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QUESTION 1

Select the CORRECT answer.

Which of the following statements apply to reversible reactions?

I: The reaction does not go to completion.
II: The reaction is indicated with a double equilibrium arrow (⇌).
III: The reaction occurs in both the forward and reverse directions.
IV: The reaction stops when one or all of the reactants are used up.

- statements I and IV
- statements I, II, and III ✓
- statements II and III
- statements II, III, and IV

QUESTION 2

Select the CORRECT answer.

Consider the general representation for a reversible reaction:

reactants ⇌ products

Select the *CORRECT* arrangement of the steps that occur during a reversible reaction.

a. Both the forward and reverse reactions continue to occur at equal rates.
b. The mixture contains only reactants, and the reaction proceeds quickly in the forward direction.
c. The concentrations of the reactants and products remain constant at a given temperature.
d. The rate of the forward reaction slows down and the rate of the reverse reaction speeds up.

a - b - d - c

b - d - c - a ✓

b - d - a - c

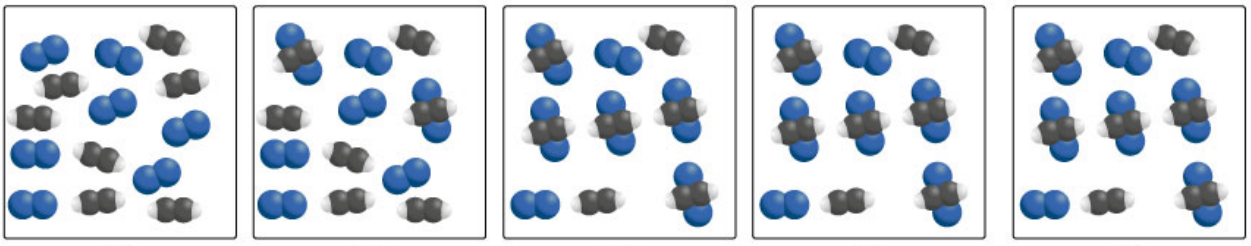
d - b - c - a

QUESTION 3

Select the CORRECT answer.

Consider the iodation reactions of ethene (C_2H_4):

$$C_2H_4(g) + I_2(g) \rightleftharpoons C_2H_4I_2(g)$$



The equilibrium is reached at stage c ✓ .

QUESTION 4

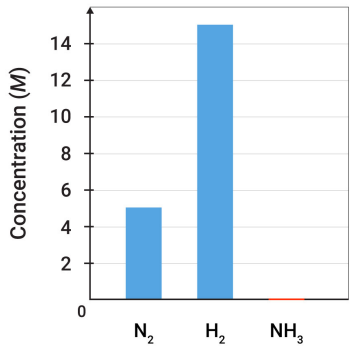
Select the CORRECT representation.

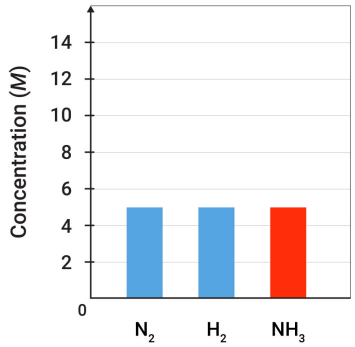
The Haber Process for converting hydrogen (H_2) and nitrogen (N_2) gases to ammonia (NH_3) is a reversible reaction.

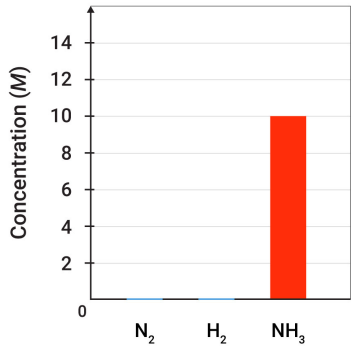
$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

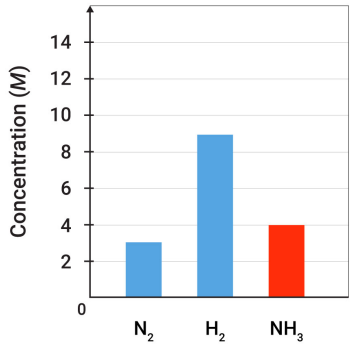
The reaction reached equilibrium when the gases are present in their stoichiometric amounts in the reaction mixture.

Which of the following charts represents the above reaction at equilibrium?









QUESTION 5

Select the CORRECT answer.

Copper (II) sulfate ($CuSO_4$) is a white solid.

When you add water, the white solid is then hydrated and turns into blue crystals.

When these blue crystals are heated, water evaporates and a white solid remains.

Which of the following is true about the above reaction?



- [x] The reaction is reversible.
- [ ] The reaction occurs in one direction.
- [ ] The reaction goes to completion.
- [ ] The reaction is athermic.

QUESTION 6

Select the CORRECT answer.

Rust is usually a reddish-brown oxide that forms by the reaction of iron and oxygen in the humid air.

Which of the following is CORRECT about the rusting reaction?



- Rusting reactions can occur in a reverse direction.
- ✓ Rusting reactions are irreversible reactions.
- The equation for rusting is indicated using (⇌).
- Rusting reactions can never go to completion.

