CHE 107 Exam 2 Spring 2016

Your Name: _____ **Your ID:** _____

Question #: 1

Given the reaction $2\ S_2O_8^{2-}(aq) + 3\ I^-(aq) \rightarrow 2\ SO_4^{2-}(aq) + I_3^-(aq)$, select the correct expression of the rate of the reaction.

A. $$\text{Rate} = 3\frac{\Delta[I^-]}{\Delta t}$$

B. $$\text{Rate} = \frac{1}{2}\frac{\Delta[S_2O_8{}^{2-}]}{\Delta t}$$

C. $$\text{Rate} = \frac{1}{2}\frac{\Delta[SO_4{}^{2-}]}{\Delta t}$$

D. $$\text{Rate} = -\frac{\Delta[I_3{}^-]}{\Delta t}$$

Question #: 2

Dinitrogen monoxide decomposes into nitrogen and oxygen when heated.

$$2\ N_2O(g) \rightarrow 2\ N_2(g) + O_2(g)$$

During the first 5.00 seconds of the reaction, the concentration of N_2O decreases from 0.351 M to 0.142 M. What is the **average rate of the reaction** in M/s during this interval of time?

A. 0.0209 M/s
B. 0.0442 M/s
C. 0.0825 M/s
D. 0.105 M/s

Question #: 3

The reaction
$2\ NO(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$
obeys the rate law, rate = $k[NO]^2[H_2]$.
The reaction is __1__ [**first, second, third**] order with respect to $NO(g)$.
The reaction is __2__ [**first, second, third**] order with respect to $H_2(g)$.
The reaction is __3__ [**first, second, third**] order overall.

1. _____

2. _____

3. _____

Question #: 4

Given the following reaction and data, determine the **order** of each reactant and the corresponding **rate law**:

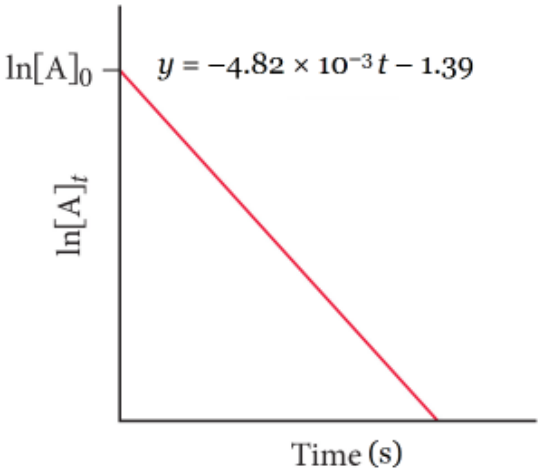
$2\ NO_2(g) + F_2(g) \rightarrow 2\ NO_2F_2(g)$

$[NO_2]$ (M)	$[F_2]$ (M)	Initial Rate (M/s)
0.100	0.100	0.026
0.200	0.100	0.051
0.200	0.200	0.103
0.400	0.400	0.411

A. rate = $k[NO_2][F_2]^2$
B. rate = $k[NO_2][F_2]$
C. rate = $k[F_2]$
D. rate = $k[NO_2]^2[F_2]$

Question #: 5

The decomposition of N_2O_5 in carbon tetrachloride is first order in N_2O_5.
$2\ N_2O_5 \rightarrow 4\ NO_2 + O_2$
The reaction was monitored at 64 °C and the initial concentration of $[N_2O_5]$ was 0.250 M.
The data are plotted at right.

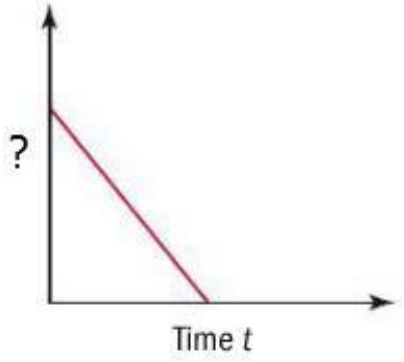


Given this information, what concentration of N_2O_5 remains at 120. seconds?

A. 0.220 M
B. 0.140 M
C. 0.090 M
D. 0.072 M

Question #: 6

Consider the straight-line plot of a zero-order reaction X →Y.



_____ is plotted along the *y*-axis.
The slope of the line defines _____ for the reaction.

A. [X]; k
B. [X]; $-k$
C. [Y]; k
D. [Y]; $-k$

Question #: 7

The rate constant for the first-order decomposition of N_2O is 3.40 s^{-1}.
What is the half-life of the decomposition reaction if the initial concentration of N_2O is 1.20 M?

