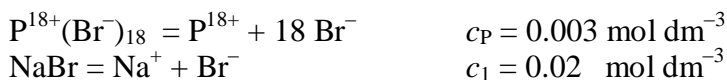
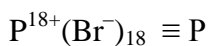


## Problem 12-01 Membrane equilibria

Aqueous solution of a polyelectrolyte  $\text{P}^{18+}(\text{Br}^-)_{18}$  in concentration  $0.003 \text{ mol dm}^{-3}$ , which is in solution completely dissociated, contains also NaBr in concentration  $0.02 \text{ mol dm}^{-3}$ . Part of this low-molecular electrolyte must be removed. The solution was separated by a semipermeable membrane (non-permeable for ions  $\text{P}^{18+}$ ) from the compartment of the same volume filled with pure water. What amount of NaBr (in per cents of initially present amount) will pass over into the compartment initially containing pure water?

[78.723 %]

Solution:



Balance:	at the beginning		in equilibrium	
	Left	Right	Left	Right
$\text{P}^{18+}$	$c_{\text{P}}$	0	$c_{\text{P}}$	0
$\text{Br}^-$	$18 c_{\text{P}} + c_1$	0	$18 c_{\text{P}} + c_1 - x$	$x$
$\text{Na}^+$	$c_1$	0	$c_1 - x$	$x$

Donnan equilibrium condition:  $(c_{\text{Na}^+} \cdot c_{\text{Br}^-})_{\text{Left}} = (c_{\text{Na}^+} \cdot c_{\text{Br}^-})_{\text{Right}}$

$$(c_1 - x) \cdot (18 c_{\text{P}} + c_1 - x) = x \cdot x$$

$$c_1 \cdot (18 c_{\text{P}} + c_1) - x \cdot (18 c_{\text{P}} + c_1) - x \cdot c_1 + x^2 = x^2$$

$$x = \frac{c_1 \cdot (18 c_{\text{P}} + c_1)}{18 c_{\text{P}} + 2 c_1} = \frac{0.02 \cdot (18 \cdot 0.003 + 0.02)}{18 \cdot 0.003 + 2 \cdot 0.02} = 0.0157447 \text{ mol dm}^{-3}$$

$$100 \cdot \frac{x}{c_1} = 100 \cdot \frac{0.0157447}{0.02} = 78.723 \%$$