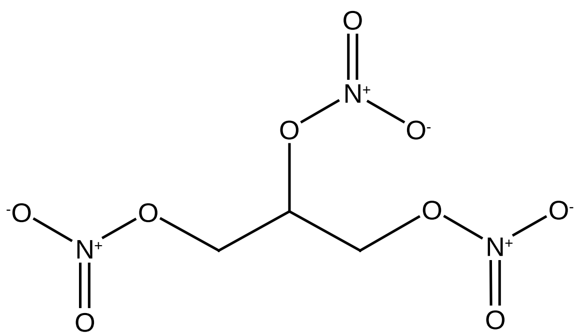
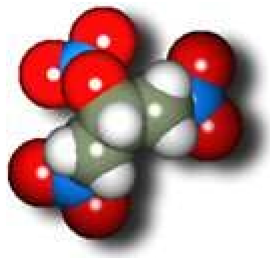
Chem V
Extra Ideal gas Law Problems

1.

1.59 g of nitroglycerin $C_3H_5N_3O_9$ react within a 1.0 ml container. What pressure is generated by the explosion?

- The molar mass of nitroglycerin is 227g/mole.
- The temperature is difficult to estimate because the surrounding air will remove some the heat that is calculated from Q= mcΔT. **So let's use a rough 1000^{o}C (with one sig fig only)**
- Be careful with moles! Look at this carefully.
  $4\ C_3H_5N_3O_{9(l)} \rightarrow 12\ CO_{2(g)} + O_{2(g)} + 6\ N_{2\ (g)} + 10\ H_2O_{(g)}$

- Container will break very quickly, so the volume assumption probably overestimates pressure.

ANSWER

Total moles produced:

0.007(12/4 + ¼ + 6/4 + 10/4) = 0.05075000000 moles

P = nRT/V = 0.05075000000(8.31)(1273)/0.001 = 536865.4725= kPa = 5 X 10^5 kPa

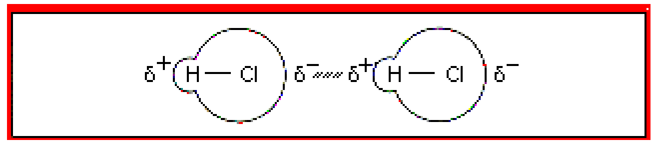
2. HCl does not act as an ideal gas. **Calculate R** for this gas. Respect sig figs. (2 marks)

pressure	moles	Volume	T
101.3 kPa	1.00	22 100 ml	0.0 ^{o}C

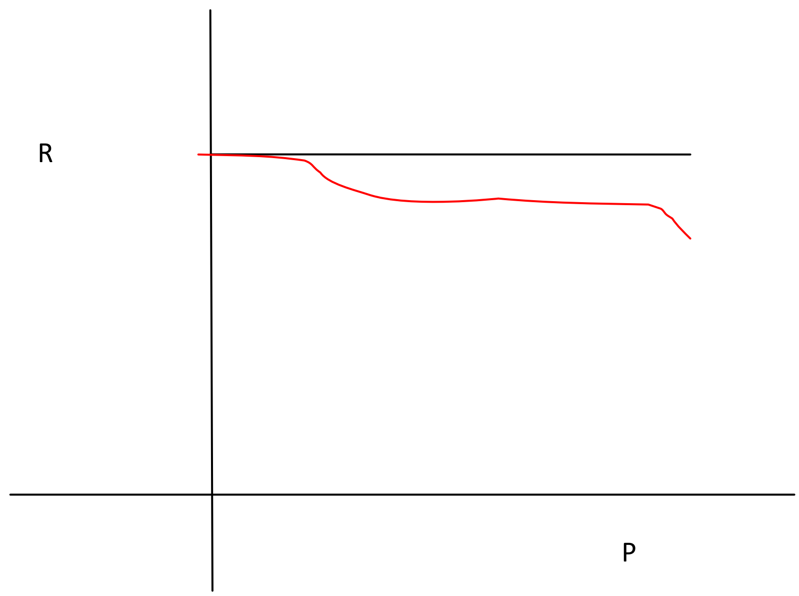
R = PV/(nT)=101.3(22.1 L)/1/273 =8.20L*kpa/(Kmole)

b) Which measurement caused R to be smaller than expected? volume

c) What between the molecules caused that measurement to be smaller than expected? Show with a diagram. The attractions between HCl molecules caused real gas behaviour by lowering volume at constant pressure and temperature. In the molecule, the Cl is a lot more electronegative than H, so the sharing of electrons is far from perfect. There is a bit of a negative charge on the Cl atom and a bit of a positive charge on the H atom.



