1. It has been hypothesized that some bacteria can grow autotrophically using nitrous oxide (N_2O) in a disproportionation reaction as both an electron donor and electron acceptor simultaneously. Given that the endproducts of this metabolism are nitrogen gas (N_2) and nitrate (NO_3^-) show the possible balanced equation for the reaction and calculate the free energy yield. Is this metabolism possible and is it more or less likely to occur than elemental sulfur (S^o) disproportionation into sulfate and sulfide? Use the following free energies of formation (G^o_f) to calculate your answer and assume 1 molar concentrations of each at 25 ^oC

Compound	G^o_f **(kJ/mol)**
N_2	0
N_2O	+104.18
NO_3^-	-111.34
S^o	0
HS^-	+12.05
SO_4^{2-}	-744.6

Remember for the equation

$$aA + bB \rightarrow cC + dD$$

$$\Delta G = \Delta G^o + RT \ln K$$

$$\Delta G^o = \Sigma \Delta G_f^o(\text{products}) - \Sigma \Delta G_f^o(\text{reactants})$$

$$K = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

R = Universal gas constant = 0.00829kJ/mol/^{o}K
T = absolute temperature ^{o}K
To convert ΔG^o to $\Delta G^{o\prime}$ i.e. from standard conditions (pH 0) to biochemical conditions (pH 7) in reactions involving H+

$$\Delta G^{o\prime} = \Delta G^o + mG'f(H^+)$$

Where m is the net number of protons in the reaction (negative if more are consumed than produced) and $G'f(H^+)$ is the free energy of formation of a proton at pH 7 = -39.83 kJ at 25^{o}C