A. 0.294 s
B. 0.245 s
C. 0.204 s
D. 0.170 s

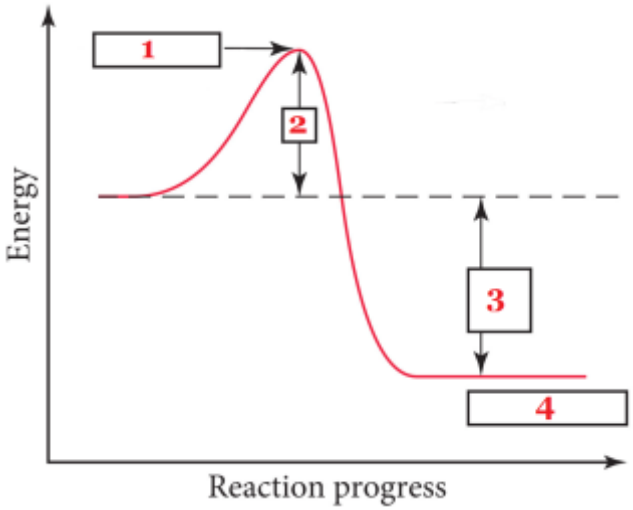
Question #: 8

A temperature increase from 10.0 °C to 20.0 °C doubles the rate constant for a reaction.
The value of the **activation energy** (E_a) for the reaction is __1__ **kJ/mol**.
Report your answer with **two** significant digits. For scientific notation, use the form 2.2E2 or 2.2E-2.

1. _____

Question #: 9

The diagram shows the energy of a system as a reaction progresses. Fill in the **word** or **phrase** that identifies __1__, __2__, __3__ and __4__ on the diagram.
Choose from these options, **not** all of which will be used: **reactant**, **product**, **transition state**, **reaction enthalpy**, **activation energy**.



1. _____ 2. _____

3. _____ 4. _____

Question #: 10

The three-step mechanism at right describes the behavior of the pollutant, nitrogen dioxide, in the atmosphere.
The net result is the absorption of a photon of light (hv) but **no** net chemical change.
Select **all** of the intermediate(s) in this mechanism.

$$NO_2 \xrightarrow{h\nu} NO + O$$

$$O + O_2 \longrightarrow O_3$$

$$O_3 + NO \longrightarrow NO_2 + O_2$$

A. NO_2
B. NO
C. O
D. O_2
E. O_3

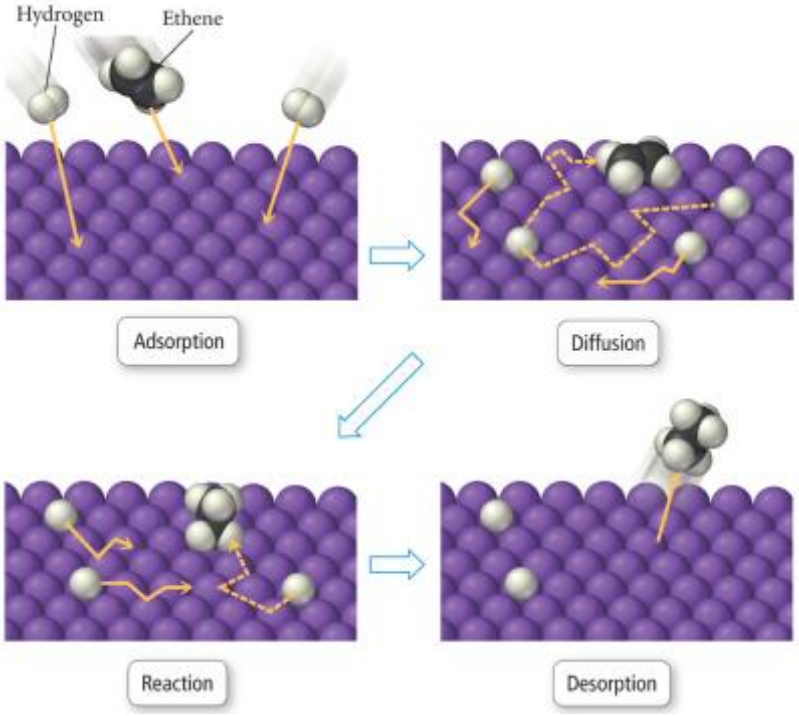
Question #: 11
If the reaction

$$2\ NO(g) + Cl_2(g) \rightarrow 2\ NOCl(g)$$

proceeds by the mechanism below, what is the overall rate law for the reaction?
Step 1: $NO(g) + Cl_2(g) \rightleftharpoons NOCl_2(g)$ **FAST**
Step 2: $NOCl_2(g) + NO(g) \rightarrow 2\ NOCl(g)$ **SLOW**