QUESTION 7

Select the CORRECT answer to complete the sentences.

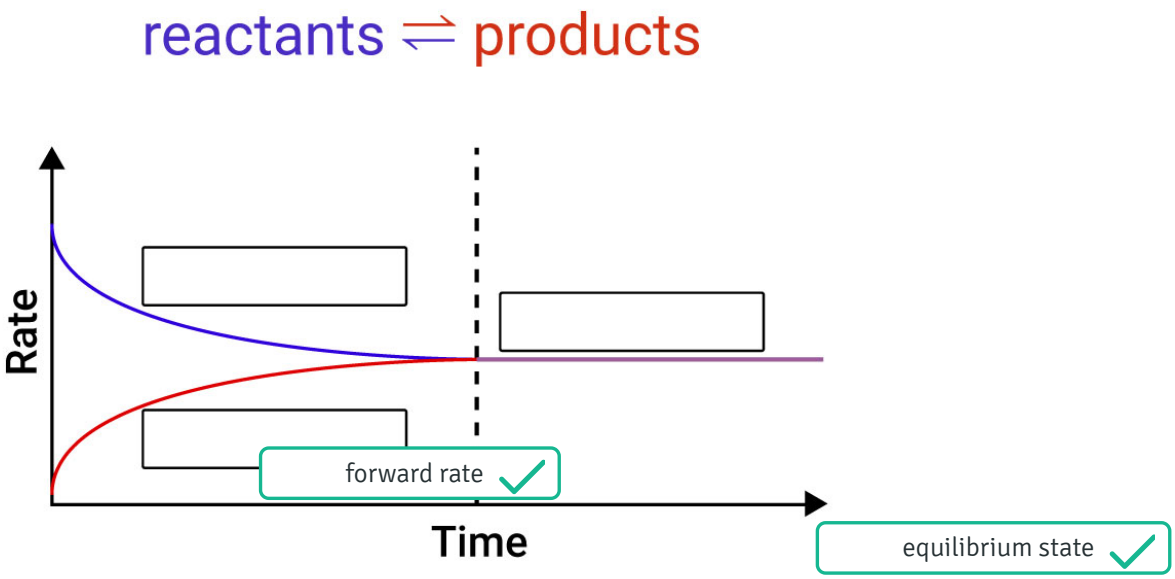
A _____ is a state in which the forward and the reverse chemical reactions take place at the same rate. Although the concentrations of reactants and products at equilibrium are constant, the opposing reactions are ongoing. This is why we refer to this state as a _____ equilibrium.

- chemical equilibrium; static
- dynamic equilibrium; stable
- ✓ chemical equilibrium; dynamic
- stable equilibrium; dynamic

QUESTION 8

Drag and drop the CORRECT answers to label the graph.

The graph shows the change in the rate of a reversible reaction over time.



products | reactants | reaction completion

QUESTION 9

Select the CORRECT answer to complete the sentence.

At a given temperature, the colorless gas dinitrogen tetroxide (N_2O_4) in a closed glass tube forms the brown gas nitrogen dioxide (NO_2). The equation for this reversible reaction is:

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

The reverse reaction proceeds when _____.

- the forward reaction stops occuring

the amount of N_2O_4 tends to be zero

enough NO_2 molecules are present

enough N_2O_4 molecules are present

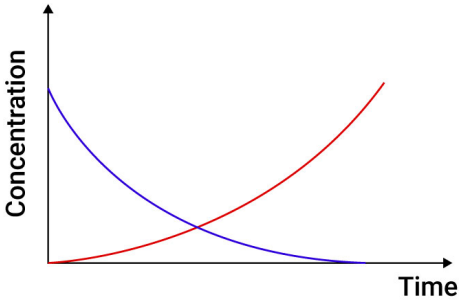
QUESTION 10

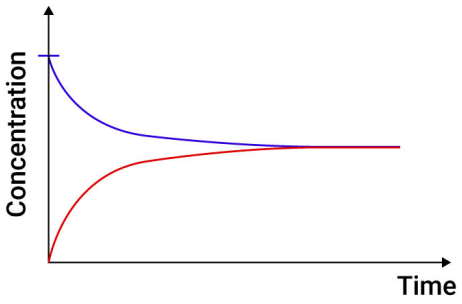
Select the CORRECT answer.

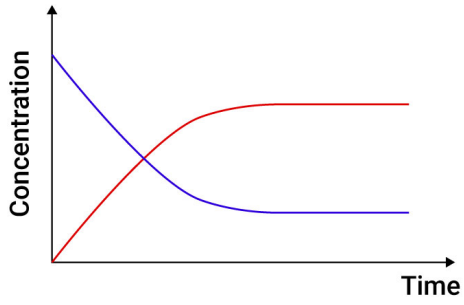
Consider the following irreversible reaction:

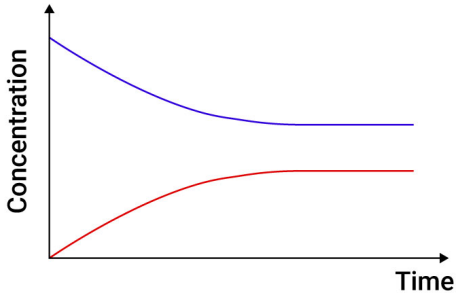
reactants → products

Which of the following graphs represents the change of the concentrations in the above reaction?









