

a)

	A	+	B	\rightleftharpoons	C	
Initial []	/		/		/	
Initial Amount	5 mol		4 mol		0	
Final Amount	5 - x		4 - x		x	✓
Final []	$\frac{5-x}{8}$		$\frac{4-x}{8}$		$\frac{x}{8}$	✓

8 L flask
 Let x represent the amount of C that forms

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

$$0.5 = \frac{\left(\frac{x}{8}\right)}{\left(\frac{5-x}{8}\right)\left(\frac{4-x}{8}\right)} \quad \checkmark$$

$$0.5 = \left(\frac{8}{5-x}\right)\left(\frac{8}{4-x}\right)\left(\frac{x}{8}\right)$$

$$0.5(5-x)(4-x) = 8x$$

$$20 - 9x + x^2 = 16x$$

$$0 = x^2 - 25x + 20$$

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

$$x = \frac{+25 \pm \sqrt{(25)^2 - 4(1)(20)}}{2(1)}$$

$$x = \frac{25 \pm 23.3}{2}$$

$x = \cancel{24.2}$ or $x = 0.827 \quad \checkmark \checkmark$
extraneous (too large)

$$\begin{aligned} \therefore [A] &= \frac{5-x}{8} & [B] &= \frac{4-x}{8} \\ &= \frac{5-0.827}{8} & &= \frac{4-0.827}{8} \\ &= 0.522 \text{ mol/L} & &= 0.397 \text{ mol/L} \end{aligned}$$

$$\begin{aligned} [C] &= \frac{x}{8} \quad \checkmark \checkmark \\ &= \frac{0.827}{8} \\ &= 0.103 \text{ mol/L} \end{aligned}$$

b)

	A	+ B	⇌ C
Initial []	0.522 mol/L + $\frac{x}{8}$ mol/L	0.397 mol/L	0.103 mol/L
Initial amount	4.176 mol + x mol ✓	3.176 mol	0.824 mol ✓
Final amount	4.176 + x - 0.376 3.8 + x	3.176 - 0.376 ✓ = 2.8 mol	0.824 + 0.376 = 1.2 mol ✓
Final []	$\frac{3.8+x}{8}$ ✓	0.35 mol/L ✓	0.150 mol/L

8L flask
Let x represent
the amount of
A added ✓

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

$$\therefore [A] = \frac{3.8 + 3.057}{8}$$

$$0.5 = \frac{(0.150)}{\left(\frac{3.8+x}{8}\right)(0.35)} \quad \checkmark$$

$$[A] = 0.8571 \text{ mol/L}$$

$$\frac{3.8+x}{8} = \frac{0.150}{(0.5)(0.35)}$$

$$3.8+x = 6.857$$

$$x = 3.057 \text{ mol} \quad \checkmark$$

- c) S: ↑P
 R: ↓P
 H: make less gas
 D: shift right
 E: ∴ ↓n_A, ↓n_B, ↑n_C
 ↑[A], ↑[B], ↑[C]

	A	+	B	⇌	C
Initial []	0.8571 mol/L		0.35 mol/L		0.15 mol/L
Amount Initial	6.857 mol		2.8 mol		1.2 mol
Final amount	6.857 - x		2.8 - x		1.2 + x
Final []	$\frac{6.857 - x}{5}$		$\frac{2.8 - x}{5}$		$\frac{1.2 + x}{5}$

8 L flask → 5 L flask
 Let x represent the amount of C that forms
 5L

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

$$0.5 = \frac{\left(\frac{1.2+x}{5}\right)}{\left(\frac{6.857-x}{5}\right)\left(\frac{2.8-x}{5}\right)}$$

$$0.5 = \left(\frac{1.2+x}{5}\right)\left(\frac{5}{6.857-x}\right)\left(\frac{5}{2.8-x}\right)$$

$$19.2 - 9.66x + x^2 = 12 + 10x$$

$$0 = x^2 - 19.66x + 7.2$$

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

$$x = \frac{19.66 \pm \sqrt{(19.66)^2 - 4(1)(7.2)}}{2(1)}$$

$$x = \frac{19.66 \pm 18.91}{2}$$

$$x = \cancel{19.3} \text{ or } x = 0.373 \checkmark \checkmark$$

extraneous (too large)

$$\begin{aligned} \therefore [A] &= \frac{6.857-x}{5} & [B] &= \frac{2.8-x}{5} \\ &= \frac{6.857-0.373}{5} & &= \frac{2.8-0.373}{5} \\ &= 1.30 \text{ mol/L} & &= 0.485 \text{ mol/L} \end{aligned}$$

$$\therefore [C] = 0.315 \text{ mol/L}$$

Concentration vs Time (Reaction Coordinate)

