AP Chemistry - unit 9 - NMSI Sudden Problem

$$2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$$

Initial	5.00 mol	0	0	in 5.00 L Rxn Vessel
Equil		3.00 mol		@ 400K

A) Equilibrium Constant, K_c

$$K_c = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$$

B) initial molar concentration SO_3

$$[SO_3] = \frac{5.00\ mol}{5.00\ L} = 1.00\ M$$

C) Equilibrium [ ] of O_2, SO_2, SO_3

$$[SO_2]_{eq} = \frac{3.00\ mol}{5.00\ L} = 0.600\ M$$

	$2SO_3$	$\rightleftharpoons$	$2SO_2$	O_2
I	1.00		0	0
C	-2x		2x	x
E			.600 M	$\rightarrow \therefore x = .300$

Solve E $-2(.300)$ .300 M

$-.600$

$1.00 - .600$

$.400$

$[SO_3]_{eq} = .400\ M$ $[SO_2]_{eq} = .600\ M$ $[O_2]_{eq} = .300\ M$

AP Chem - Unit 9 - NMSI Super Problem

1)

c) $K_c = ?$

$$K_c = \frac{[SO_2]^2[O_2]}{[SO_3]^2} = \frac{[.600]^2[.300]}{[.400]^2}$$

$K_c = .675$

d) $K_p = ?$

$$K_p = K_c(RT)^{\Delta n}$$

$$= (.675)[(.0821)(400)]^1$$

$K_p = 22.2$

Δn = product g mole − R g mole

$= 3 - 2$

$\Delta n = 1$

$T = 400\,K$

e) Rxn vessel is cooled from 400K to 298K

Result: Shift to Left ∴ more Reactants & fewer products

So eqn has to be $\text{heat} + 2SO_{3(g)} \leftrightharpoons 2SO_{2(g)} + O_{2(g)}$

∴ Reaction is **Endothermic**

h) moles of SO_3 Δ ?

i) temp ↓

Since eqn/Rxn is endothermic a decrease in temp will cause Shift to Left ∴ increase in SO_3

ii) Volume in Rxn container ↑

2 moles gas ⇌ 3 moles gas Result of V↑, pressure↓

∴ Shift to Right + decrease in SO_3

AP Chem - Unit 9 - NMSI - SP

$SO_{2(g)} + \frac{1}{2} O_{2(g)} \rightleftharpoons SO_{3(g)}$ @ 400K

i) $K_c = ?$ (K_2)

$K_2 = \frac{1}{K_1}$ ← original value since Rxn Reversed

Coeff are mult by ½

∴ Kc raised to ½

$K_2 = \frac{1}{K_c^{1/2}}$

$K_2 = \frac{1}{(.675)^{1/2}}$

$\boxed{K_2 = 1.22}$