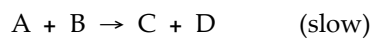


MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

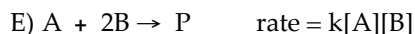
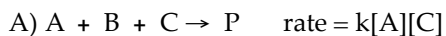
- 1) The mechanism for formation of the product X is: 1) _____



The intermediate reactant in the reaction is _____.

- A) A B) B C) C D) D E) X

- 2) The overall reactions and rate laws for several reactions are given below. Of these, only _____ 2) _____
could represent an elementary step.



- 3) A catalyst can increase the rate of a reaction _____ 3) _____

A) by providing an alternative pathway with a lower activation energy

B) by lowering the overall activation energy (E_a) of the reaction

C) by changing the value of the frequency factor (A)

D) by lowering the activation energy of the reverse reaction

E) All of these are ways that a catalyst might act to increase the rate of reaction.

- 4) At equilibrium, _____ 4) _____

A) the rates of the forward and reverse reactions are equal

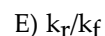
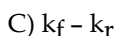
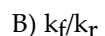
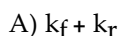
B) the rate constants of the forward and reverse reactions are equal

C) all chemical reactions have ceased

D) the value of the equilibrium constant is 1

E) the limiting reagent has been consumed

- 5) The relationship between the rate constants for the forward and reverse reactions and the 5) _____
equilibrium constant for the process is $K_{eq} =$ _____.



6) The equilibrium constant for the gas phase reaction

6) _____

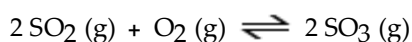


is $K_{\text{eq}} = 230$ at $300\text{ }^\circ\text{C}$. At equilibrium, _____.

- A) roughly equal amounts of products and reactants are present
- B) only reactants are present
- C) reactants predominate
- D) products predominate
- E) only products are present

7) Consider the following equilibrium.

7) _____

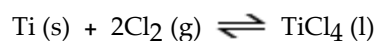


The equilibrium **cannot be** established when _____ is/are placed in a 1.0-L container.

- A) 0.75 mol $\text{SO}_2(\text{g})$
- B) 0.25 mol $\text{SO}_2(\text{g})$ and 0.25 mol $\text{O}_2(\text{g})$
- C) 0.25 mol of $\text{SO}_2(\text{g})$ and 0.25 mol of $\text{SO}_3(\text{g})$
- D) 1.0 mol $\text{SO}_3(\text{g})$
- E) 0.50 mol $\text{O}_2(\text{g})$ and 0.50 mol $\text{SO}_3(\text{g})$

8) The equilibrium-constant expression for the reaction

8) _____



is given by

- A) $\frac{[\text{Ti}(\text{s})][\text{Cl}_2(\text{g})]^2}{[\text{TiCl}_4(\text{l})]}$
- B) $1/[\text{Cl}_2(\text{g})]^2$
- C) $\frac{[\text{TiCl}_4(\text{l})]}{[\text{Ti}(\text{s})][\text{Cl}_2(\text{g})]^2}$
- D) $\frac{[\text{TiCl}_4(\text{l})]}{[\text{Cl}_2(\text{g})]^2}$
- E) $\frac{[\text{TiCl}_4(\text{l})]}{[\text{Ti}(\text{s})][\text{Cl}_2(\text{g})]}$

9) Consider the following reaction at equilibrium:

9) _____



Le Chatelier's principle predicts that the moles of H₂ in the reaction container will increase with _____

- A) a decrease in the total volume of the reaction vessel (T constant)
- B) addition of some N₂ to the reaction vessel (V and T constant)
- C) some removal of NH₃ from the reaction vessel (V and T constant)
- D) an increase in total pressure by the addition of helium gas (V and T constant)
- E) a decrease in the total pressure (T constant)

10) The conjugate acid of HSO₄⁻ is

10) _____

- A) SO₄²⁻ B) HSO₃⁺ C) H⁺ D) H₂SO₄ E) HSO₄⁺

11) A substance that is capable of acting as both an acid and as a base is _____.

11) _____

- A) amphoteric
- B) saturated
- C) miscible
- D) conjugated
- E) autosomal

12) In balancing the nuclear reaction ${}_{92}^{293}\text{U} \rightarrow {}_{90}^{234}\text{E} + {}_2^4\text{He}$, the identity of element E is _____ . 12) _____

- A) Pu. B) U. C) Th. D) Np. E) Pa.

