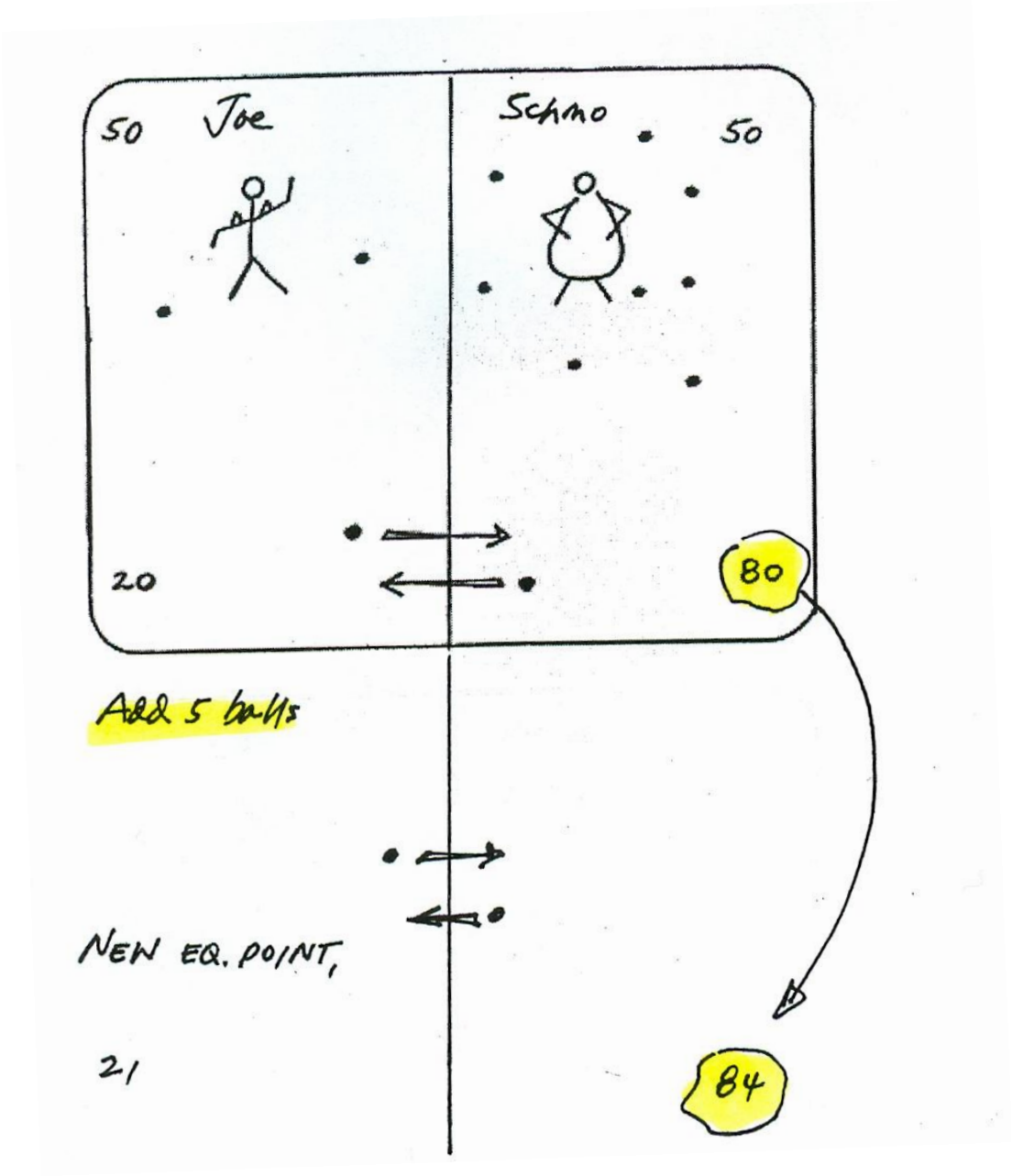
Aim: How do we shift a chemical equilibrium point?



The equilibrium "shifted" to the RIGHT.

Why?

$$\frac{\text{\# balls on right side}}{\text{\# balls on left side}} = \frac{80}{20} = \frac{84}{21} = \frac{4}{1}$$

GO TO THE HANDOUT.

"What you do, it tries to undo."

a. Add more H_2O

H_2O H_2O H_2O

$$\underset{\text{blue}}{CoCl_2} + 6\,H_2O \;\underset{\text{c. SHIFTS}}{\Longleftrightarrow}\; \underset{\text{pink}}{Co(H_2O)_6^{+2}} + 2\,Cl^{-1}$$

d. Incr amounts of $Co(H_2O)_6^{+2}$ & Cl^-

b. Incr # collisions between $CoCl_2$ & H_2O

RESULTS

e. Finally, the amount of $CoCl_2$ decr' b/c it's used to form products.

STRESS	SHIFT	$[CoCl_2]$	$[H_2O]$	$[Co(H_2O)_6^{+2}]$	$[Cl^{-1}]$	OBSERVATION
add H_2O	→	↓	×	↑	↑	more pink
add Cl^{-1} with HCl^-	←	↑	↑	↓	×	more blue
remove H_2O	←	↑	×	↓	↓	more blue
remove Cl^{-1} with $Ag^+NO_3^-$ (ppt)	→	↓	↓	↑	×	more pink

RULES for shifting:

1a) Adding a component causes the equilibrium to shift in the direction away from that component.

b) Removing a component causes the equilibrium to shift in the direction towards that component.

2a) A shift to the right side makes everything on the right side increase & everything on the left side decrease (except, of course, the component that was added).

b) A shift to the left side makes everything on the left side increase & everything on the right side decrease (except, of course, the component that was added).

Le Chatelier's Principle –when a stress is applied to a system at equilibrium, it shifts in the direction that will relieve that stress.

Simply stated: "What you do, it tries to undo."

$$2\ H^+ + 2\ CrO_4^{-2} \Longleftrightarrow Cr_2O_7^{-2} + H_2O$$

yellow — orange

In other words,

increasing concentration

decreasing concentration

RESULTS

STRESS	SHIFT	$[H^+]$	$[CrO_4^{-2}]$ yellow	$[Cr_2O_7^{-2}]$ orange	$[H_2O]$	Observation
add H^+ with H^+Cl^- (acid)	→	X	↓	↑	↑	more orange
remove H^+ with Na^+OH^- (base)	← (→ HOH)	X	↑	↓	↓	more yellow
add CrO_4^{-2}	→	↓	X	↑	↑	more orange
remove $Cr_2O_7^{-2}$	→	↓	↓	X	↑	more orange
add H_2O	←	↑	↑	↓	X	more yellow

Another way of asking the question:

To obtain (produce, form...) the maximum amount of $Cr_2O_7^{-2}$ (orange), the equilibrium should be shifted to the ____RIGHT_____

To do so,

To shift the eq. in this direction,

__ADD__ H^+ (add / remove) __ADD__ CrO_4^{-2} (add / remove) __REMOVE__ H_2O (add / remove)