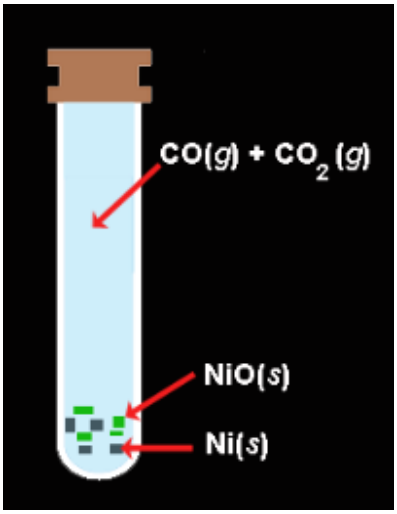
A. rate = $k[NOCl_2][NO]$
B. rate = $k[NO]^2[Cl_2]$
C. rate = $k[NO][Cl_2]$
D. rate = $k[NOCl_2][NO]^2[Cl_2]$

Question #: 12
The figure at right depicts the platinum-catalyzed hydrogenation of ethene to ethane.
$H_2C{=}CH_2(g) + H_2(g) \rightarrow H_3C{-}CH_3(g)$
This reaction is an example of _____ catalysis.



A. enzymatic
B. homogeneous
C. heterogeneous
D. intermediate

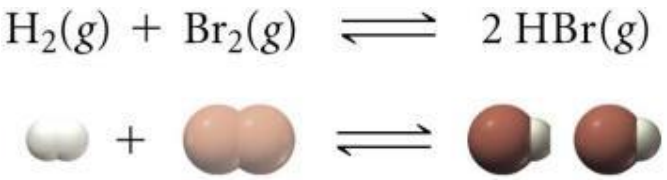
Question #: 13
At 1300 K, NiO(*s*) is reduced to Ni(*s*) by CO(*g*). Select **all** of the true statements or equations about this system at equilibrium.
$NiO(s) + CO(g) \rightleftharpoons Ni(s) + CO_2(g)$ $K_P = 100$

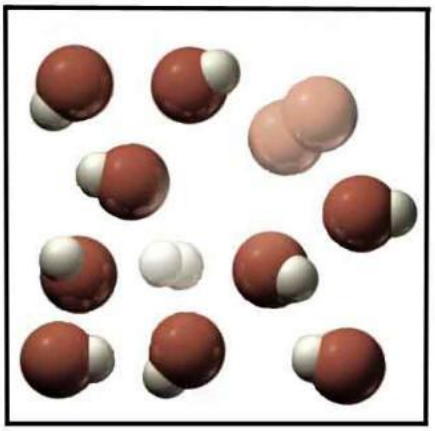


A. $P_{CO2} = 100 \times P_{CO}$
B. The rates of the forward and reverse reactions are equal.
C. P_{CO2} will continue to increase until all NiO(*s*) is converted to Ni(*s*).
D. Adding more NiO(*s*) will increase P_{CO2}.

Question #: 14

For the reaction at right, the image inside the box represents the quantity of each substance at equilibrium. Select the **true** option.





A.

$$K_c = \frac{[HBr]^2}{[H_2][Br_2]}$$ and $K_c > 1$

B.

$$K_c = \frac{[HBr]^2}{[H_2][Br_2]}$$ and $K_c < 1$

C.

$$K_c = \frac{[H_2]+[Br_2]}{[HBr]^2}$$ and $K_c = 1$

D.

$$K_c = \frac{[H_2]+[Br_2]}{[HBr]^2}$$ and $K_c > 1$

Question #: 15

Using these reactions and their equilibrium constants,

$$NO(g) + \tfrac{1}{2}Br_2(g) \rightleftharpoons NOBr(g) \quad K_P = 5.3$$

$$2\ NO(g) \rightleftharpoons N_2(g) + O_2(g) \quad K_P = 2.1 \times 10^{30}$$

what is the value of K_P for this reaction?

$$N_2(g) + O_2(g) + Br_2(g) \rightleftharpoons 2\ NOBr(g) \quad K_P = ??$$

A. 1.3×10^{-29}
B. 2.5×10^{-30}
C. 3.9×10^{32}
D. 2.1×10^{30}

Question #: 16

The reaction

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3\ H_2(g)$$

has $K_p = 7.7 \times 10^{24}$ at 298 K.
At the same temperature, K_c = __1__.
Report your answer with **two** significant figures, using the format 2.2E2 or 2.2E-2 for scientific notation.