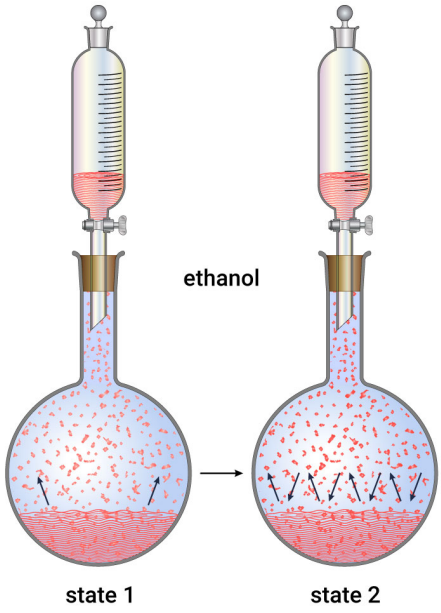
QUESTION 11

Select the CORRECT answer.

At a given temperature, ethanol (C_2H_5OH) evaporates to form vapor (C_2H_5OH) in a closed flask.

We can represent the opposing processes of evaporation and condensation with the following equation:

$$C_2H_5OH(l) \rightleftharpoons C_2H_5OH(g)$$



In state 1, $rate_{(evaporation)} < rate_{(condensation)}$.

- [x] In state 1, $\text{rate}_{(\text{evaporation})} > \text{rate}_{(\text{condensation})}$.
- [ ] In state 1, $\text{rate}_{(\text{evaporation})} = \text{rate}_{(\text{condensation})}$.
- [ ] In state 2, $\text{rate}_{(\text{evaporation})} < \text{rate}_{(\text{condensation})}$.
- [x] In state 2, $\text{rate}_{(\text{evaporation})} = \text{rate}_{(\text{condensation})}$.
- [ ] In state 2, $\text{rate}_{(\text{evaporation})} > \text{rate}_{(\text{condensation})}$.

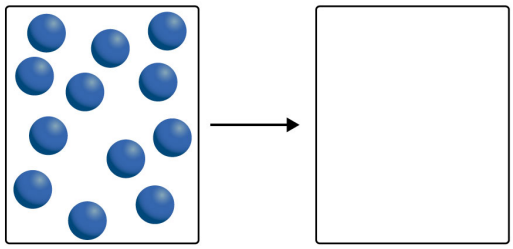
QUESTION 12

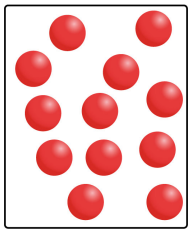
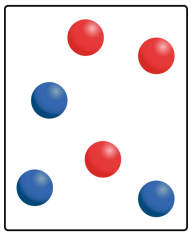
Select the CORRECT answer.

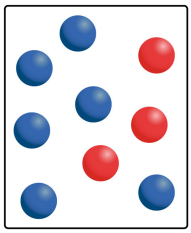
Consider the equilibrium below:

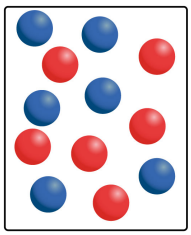
$$2A(g) \rightleftharpoons B(g)$$

Which of the following shows the CORRECT representation of the mixture at equilibrium?



- ○ 
- ○ 





QUESTION 13

Select the CORRECT answer.

When heating calcium carbonate ($CaCO_3$) or limestone, it decomposes to produce lime (CaO) according to the following equation:

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

Which of the following is ***NOT CORRECT*** about the above reaction?

- The rate of limestone decomposition is equal to the rate of its formation at equilibrium.
- As the reverse reaction proceeds, the concentrations of the products decrease.
- At the start, the reaction proceeds in the forward direction to decompose limestone.
- The amount of the CO_2 gas and the solids are actually equal at equilibrium. ✓

QUESTION 14

Drag and drop the CORRECT equations.

Consider the reversible reaction between bromine gas (Br_2) and chlorine gas (Cl_2) to produce bromine monochloride gas (BrCl).

forward reaction: $Br_2(g) + Cl_2(g) \rightarrow 2BrCl(g)$ ✓

reverse reaction: $Br_2(g) + Cl_2(g) \leftarrow 2BrCl(g)$ ✓

equilibrium state: $Br_2(g) + Cl_2(g) \rightleftharpoons 2BrCl(g)$ ✓

$2BrCl(g) \rightleftharpoons Br_2(g) + Cl_2(g)$

$2BrCl(g) \rightarrow Br_2(g) + Cl_2(g)$

QUESTION 15

Select the CORRECT answer.

Which of the following reactions will not reach a dynamic equilibrium state?

- $N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g)$
- $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$
- $H_2O(g) + C(s) \rightleftharpoons H_2(g) + CO(g)$
- $2CH_3OH(g) + 3O_2(g) \rightarrow 4H_2O(l) + 2CO_2(g)$ ✓