3. a) For the following relationship, do any of the other variables have to remain constant for an ideal gas?

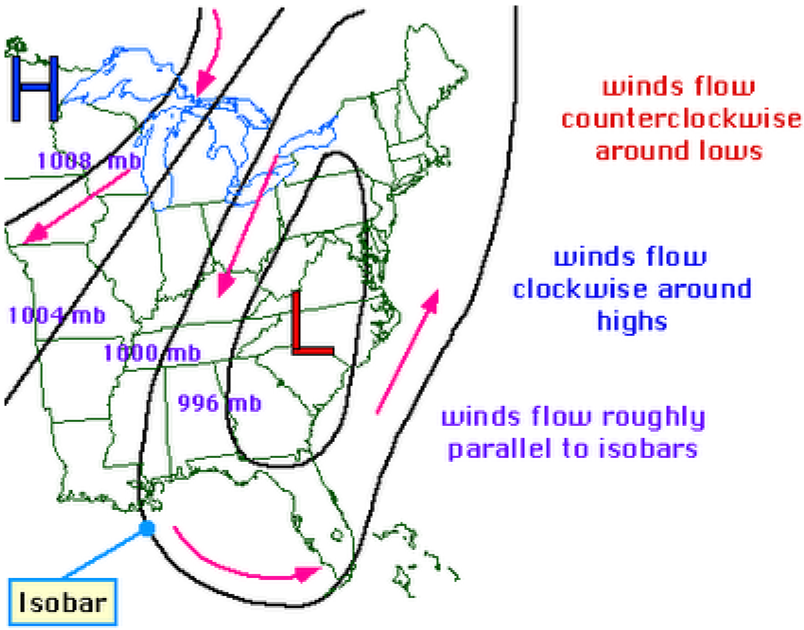


ANSWER: NO

b) Draw the same relationship for real gas behaviour.

ANSWER:
(Overall it will be a horizontal line but the value of R will be lower. But at lower pressures, the ideal gas behaviour will kick in because there will be limited attractions when molecules are far apart. As a result R will be close to 8.31 at low pressures. At very high pressures, the attractions will become even stronger, and cause V and R to decrease even more.See previous question)

4.



The direction of winds as shown in the diagram is complicated by the earth's rotation. But putting that aside, what role does air pressure play in creating wind?

1 mb = 0.1 kPa

ANSWER:

If the pressure of one air mass (X) is higher, its molecules will push against those of the one with a lower pressure (Y), so the wind will blow in the direction of the net force, from X to Y.

5. What's the most $AB_{3(g)}$ that can be produced if we react 1.0 L of $A_{2(g)}$ with 1.0 L of $B_{2(g)}$?

$A_{2(g)} + 3\ B_{2(g)} \rightarrow 2\ AB_{3(g)}$

Assuming ideal gas behaviour and the same conditions of pressure and temperature, moles and liters of gas will be proportional. But according to the ratio in the equation, 1.0 L $A_{2(g)}$of needs 3.0 L of $B_{2(g)}$ So only part of the 1.0 L of $A_{2(g)}$ will react. But all of the 1.0 L of $B_{2(g)}$ will react with only 1/3 L of $A_{2(g)}$ (see ratio), and only 2/3 L = **0.67 L of AB_3 will be produced**.

How do we get 2/3 L? Either do : 1/3 L of $A_{2(g)}$ (2 $AB_{3(g)}$/ 1 $A_{2(g)}$) =2/3 L of $AB_{3(g)}$ or

you can do 1.0 L of $B_{2(g)}$ ((2 $AB_{3(g)}$/ 3 $B_{2(g)}$) = 2/3 L of $AB_{3(g)}$