) A column of air 5cm is trapped by mercury thread of 10cm as shown in the figure below.

If the tube is laid horizontally as shown in **(b)**, calculate the new length of trapped air

(atmospheric pressure =75.0cmHg and density of mercury = 13600kgm^{-3})

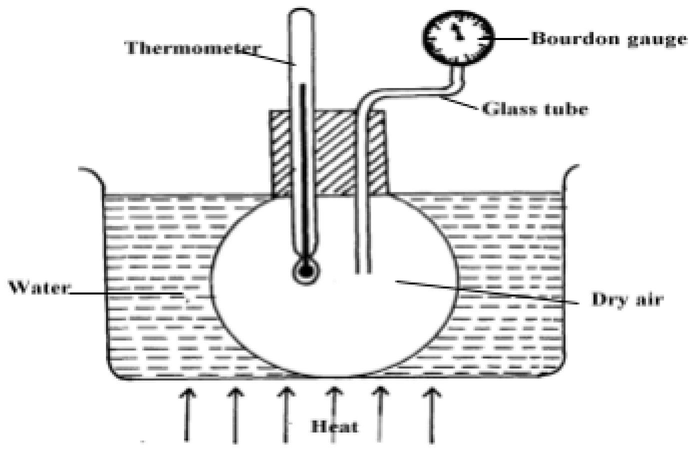


(c) Explain why:

(i) It is difficult to remove the lid from a preserving jar which was closed when the

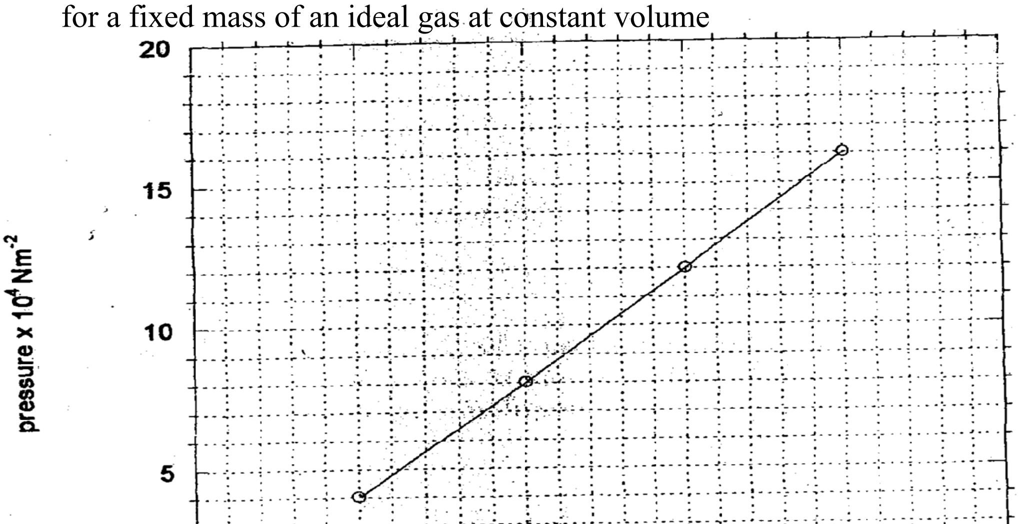
(ii) A force pump must be used instead of a lift pump to raise water from a deep well over 10m

2. The figure below shows a simple set up for pressure law apparatus:-



a) Describe how the apparatus may be used to verify pressure law

b) The graph in the figure below shows the relationship between the pressure and temperature for a fixed mass of an ideal gas at constant volume



i) Given that the relationship between pressure, **P** and temperature, **T** in Kelvin is of the form

$$P = kT + C$$

Where **k** and **C** are constants, determine from the graph, values of **k** and **C**

ii) Why would it be possible for pressure of the gas to be reduced to zero in practice?

c) A gas is put into a container of fixed volume at a pressure of 2.1×10^5. Nm^{-2} and temperature 27°C. The gas is then heated to a temperature of 327°C. Determine the new pressure

3. (a) State Boyle's law

(b) The volume of a bubble at the base of a container of water is $3cm^3$. The depth of water is 30cm. The bubble rises up the column until the surface ;

(i) Explain what happens to the bubble as it rises up the water column

(ii) Determine the volume of the bubble at a point 5cm below the water surface

(c) A faulty thermometer records 11°C instead of 0°C and 98°C instead of 100°C. Determine the reading on the thermometer when dipped in liquid at a temperature of 56°C

4. (a) State Boyles law

Some students carried out an experiment to verify Boyle's law and recorded their results as shown in the table below:-

Pressure $^{KN}/_{M2}$	400	320	160	180
Volume (m^3)	2.0	2.5	5.0	10.0

$^{1}/_{V}$ (mm^{-3})				

(i) Complete the table

(ii) Plot a graph of pressure against $^{1}/_{volume}$

(c) Determine the gradient for the graph and state its units

(d) A sample of gas has a pressure of 1.0 x 10^5Pa when its temperature is 10ºC. What will be its pressure if its temperature is raised to 100ºC and its volume doubled

5. (a) State: (i) Boyle's Law

(ii) Charles' Law.

(b) A form three student carried out an experiment on one of the gas law. She obtained the following results.

Temperature (^{0}c)	10	35	60	80	90	110
Volume V(cm^3)	5	5.8	6.4	7.0	7.2	7.8

(i) Plot a graph of volume V against temperature.