1. _____

Question #: 17

Elemental silicon reacts with fluorine gas according to this equation.

$$Si(s) + 2\ F_2(g) \rightleftharpoons SiF_4(g)$$

What is the K_p expression for this reaction?

A. $K_p = (P_{F_2})^2$

B. $K_p = \dfrac{(P_{Si})(P_{F_2})^2}{(P_{SiF_4})}$

C. $K_p = \dfrac{(P_{SiF_4})}{(P_{F_2})^2}$

D. $K_p = (P_{F_2})^{-2}$

Question #: 18

Consider the reaction at right.

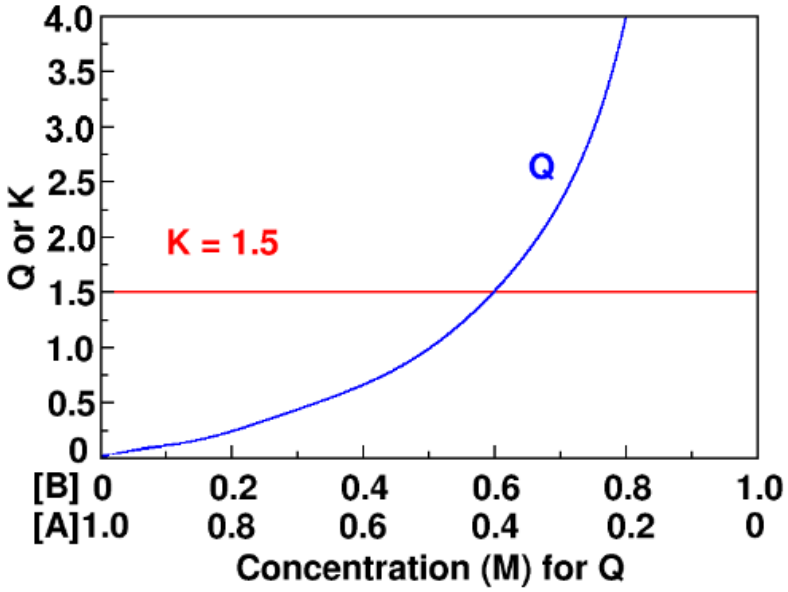
$$H_2(g) + I_2(g) \rightleftharpoons 2\ HI(g)$$

A sealed flask is charged with 0.0290 M H_2 and 0.0290 M I_2. When the system reaches equilibrium, the concentration of HI is 0.0460 M.
What is the value of K_c at this temperature?
Report your answer to **two** significant figures and do **not** use scientific notation.
K_c = __1__

1. _____

Question #: 19

Consider the diagram at right displaying the equilibrium constant (K) and the reaction quotient (Q) at the same temperature for the reaction **A** ⇌ **B**.
Which of the following statements is **true**?



A. When [**A**] = 0.3 M and [**B**] = 0.7 M, the reaction will proceed to the left (towards reactants).
B. When [**A**] = 0.6 M and [**B**] = 0.4 M, the reaction will proceed to the left (towards reactants).
C. When [**A**] = 0.5 M and [**B**] = 0.5 M, the reaction is at equilibrium.
D. The direction that the reaction will proceed cannot be determined from this diagram.

Question #: 20

Consider the equilibrium decomposition of ammonium hydrosulfide below.

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

At a certain temperature, $K_c = 8.5 \times 10^{-3}$. At this temperature, there are concentrations of $[NH_3] = [H_2S] = 0.166$ M above a sample of solid NH_4HS.
Which of the following statements is **correct**?

A. The system is at equilibrium.
B. More $NH_4HS(s)$ will decompose in order to reach equilibrium.
C. More $NH_4HS(s)$ will form in order to reach equilibrium.
D. The answer cannot be determined from the information given.

