0.0755 g of selenium vapours occoupying a volume of 114.2 mL at 700 and 185 mm of Hg. The vapours are in equilibrium as Se6(g)⇌3Se2(g). Calculate (i) Degree of dissociation of (Se=79). (ii) Kp. (iii) Kc.

Solution. i)First, let's define the degree of dissociation. The degree of dissociation is the ratio of the number of disintegrated particles to the total number of particles. We write in mathematical form, taking the designation of the degree of dissociation as α: $\alpha=\frac{Ndiss}{Ntot}$.
Now we apply the Mendeleev-Clapeyron law: PV=nRT, where P – pressure, kPa; T – temperature, K; V – volume, L; R - gas constant, J/(K * mol); n – moles.
Find the molar mass of the gas from the Mendeleev-Clapeyron equation: $M=\frac{mRT}{PV}=\frac{0.075\times8.31\times973}{24.65\times0.1142}=215.42\ \frac{g}{mol}$. This molar mass consists of molar masses Se_6 and Se_2 according to their mole fractions in the mixture. Then we denote the share Se_6 for value ω, then for Se_2 value will be (1-ω). Then: $M=\omega\times M(Se_6)+(1-\omega)\times M(Se_2)=582\omega+194-194\omega=215.42$, and ω=0.055. So, we have a mole fraction for Se_6 0.055 and for Se_2 1-0.055=0.945, but at the same time we know, that the mole fraction is the ratio of moles of the component in the mixture to the total number of moles of the component in the mixture. The number of moles is related to the number of molecules through the Avogadro number. We have an equilibrium mixture, and therefore the number of particles in an equilibrium mixture for Se_6 written like this: $N(Se_6)=N^0(Se_6)\times(1-\alpha)$. Further reasoning is as follows. Reacted Nα of particles Se_6, and formed 3Nα of particles Se_2. Then we can write the equation: $\frac{(1-\alpha)N(Se_6)}{(1-\alpha)N(Se_6)+3N(Se_6)\alpha}=0.055$. Having solved this equation, we obtain the degree of dissociation equal to α=0.851.
ii) Partial pressure of Se_2, based on previous arguments, will be equal 0.945×24650 Pa=23294.25 Pa. Partial pressure of Se_6 will be equal 24650-23294.25=1355.75 Pa. Then $K_p=\frac{p^3_{Se_2}}{p_{Se_6}}=9.32\times10^9$ Pa^2.
iii)$K_c=K_p\times(RT)^{-\Delta n}$. Δn=3-1=2. $K_c=9.32\times10^9\times(8.31\times973)^{-2}=142.6$ mol^2/m^4.
Abswer: i)α=0.851; ii)$K_p=9.32\times10^9$ Pa^2; iii)$K_c=142.6$ mol^2/m^4.