(ii) From the graph, determine the volume of the gas at 0ºc.

(iii) Determine the slope of the graph.

(iv) The equation of the line obtained is of the form V = kT + c. What is the value of k and c?

6. (a) State **Charles' law**

(b) A mass of gas occupies a volume of 150cm^3 at a temperature of -73°C and a pressure of 1 atmosphere. Determine the 1.5 atmospheres and the temperature 227 °C

7. In an experiment to verity Boyle's law, two quantities were advised to be kept constant

(a). State the quantities.

(b). the results of experiment to verify Boyle's law were recorded in the table below.

Pressure(atmospheres)	1.0	1.2	1.4	1.6	1.8

Volume (litres)	0.62	0.521	0.450	0.391	0.351

Plot a suitable graph to verify the law.

(c). Determine the volume of the gas when the pressure is two atmospheres.

GAS LAWS

1. (a) It states that the pressure of a fixed mass of gas is inversely proportional to its volume provided temperature is kept constant (PV = K)

(b) $P_1L_1 = P_2L_2$

$86 \times 5 = 75 \times L_2$

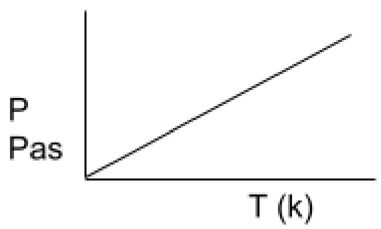
$= 5.73cm$

(c) (i) When steam condenses, the pressure inside the container will be lower than the atmospheric pressure on the outside. The excess atmospheric pressure acting on the lid exerts a force on the lid thus making it difficult to open the lid.

(ii) The lift pump depends only on atmospheric pressure which can only support a column of water 10m long. The force pump uses force and therefore can lift water to the length greater than 10m.

2. a) Describe how the apparatus may be used to verify pressure law

Plotting pressure against absolute temp we get a straight line graph



Conclusion

Pressure of infixed mass of a gas indirectly proportional to its absolute to temperature if volume is kept constant

b) i) Given that the relationship between pressure, P and temperature, T in Kelvin is of the form

$P = kT + C$

Where k and C are constants, determine from the graph, values of k and C

$K = \text{gradient}$

$= \frac{(8-0)}{200 - 0} X 10^4 NM^{-2}$

$K = 400N m^{-2} K^{-1}$

$C = O$

ii) Why would it be possible for pressure of the gas to be reduced to zero in practice?

- The gas liquefies at low temperature before reaching zero Kelvin

c) A gas is put into a container of fixed volume at a constant volume at a pressure of 2.1×10^5.
Nm^{-2} and temperature 27°C. The gas is then heated to a temperature of 327°C. Determine
the new pressure

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

$P_1 = 2.1 X 105\ Nm^{-2}$
$P_2 = ?$
$T_1 = 27 + 273$
$X10^5 NM^{-2}$
$= 300K$

$T_2 = 273 + 327$
$= 600K$

$P_2 = \frac{P_1 T_2}{T_1}$
$= \frac{(2.1 X 600)}{300} X 10^5 NM^{-2} = 4.2$

3. a) The volume of a fixed mass of gas is inversely proportional to its pressure provided
temperature is kept constant.

(b) (i) The bubble expands as it comes up finally bursts when at the surface

(ii) $p_1V_1 = P2V_2$
$(76 + 30) x 3 = (76 + 5) V_2$
$106 x3 = 81 X V_2$
$V_2 = \frac{106 x 3}{81}$
$= 3.93cm^3$

(c) $100^oC - 0^oC = 98 - 11$
1 division $= \frac{87}{100}$
Reading $= \frac{8 x 56}{1000}$
$= 48.72^oC$

4. a) The volume of a fixed mass of a gas is inversely proportional to the pressure provided
that temperature is kept constant √ 1

$^1/_v$ (mm^{-3})	0.5	0.4	0.2	0.1

b) Labeling the axes

Scale

Plotting (3,4) pts

2 points

Below 2 points
Smooth curve / straight line

c) Gradient = $\frac{\Delta y}{\Delta x}$

$= \frac{400 - 160}{(0.5 - 0.2) X 10^{-9}}$ √ 1

$= \frac{340}{0.3 X 10^{-9}}$

$= 1133.33 X 10^{-9}$

$= 1.1333 X 10^{-6}$ KNM

d) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ √ 1

$\frac{1 X 10^5 X V_1}{285} = \frac{P_2 2_{V1}}{373}$ √ 1

$P2 = 6.95 X 10^4$ Pa √ 1

5. a) Boyles Law: States:-

(i) - The pressure of a fixed mass of a gas is inversely proportional to its volume, provided the temperature is kept constant. 1

(ii) Charles Law states:

- The volume of a fixed mass of a gas is directly proportional to its absolute temperature at constant pressure. 1

b) (i)

(ii) at 0^0c, v = 4.7 cm^3 ± 0.1 1

(iii) Slope = $\frac{DV}{DT}$

$= \frac{(6.4. - 50) cm^3}{(60 - 10)^0 c}$ 1= 0.028 $cm^3/^0c$ ± 0.002 1

(iv) V = KT + C.

K = Slope = 0.028$cm^3/^0c$ ± 0.002 1

C = V intercept when T = 0 and 1

= 4.7. cm^3 ± 0.1