Question #: 21

A system described by the reaction 

is at equilibrium at a fixed temperature and volume with $P_{CO} = 0.015$ atm and $P_{CO_2} = 60.$ atm.
Additional $CO_2(g)$ is added to increase the partial pressure of $CO_2(g)$ from 60. atm to 80. atm.
What is the partial pressure of $CO(g)$ after the system returns to equilibrium?

A. 0.020 atm
B. 0.011 atm
C. 0.0060 atm
D. 5.0 atm

Question #: 22

At a fixed temperature

$$2\ NO(g) + 2\ H_2(g) \rightleftharpoons N_2(g) + 2\ H_2O(g) \quad K_P = 3.5 \times 10^3$$

If $P_{NO} = P_{H2} = 0.63$ atm and $P_{N2} = 23$ atm at equilibrium, what is the equilibrium partial pressure of H_2O?

A. 7.8 atm
B. 5.7×10^{-10} atm
C. 4.9 atm
D. 24 atm

Question #: 23

Consider the reaction below at equilibrium at a fixed temperature.

$$Xe(g) + 2\ F_2(g) \rightleftharpoons XeF_4(g)$$

Select **all** of the following disturbances that will cause the reaction to shift to the **right** (towards products) in order to reestablish equilibrium.

A. decrease in volume
B. increase in volume
C. increase in the number of moles of F_2
D. decrease in the number of moles of XeF_4
E. pressure increase by addition of an inert gas

Question #: 24

Coal, which is primarily carbon, can be converted to natural gas by the following endothermic reaction.

$$C(s) + 2\ H_2(g) \rightleftharpoons CH_4(g)$$

Heat is added to the system at equilibrium (i.e., the temperature is raised).
Select **all** of the following statements that are **true** in order for the system to return to equilibrium.

A. More $CH_4(g)$ is produced.
B. More $C(s)$ is consumed.
C. More $H_2(g)$ is produced.
D. Raising the temperature does not alter the equilibrium pressures.

Question #: 25

Reaction 1: $KOH(aq) \rightarrow K^+(aq) + OH^-(aq)$

Reaction 2: $NH_3(aq) + HCl(aq) \rightarrow NH_4^+(aq) + Cl^-(aq)$

Reaction 1 is best described by the ____ acid-base theory; KOH is a ___ .

Reaction 2 is best described by the ____ acid-base theory; ___ is the base and ___ is the acid.

A. Arrhenius; base
Brønsted-Lowry; NH_3; HCl

B. Brønsted-Lowry; base
Arrhenius; HCl; NH_3

C. Arrhenius; base
Brønsted-Lowry; HCl; NH_3

D. Arrhenius; acid
Arrhenius theory; NH_3; HCl

Question #: 26

According to Brønsted-Lowry acid-base theory, in this reaction

$$N(CH_3)_3(aq) + H_2O(l) \rightleftharpoons HN(CH_3)_3^+(aq) + OH^-(aq)$$

$N(CH_3)_3$ acts as a(n) __1__ [acid, base].

OH^- is the conjugate base of __2__.

Enter a chemical formula without using superscripts or subscripts (e.g., enter NH_4^+ as NH4+).

1. _____ 2. _____

Question #: 27

For the acids listed in the table below, __1__ is the **strongest** acid and __2__ is the **weakest** acid. Write the names of the acids as they appear in the table.

Acid	K_a
phenol	1.3×10^{-10}
formic acid	1.8×10^{-4}
nitrous acid	4.6×10^{-4}
benzoic acid	6.5×10^{-5}

1. _____ 2. _____

Question #: 28

$[H_3O^+]$ in a glass of cherry juice is 4.2×10^{-4} M.
pH of the juice = __1__.
Report your answer with two digits to the right of the decimal.

1. _____

Question #: 29

What is $[H^+]$ in an aqueous solution at 25 °C with pOH = 4.36?
At 25 °C, $K_w = 1.0 \times 10^{-14}$.

A. 2.29×10^{-10} M
B. 1.28×10^{-2} M
C. 4.37×10^{-5} M
D. 2.31×10^{-6} M

Question #: 30

For the autoionization of water, which statement is true at **all** temperatures?

A. $K_w = [H_3O^+][OH^-]$
B. $K_w = 1.0 \times 10^{-14}$
C. $[H_3O^+] = 1.0 \times 10^{-7}$ M
D. Statements **a**—**c** are all true at all temperatures.