13) What is the largest number of protons that can exist in a nucleus and still be stable _____ ? 13) _____

- A) 83 B) 84 C) 206 D) 50 E) 92

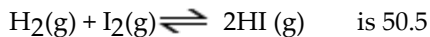
14) In the nuclear transmutation represented by ${}_{8}^{16}\text{O}(\text{p}, \alpha){}_{7}^{13}\text{N}$, the emitted particle is _____ . 14) _____

- A) a beta particle.
- B) a positron.
- C) a proton.
- D) a neutron.
- E) an alpha particle.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) At 448 °C the equilibrium constant K_c of the reaction

15) _____



Predict in which direction the reaction will proceed to reach the equilibrium if we start with 2.0×10^{-2} mol of HI 1.0×10^{-2} mol of H_2 and 3.0×10^{-2} mol of I_2 in a 2.00 L container

Initial concentrations

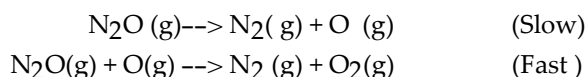
$$\left\{ \begin{array}{l} \text{HI} = \frac{2.0 \times 10^{-2}}{2\text{L}} = 1.0 \times 10^{-2}\text{M} \\ \text{H}_2 = \frac{1.0 \times 10^{-2}}{2\text{L}} = 5 \times 10^{-3} \\ \text{I}_2 = \frac{3.0 \times 10^{-2}}{2\text{L}} = 1.5 \times 10^{-2} \end{array} \right\} \text{1.5 points}$$

$$\left\{ Q_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{[1.0 \times 10^{-2}]^2}{[5 \times 10^{-3}][1.5 \times 10^{-2}]} = 1.3 \right\} \text{1.5 points}$$

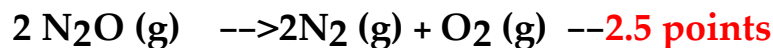
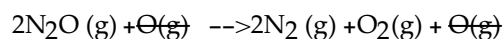
$Q_c < K_c$ so the reaction proceeds from the left to right as the reaction proceeds toward the equilibrium. --- 2 points

16) The decomposition of Nitric oxide is believed to occur by a two step mechanism:

16) _____



a) write the equation for the overall reaction.



b) Write the rate law of the overall reaction.



This takes into consideration only the slow step

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 17) ^{131}I has a half-life of 8.04 days. Assuming you start with a 1.53 mg sample of ^{131}I , how many mg will remain after 13.0 days _____ ?

A) B) C) D) E)

$$\ln \frac{N_t}{N_0} = -kt$$

$$\ln N_t - \ln N_0 = -kt$$

$$\ln N_t - \ln 1.53 = -0.0862/\text{day} \times 13 \text{ days}$$

$$\ln N_t - 0.42562 = -1.12047$$

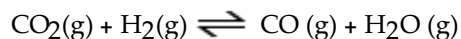
$$\ln N_t = -0.69512$$

$$N_t = 0.499 \text{ mg}$$

1 point for k and 4 points for Nt

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

- 18) A mixture of 0.2000 mol of CO_2 , 0.1000 mol of H_2 and 0.1600 mol of H_2O is placed in a 2.000 L vessel. The following equilibrium is established at 500K:



TO GET CREDIT FOR THIS PROBLEM YOU MUST DRAW THE TABLE

- a) Calculate the initial partial pressure of CO_2 , H_2 , and H_2O .

$$\left. \begin{array}{l} P_{\text{CO}_2} = \frac{n}{V} RT = \frac{0.2 \text{ mole}}{2\text{L}} \times 0.08211 \text{ atm/mol.K} \times 500\text{K} = 4.11 \text{ atm} \\ P_{\text{H}_2} = \frac{n}{V} RT = \frac{0.1 \text{ mole}}{2\text{L}} \times 0.08211 \text{ atm/mol.K} \times 500\text{K} = 2.05 \text{ atm} \\ P_{\text{H}_2\text{O}} = \frac{n}{V} RT = \frac{0.16 \text{ mole}}{2\text{L}} \times 0.08211 \text{ atm/mol.K} \times 500\text{K} = 3.28 \text{ atm} \end{array} \right\} 5 \text{ points}$$

- b). At equilibrium $P_{\text{H}_2\text{O}} = 3.51 \text{ atm}$.

Calculate the equilibrium partial pressures of CO_2 , H_2 and CO .

	$\text{CO}_2(\text{g})$	+	$\text{H}_2(\text{g})$		$\text{CO}(\text{g})$	+	$\text{H}_2\text{O}(\text{g})$
initial	4.105 atm		2.05 atm		0		3.28 atm
Change	- 0.23 atm		-0.23 atm		+0.23 atm		+0.23 atm
Equilibrium	3.88 atm		1.82 atm		0.23 atm		3.51 atm

5 points

- c) Calculate the K_p for the reaction

$$K_p = \frac{P_{\text{CO}} P_{\text{H}_2\text{O}}}{P_{\text{H}_2} P_{\text{CO}_2}} = \frac{0.23 \times 3.51}{1.82 \times 3.875} = 0.11$$

5 points

Answer Key

Testname: TEST 3 KEY

- 1) D
- 2) C
- 3) A
- 4) A
- 5) B
- 6) D
- 7) A
- 8) B
- 9) E
- 10) D
- 11) A
- 12) C
- 13) A
- 14) E
- 15)
- 16)
- 17) B
- 18)