Chemistry 240 Semester 01-2009
Homework for Submission #1

Answer the following questions and submit them for marking on or before 26th Jan 2009 in class. Credit can only be earned if working is shown clearly. If any answers show evidence of copying, the whole exercise will attract zero marks.

1) There are various ways of expressing the speed of the molecules of a gas. The root mean square speed has been dealt with in class. The average speed of the molecules of a gas is given by $\sqrt{\frac{8RT}{\pi M}}$ and the most probable speed is given by $\sqrt{\frac{2RT}{M}}$.

a) Prove that the root mean square speed is the largest and the most probable speed the smallest of these quantities, regardless of the value of T or M.

b) Evaluate these speeds for nitrogen gas at 100°C.

c) Compare your value for nitrogen with the escape velocity for the Earth of 11.2 km s^{-1} and comment on your result.

2) You are told that 2.55 g of a gaseous hydrocarbon occupies a vessel of volume 3.00 L at 0.950 atm and 82.0°C. Draw the Lewis structure for this hydrocarbon.

3) Ammonia and hydrogen chloride gases react on contact to form a white solid. A tube is plugged with glass wool soaked in concentrated hydrochloric acid at the left hand end and another plug soaked in concentrated ammonia at the right hand end at the same time. The distance between the inside surfaces of the plugs is 3.00 m. After a while a narrow white annular band has formed on the inside of the tube, perpendicular to its length. Calculate the distance of the band from the left hand end of the tube.

4) Two glass vessels, one containing oxygen at 4.00 atm and the other containing nitrogen at 5.25 atm. Given that the volume of the vessels is 1.00 L and 2.00 L respectively, calculate the final pressure if the two vessels are connected without any change in total volume or temperature.

Now suppose that the gases are hydrogen chloride and ammonia respectively, what is the final pressure after connection and cooling to the original temperature? (NB the volume of solids is negligible compared to that of gases.)

5) A vessel contains 46.2 g of a gas. The vessel and its contents are heated from 0.00°C to 327.2°C. What mass of gas must be allowed to escape to maintain a constant pressure? (Assume the volume of the container remains constant.)