CHE 107 Exam 2 Spring 2016 Key

Your Name: _____ **Your ID:** _____

Question #: 1

Given the reaction $2\ S_2O_8^{2-}(aq) + 3\ I^-(aq) \rightarrow 2\ SO_4^{2-}(aq) + I_3^-(aq)$, select the correct expression of the rate of the reaction.

A. $$\text{Rate} = 3\frac{\Delta[I^-]}{\Delta t}$$

✓C. $$\text{Rate} = \frac{1}{2}\frac{\Delta[SO_4^{2-}]}{\Delta t}$$

B. $$\text{Rate} = \frac{1}{2}\frac{\Delta[S_2O_8^{2-}]}{\Delta t}$$

D. $$\text{Rate} = -\frac{\Delta[I_3^-]}{\Delta t}$$

Question #: 2

Dinitrogen monoxide decomposes into nitrogen and oxygen when heated.

$$2\ N_2O(g) \rightarrow 2\ N_2(g) + O_2(g)$$

During the first 5.00 seconds of the reaction, the concentration of N_2O decreases from 0.351 M to 0.142 M. What is the **average rate of the reaction** in M/s during this interval of time?

✓A. 0.0209 M/s

B. 0.0442 M/s

C. 0.0825 M/s

D. 0.105 M/s

Question #: 3

The reaction

$2\ NO(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$

obeys the rate law, rate = $k[NO]^2[H_2]$.

The reaction is __1__ [**first, second, third**] order with respect to $NO(g)$.

The reaction is __2__ [**first, second, third**] order with respect to $H_2(g)$.

The reaction is __3__ [**first, second, third**] order overall.

1. second|2|2nd|
2. first|1|1st|
3. third|3|3rd|

Question #: 4

Given the following reaction and data, determine the **order** of each reactant and the corresponding **rate law**:

$2\ NO_2(g) + F_2(g) \rightarrow 2\ NO_2F_2(g)$

$[NO_2]$ (M)	$[F_2]$ (M)	Initial Rate (M/s)
0.100	0.100	0.026
0.200	0.100	0.051
0.200	0.200	0.103
0.400	0.400	0.411

A. rate = $k[NO_2][F_2]^2$
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C. rate = $k[F_2]$
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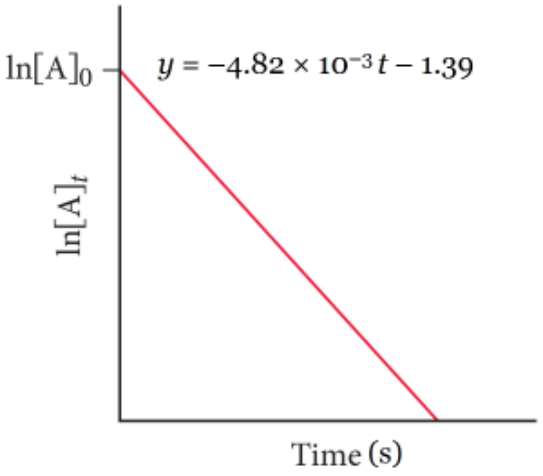
The decomposition of N_2O_5 in carbon tetrachloride is first order in N_2O_5.
$2\ N_2O_5 \rightarrow 4\ NO_2 + O_2$
The reaction was monitored at 64 °C and the initial concentration of $[N_2O_5]$ was 0.250 M.
The data are plotted at right.



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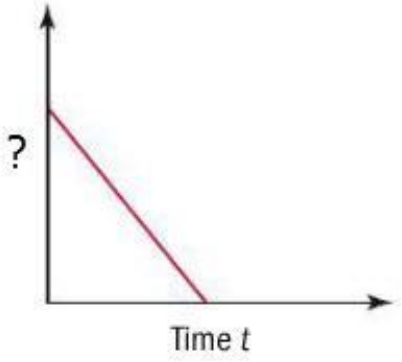


_____ is plotted along the *y*-axis.
The slope of the line defines _____ for the reaction.

A. [X]; *k*
✓B. [X]; –*k*
C. [Y]; *k*
D. [Y]; –*k*

Question #: 7

The rate constant for the first-order decomposition of N_2O is 3.40 s^{-1}.
What is the half-life of the decomposition reaction if the initial concentration of N_2O is 1.20 M?

