Assigned problems for Lecture 2 are listed below. The questions occur in the following editions of "Physical Chemistry" by P.W. Atkins:

10th edition	9th edition	8th edition

Note: The letter "P" in front of a number indicates that the question is in the "Problem" category as opposed to the "Exercise" category in Atkins' books.

Question 2.01

1A.8	1.8	1.8

1A.8(a) At 500 °C and 93.2 kPa, the mass density of sulfur vapour is 3.710 kg m^{-3}. What is the molecular formula of sulfur under these conditions?
1A.8(b) At 100 °C and 16.0 kPa, the mass density of phosphorus vapour is 0.6388 kg m^{-3}. What is the molecular formula of phosphorus under these conditions?

Question 2.02

1A.10	1.10	1.10

1A.10(a) Given that the density of air at 0.987 bar and 27 °C is 1.146 kg m^{-3}, calculate the mole fraction and partial pressure of nitrogen and oxygen assuming that (i) air consists only of these two gases, (ii) air also contains 1.0 mole per cent Ar.
1A.10(b) A gas mixture consists of 320 mg of methane, 175 mg of argon, and 225 mg of neon. The partial pressure of neon at 300 K is 8.87 kPa. Calculate (i) the volume and (ii) the total pressure of the mixture.

Question 2.03

1A.11	1.11	1.11

1A.11(a) The density of a gaseous compound was found to be 1.23 kg m^{-3} at 330 K and 20 kPa. What is the molar mass of the compound?
1A.11(b) In an experiment to measure the molar mass of a gas, 250 cm^3 of the gas was confined in a glass vessel. The pressure was 152 Torr at 298 K, and after correcting for buoyancy effects, the mass of the gas was 33.5 mg. What is the molar mass of the gas?

Question 2.04

1A.13	1.18	1.18

1A.13(a) A vessel of volume 22.4 dm^3 contains 2.0 mol H_2 and 1.0 mol N_2 at 273.15 K. Calculate (i) the mole fractions of each component, (ii) their partial pressures, and (iii) their total pressure.
1A.13(b) A vessel of volume 22.4 dm^3 contains 1.5 mol H_2 and 2.5 mol N_2 at 273.15 K. Calculate (i) the mole fractions of each component, (ii) their partial pressures, and (iii) their total pressure.

Question 2.05

1A.5	1.5	1.5

1A.5(a) A diving bell has an air space of 3.0 m^3 when on the deck of a boat. What is the volume of the air space when the bell has been lowered to a depth of 50 m? Take the mean density of sea water to be 1.025 g cm^{-3} and assume that the temperature is the same as on the surface.
1A.5(b) What pressure difference must be generated across the length of a 15 cm vertical drinking straw in order to drink a water-like liquid of density 1.0 g cm^{-3}?

Question 2.06

P1A.1	P1.1	P1.1

P1A.1 Recent communication with the inhabitants of Neptune have revealed that they have a Celsius-type temperature scale, but based on the melting point (0 °N) and boiling point (100 °N) of their most common substance, hydrogen. Further communications have revealed that the Neptunians know about perfect gas behaviour and they find that in the limit of zero pressure, the value of pV is 28 dm^3 atm at 0 °N and 40 dm^3 atm at 100 °N. What is the value of the absolute zero of temperature on their temperature scale?

Question 2.07

P1A.10	P1.28	P1.28

P1A.10 Balloons are still used to deploy sensors that monitor meteorological phenomena and the chemistry of the atmosphere. It is possible to investigate some of the technicalities of ballooning by using the perfect gas law. Suppose your balloon has a radius of 3.0 m and that it is spherical. (a) What amount of H_2 (in moles) is needed to inflate it to 1.0 atm in an ambient temperature of 25 °C at sea level? (b) What mass can the balloon lift at sea level, where the density of air is 1.22 kg m^{-3}? (c) What would be the payload if He were used instead of H_2?

Clarifications:

Question 2.01

1A.8	1.8	1.8

Ex. 1.8b, 8th Ed. The pressure in this question should be 16.0 kPa not 1.60 kPa; otherwise you get something like a formula of P_{40} for your final answer. Previous editions are correct, and list the pressure as 120 Torr. This has been fixed in later editions.

Question 2.02

1A.10	1.10	1.10

Ex. 1.10a, 8th Ed. This question is a little bit tricky, but it helps if you start off with the assumption that the volume is 1 L (or 1 dm^3). Then, you know the p, V and T, so you can calculate the total number of moles of gas. You also know that the total mass of the gas: $m_{TOT} = n_{N2}M_{N2} + n_{O2}M_{O2}$. So, you should have two equations in two unknowns, from which you can solve for the number of moles of O_2 and N_2, and ultimately the partial pressures of each.