1) Represent the Lewis structure for the molecules and ions listed below.

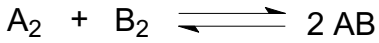
Describe the geometry of the electron groups, the molecular geometry and any resonance forms.

Describe the type of hybridisation of the central atom.

Indicate which of the neutral molecules are polar.

a) SO_2 b) PO_4^{3-}

2) The equilibrium constant of the reaction in the gas phase:



is 48.0 at 723 K. Calculate the composition at equilibrium when 3 moles of A_2 and 2 moles of B_2 are reacted. Following an increase in pressure, does the equilibrium shift to the left or to the right?

3) At high temperatures, aluminium reacts with oxygen to produce aluminium oxide according to the following reaction (to be balanced):

$$Al_{(s)} + O_{2\,(g)} = Al_2O_{3\,(s)}$$

In an experiment, 7.58 g of Al are reacted with 3.32 g of O_2.

(a) Calculate the amount of Al_2O_3 produced at the end of the reaction.

(b) Which reactant will remain in excess at the end of the reaction? How many grams of it will not have reacted?

(P.A.: Al=27; O=16)

4) Given the reaction: $N_2 + 3\ H_2 = 2\ NH_3$, determine whether ammonia forms spontaneously at 25 °C. At what temperature is the reaction in equilibrium?

$\Delta H = -11.0$ kcal/mol; $\Delta S = -23.6$ cal/(mol K)

5) The heat of combustion of formic acid, according to the reaction:

$$CH_2O_{2(l)} + \frac{1}{2}O_2 \rightarrow CO_{2(g)} + H_2O_{(l)}$$

is $\Delta H = -276$ kJ/mol. Calculate the enthalpy of formation for formic acid, knowing the enthalpies of formation for $CO_2(g)$ and $H_2O(l)$, which are respectively 394 kJ/mol and –286 kJ/mol.

6) A mixture of 12.4 g of nitrogen and 12.4 g of oxygen exerts a pressure of 1.23 atm. Calculate the partial pressure of O_2 and N_2 in the mixture.

(PA N=14, O=16)

7) Calculate the reaction $\Delta G°$ at 25°C for the following transformation:

$2C_2H_{2\,(g)} + 5\ O_{2\,(g)} \rightarrow 4CO_{2\,(g)} + 2H_2O_{\,(l)}$

knowing that:

$\Delta H°_f(C_2H_2) = 228.2$ kJ/mol

$S°_f(C_2H_2) = 200.9$ J/mol K

$S°_f(O_2) = 205.2$ J/mol K

$\Delta H°_f(CO_2) = -393.5$ kJ/mol

$S°_f(CO_2) = 213.8$ J/mol K

$\Delta H°_f(H_2O_{(l)}) = -285.8$ kJ/mol

$S°_f(H_2O_{(l)}) = 70.0$ J/mol K