A. 0.294 s
B. 0.245 s
✓C. 0.204 s
D. 0.170 s

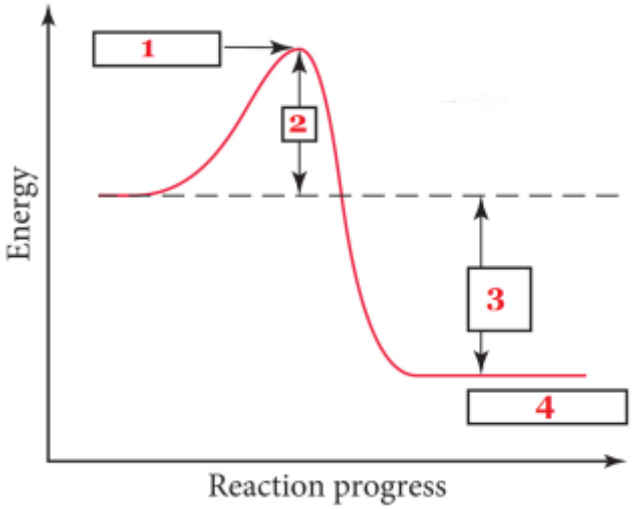
Question #: 8

A temperature increase from 10.0 °C to 20.0 °C doubles the rate constant for a reaction.
The value of the **activation energy** (E_a) for the reaction is __1__ **kJ/mol**.
Report your answer with **two** significant digits. For scientific notation, use the form 2.2E2 or 2.2E-2.

1. 47.8|48|47|49|47.8kJ/mol|48kJ/mol|47kJ/mol|49kJ/mol|47.8 kJ/mol|48 kJ/mol|47 kJ/mol|49 kJ/mol|

Question #: 9

The diagram shows the energy of a system as a reaction progresses. Fill in the **word** or **phrase** that identifies __1__, __2__, __3__ and __4__ on the diagram.
Choose from these options, **not** all of which will be used: **reactant**, **product**, **transition state**, **reaction enthalpy**, **activation energy**.



1. transition state
2. activation energy
3. reaction enthalpy
4. product

Question #: 10

The three-step mechanism at right describes the behavior of the pollutant, nitrogen dioxide, in the atmosphere.
The net result is the absorption of a photon of light (hv) but **no** net chemical change.
Select **all** of the intermediate(s) in this mechanism.

$$NO_2 \xrightarrow{h\nu} NO + O$$

$$O + O_2 \longrightarrow O_3$$

$$O_3 + NO \longrightarrow NO_2 + O_2$$

A. NO_2
✓B. NO
✓C. O
D. O_2
✓E. O_3

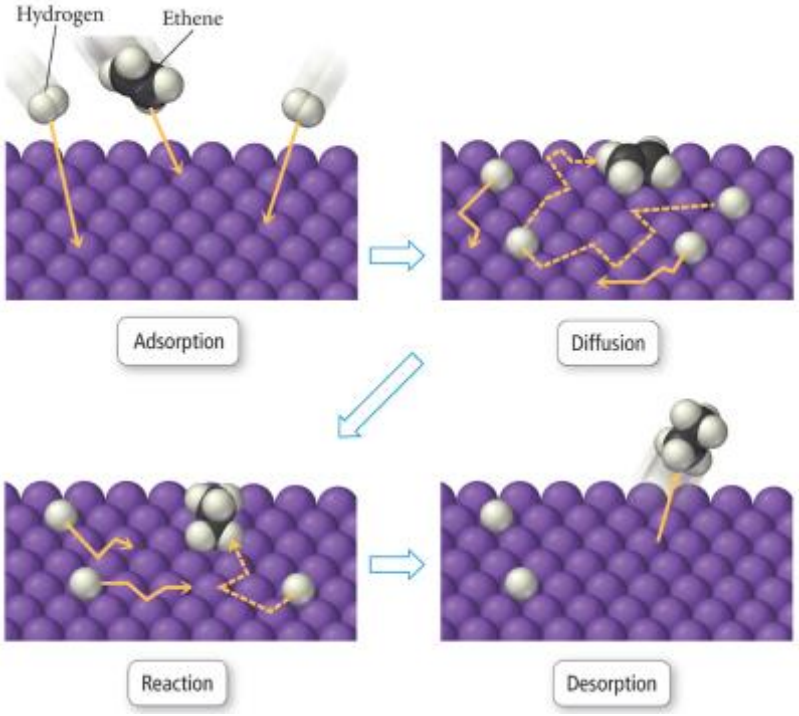
Question #: 11
If the reaction

$$2\ NO(g) + Cl_2(g) \rightarrow 2\ NOCl(g)$$

proceeds by the mechanism below, what is the overall rate law for the reaction?
Step 1: $NO(g) + Cl_2(g) \rightleftharpoons NOCl_2(g)$ **FAST**
Step 2: $NOCl_2(g) + NO(g) \rightarrow 2\ NOCl(g)$ **SLOW**

