eg of difficult Gas Phase Keq Calculation.

For the equilibrium: in a 5.0L flask

$$A(g) \rightleftharpoons B(g) + C(g)$$

Equilibrium concentrations are found to be 0.05 mol/L, 0.02 mol/L and 0.04 mol/L. What would the concentrations become if the flask volume was increased to 8 L? To the original mixture, what amount of A would be required to increase the of [C] to 0.05 mol/L?

	A ⇌	B	+ C	
Initial [ ]	0.05 mol/L	0.02 mol/L	0.04 mol/L	5.0L
Initial Amount	0.25 mol	0.10 mol	0.20 mol	
Final Amount	0.25 − x *	0.10 + x *	0.20 + x *	8.0L
Final [ ]	$\frac{0.25-x}{8}$	$\frac{0.10+x}{8}$	$\frac{0.20+x}{8}$	

S: ↓ P (↑ V)
R: ↑ P
H: make more gas *
D: shift Right
E:

a) equilibrium

Let x represent the amount of A that reacts

$$K_{eq} = \frac{[B][C]}{[A]}$$

$$0.016 = \frac{\left(\frac{0.10+x}{8}\right)\left(\frac{0.20+x}{8}\right)}{\left(\frac{0.25-x}{8}\right)}$$

$$0.016 = \left(\frac{0.10+x}{8}\right)\left(\frac{0.20+x}{8}\right)\left(\frac{8}{0.25-x}\right)$$

$$0.128(0.25-x) = (0.10+x)(0.20+x)$$

$$0.032 - 0.128x = 0.02 + 0.30x + x^2$$

$$0 = x^2 + 0.428x - 0.012$$

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

$$x = \frac{-0.428 \pm \sqrt{(0.428)^2-4(1)(-0.012)}}{2}$$

$$x = \frac{-0.428 \pm 0.48082}{2}$$

$x = -0.454$ or $x = 0.0264$

extraneous (gives −ve amounts)

$$[A] = \frac{0.25-x}{8}$$

$$= \frac{0.25-0.0264}{8}$$

$$= 0.0279 \text{ mol/L}$$

$$K_{eq} = \frac{[B][C]}{[A]}$$

$$K_{eq} = \frac{(0.02)(0.04)}{(0.05)}$$

$$K_{eq} = 0.016$$

$[B] = \frac{0.10+x}{8}$

$= 0.0158 \text{ mol/L}$

$[C] = \frac{0.20+x}{8}$

$= 0.0283 \frac{\text{mol}}{\text{L}}$

Check: $\frac{[B][C]}{[A]}$

$= 0.016 = K_{eq}$ ☺

$A \rightleftharpoons B + C$

Initial [ ]	~~0.05 mol~~ / L	0.02 mol / L	0.04 mol / L
Initial Amount	0.25 mol + x	0.10 mol	0.20 mol
Final Amount	0.25+x − 0.05 * = 0.20 + x	0.10 + 0.05 * = 0.15	0.20 + 0.05 * = 0.25 mol
Final [ ]	$\frac{0.20+x}{5}$	0.03 mol / L	0.05 mol / L

5.0 L

*assume volume stays @ 5.0 L

S: ↑[A]

R: ↓[A]

H: use A

D: shift right*

E:

Let x represent the amount of A added.

$K_{eq} = \frac{[B][C]}{[A]}$

$0.016 = \frac{(0.03)(0.05)}{\left(\frac{0.20+x}{5}\right)}$

$0.016 = 0.0015 \times \left(\frac{5}{0.20+x}\right)$

$0.20+x = 0.46875$

$x = 0.26875 \text{ mol}$