Task:

the following reaction takes place
3 CuO(s) +2NH3(g)--->3 Cu(s) +N2(g)+ 3 H20(g)

50.0g of CuO(s) was placed in an 80.0 L vessel, and the vessel was evacuated. Ammonia gas was the gradually introduced into the vessel, slow enough for the reaction to proceed, until the total pressure in the vessel (after reaction) was 1.00atm. what are the partial pressures of all 3 gases in the vessel? (Temperature is 180degrees celcius) Please show how you arrived at the answers.

Solution:
The chemical equation for the reaction is
$3\ CuO(s) + 2NH_3(g) \rightarrow 3\ Cu(s) + N_2(g) + 3\ H_20(g)$
The total pressure of a mixture of gases is equal to the sum of the partial pressures of the individual gases
$p = p(N_2) + p(H_2O) + p(NH_3)$
$MW(CuO) = 80$ g/mol
$\nu(CuO) = m(g) / MW(g/mol) = 50.0 / 80 = 0.625$ mol
According to the chemical equation
$\nu(H_2O) = \nu(CuO) = 0.625$ mol
$\nu(N_2) = \nu(CuO)/ 3 = 0.625 / 3 = 0.208$ mol
According to the ideal gas law
$pV = nRT$
$p = 1$ atm
$V = 80.0$ L
The total number of moles is
$n = pV/RT = 1.00 \cdot 80.0 / 0.082 \cdot (273+180) = 2.15$ mol
the mole fraction of each component is
$\chi(H_2O) = n(H_2O) / n = 0.625 / 2.15 = 0.291$
$\chi(N_2) = n(N_2) / n = 0.208 / 2.15 = 0.097$
$\chi(NH_3) = n(NH_3) / n = (2.15-0.625-0.208)=0.612$
The partial pressures are
$p(H_2O) = p \cdot \chi(H_2O) = 1.00 \cdot 0.291 = 0.291$ atm
$p(N_2) = p \cdot \chi(N_2) = 1.00 \cdot 0.0967 = 0.097$ atm
$p(NH_3) = p \cdot \chi(NH_3) = 1.00 \cdot 0.612 = 0.612$ atm

Answer: $p(H_2O) = 0.291$ atm
$p(N_2) = 0.097$ atm
$p(NH_3) = 0.612$ atm

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