GASES (no calculator)

These questions can be done with or without a calculator. The answers given are the ones you'd get if you didn't use a calculator.

1) A container is filled with a gas to a pressure of 2.00 atm at 27°C.
   a) What pressure will develop within the sealed container if it is warmed to 127°C? **[2.67 atm]**
   b) At what temperature (in °C) will the pressure be 10.0 atm? **[1227°C]**

2) A 1.00 L sample of a gas is collected at 27°C and 1.25 atm. What is the pressure of the gas (in atm) at 127°C if the volume is 4.00 L? **[5/12 atm]**

3) What volume will 4.40 kg of CO_2 occupy at 227°C and 380 torr? **[8.2×10^3 L]**

4) What is the density of N_2O gas at 27°C and 0.750 atm? **[1.3 g/L]**

5) If the temperature is held constant at 77°C, at what pressure will the density of N2 gas be 0.500 g/L? **[0.5 atm]**

6) A gas has a density of 0.50 g/L at 77°C and 380 mmHg. What is the molar mass of the gas? **[about 28 g/mol]**

7) A 0.500 g sample of a liquid was vaporized at 127°C. The vapor occupied a volume of 250 mL at 1.00 atm. What is the molar mass of the liquid? **[65 g/mol]**

8) Aluminum carbide, Al_4C_3 (144 g/mol), reacts with water to produce methane gas, CH_4, and $Al(OH)_3$ as follows:

   $$Al_4C_3(s) + 12H_2O(l) \longrightarrow 3CH_4(g) + 4Al(OH)_3(s)$$

   a) What volume of methane at 27°C and 1.00 atm would be obtained by the reaction of 1.44 g of Al_4C_3? **[7.5 x 102 mL]**
   b) What mass of Al_4C_3 would yield 287 mL of methane at 77°C and 760 torr? **[0.48 g]**

9) In a mixture of CO and CO_2, the partial pressures of CO and CO_2 are 0.300 atm and 0.700 atm respectively.
   a) What is the total pressure? **[1.0 atm]**
   b) What is the mole fraction of each gas in the mixture? **[$X_{CO} = 0.30$]**
   c) If the mixture occupies 11.2 L at STP, what is the total number of moles of gas? **[0.5 moles]**
   d) How many grams of each gas does the mixture contain? **[4.2 g CO and 15.4 g CO_2]**

10) Calculate the mass, in grams, of Na_2CO_3 (106 g/mol) formed by the reaction of 400 mL of 1.0 M NaOH and 5.60 L of CO_2 gas measured at STP. The equation for the reaction is:

$2NaOH(aq) + CO_2(g) \longrightarrow Na_2CO_3(aq) + H_2O(l)$

[21.2 g]

11) A particular balloon has a mass of 175 kg when uninflated and has a volume of 550 m^3 when inflated with He(g) at 25°C. What is the maximum mass of cargo that this balloon can lift if the pressure in the balloon is the same as the atmospheric pressure (1.0 atm)? Assume the mass of air is 28.8 g/mol. **[375 kg]**

12) A hydrocarbon (C_xH_y) is burned completely in oxygen to produce a mixture of CO_2(g) and H_2O(g). The total pressure of the mixture is 1.20 atm and the partial pressure of the H_2O(g) is 0.60 atm. What is the empirical formula of the hydrocarbon? **[CH_2]**

13) A mixture of the gases CO and CH_3COCH_3 (acetone) is trapped in a 1.0 L flask. The pressure in the flask is 100 mmHg initially and the pressure registers 114 mmHg after the acetone in the flask is caused to decompose according to the following reaction at the same temperature:

$CH_3COCH_3(g) \longrightarrow C_2H_4(g) + CO(g) + H_2(g)$

If all the substances present are in the gas phase, and the CO initially present is unchanged by any chemical reaction, what was the initial pressure of acetone in the mixture?
(7 mmHg)

14) Calculate the rate of effusion of sulfur dioxide (SO_2) molecules through a small opening if methane (CH_4) molecules pass through the same opening at a rate of 8.0 cm_3/sec. Assume the same temperature and equal partial pressures of the two gases. **[4.0 cm^3/sec]**

15) A mixture of neon (20 g/mol) and argon (40 g/mol) has a mass of 10.0 g and occupies a volume of 10.0 L at 27°C and 1.00 atm. What is the percent composition by mol%?
[77% by mol Ne]