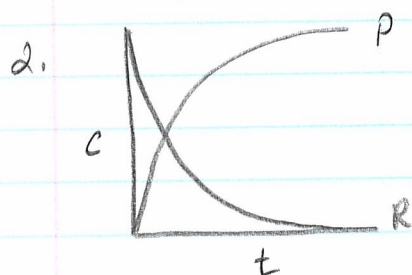
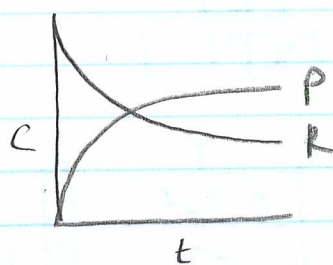


## Equilibrium Practice Test Solutions

- Equilibrium means a state of balance. Chemical equilibrium occurs when the forward and reverse reactions in a reversible system are occurring at the same rate, making the amounts of all substances constant. The term dynamic is used because the reactions are still occurring, and the system can shift by adding stresses.



IRREVERSIBLE



REVERSIBLE

An irreversible reaction **STOPS** when reactants reach or are close to zero. Reversible reactions reach constant concentrations, but continue to occur.

- All species must be isolated from other substances. For example, in an open system, the  $N_2$  and  $O_2$  in the air might react with the reactants or products in the system. OR, if a gas is being produced, it may escape the system and then can't participate in the reverse reaction.

4. EXOTHERMIC ( $\Delta H$  is -ve)

(a) left

(b) left

(c) left

(d) no change

$$(e) Q_c = \frac{[C]}{[B]^2} = \frac{3.23}{(0.24)^2} = 56$$

$Q_c > K_{eq}$ , system shifts left

- sudden change for ONE concentration
5.  $t_1 \rightarrow \uparrow [N_2]$ , so  $[NH_3]$  increases and  $[N_2]$  and  $[H_2]$  decrease
- $t_2 \rightarrow \uparrow P$  (or  $\downarrow V$ ), so  $[NH_3]$  increases (fewer molecules) and  $[H_2]$  and  $[N_2]$  decrease
- $t_3 \rightarrow \uparrow T$ , so  $[N_2]$  and  $[H_2]$  increase and  $[NH_3]$  decreases
- sudden change in ALL concentrations
- gradual change in ALL concentrations

6. (a)  $K_{eq} = \frac{[Z]}{[X]^2[Y]}$

(b)

	$2X$	$+ Y$	$\rightleftharpoons Z$
I	0.111	0.325	0
C	$-2x$	$-x$	$+x$
E	$0.111 - 2x$	$0.325 - x$	$x$

7.  $K_{eq} = \frac{[Z]}{[X]}$

	$X$	$+ 2Y(s)$	$\rightleftharpoons Z$
I	0		0.650
C	$+x$		$-x$
E	$x$		$0.65 - x$

Solve for  $x$

$$1.20 = \frac{0.65 - x}{x}$$

$$1.20x = 0.65 - x$$

$$2.20x = 0.65$$

$$x = 0.295$$

$$[Z] = 0.355 \text{ mol/L}$$

$$[X] = 0.295 \text{ mol/L}$$

8.  $K_{eq} = \frac{[N_2][H_2]^3}{[NH_3]^2}$

$$Q_c = \frac{(1.24)(0.179)^3}{(2.78)^2}$$

$$= 9.2 \times 10^{-4}$$

$Q_c > K_{eq}$   
shifts LEFT

	$2NH_3$	$\rightleftharpoons N_2 + 3H_2$
I	2.78	1.24 0.179
C	$+2x$	$-x$ $-3x$
E	$2.78 + 2x$	$1.24 - x$ $0.179 - 3x$