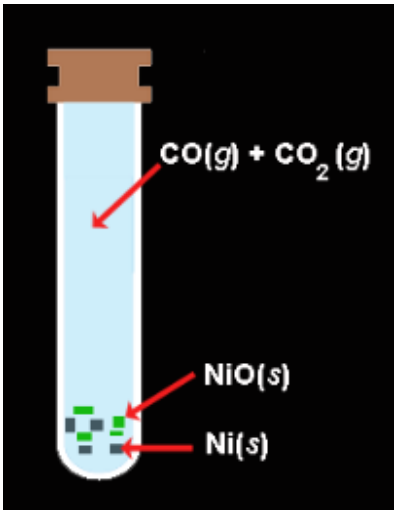
A. rate = $k[NOCl_2][NO]$
✓B. rate = $k[NO]^2[Cl_2]$
C. rate = $k[NO][Cl_2]$
D. rate = $k[NOCl_2][NO]^2[Cl_2]$

Question #: 12
The figure at right depicts the platinum-catalyzed hydrogenation of ethene to ethane.
$H_2C{=}CH_2(g) + H_2(g) \rightarrow H_3C{-}CH_3(g)$
This reaction is an example of _____ catalysis.



A. enzymatic
B. homogeneous
✓C. heterogeneous
D. intermediate

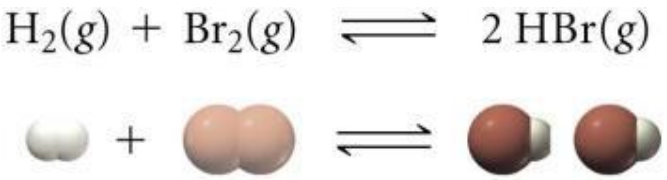
Question #: 13
At 1300 K, NiO(*s*) is reduced to Ni(*s*) by CO(*g*). Select **all** of the true statements or equations about this system at equilibrium.
$NiO(s) + CO(g) \rightleftharpoons Ni(s) + CO_2(g)$ $K_P = 100$

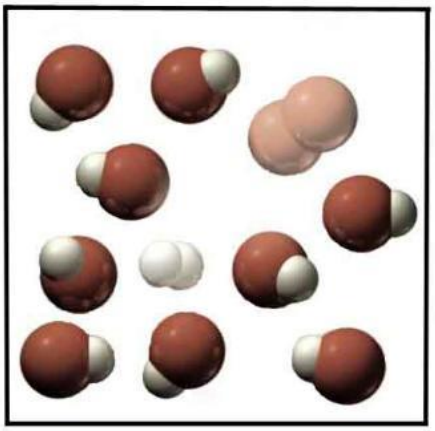


✓A. $P_{CO2} = 100 \times P_{CO}$
✓B. The rates of the forward and reverse reactions are equal.
C. P_{CO2} will continue to increase until all NiO(*s*) is converted to Ni(*s*).
D. Adding more NiO(*s*) will increase P_{CO2}.

Question #: 14

For the reaction at right, the image inside the box represents the quantity of each substance at equilibrium. Select the **true** option.





✓A. $K_c = \frac{[HBr]^2}{[H_2][Br_2]}$ and $K_c > 1$

B. $K_c = \frac{[HBr]^2}{[H_2][Br_2]}$ and $K_c < 1$

C. $K_c = \frac{[H_2]+[Br_2]}{[HBr]^2}$ and $K_c = 1$

D. $K_c = \frac{[H_2]+[Br_2]}{[HBr]^2}$ and $K_c > 1$

Question #: 15

Using these reactions and their equilibrium constants,

$$NO(g) + \tfrac{1}{2}Br_2(g) \rightleftharpoons NOBr(g) \quad K_P = 5.3$$

$$2\ NO(g) \rightleftharpoons N_2(g) + O_2(g) \quad K_P = 2.1 \times 10^{30}$$

what is the value of K_P for this reaction?

$$N_2(g) + O_2(g) + Br_2(g) \rightleftharpoons 2\ NOBr(g) \quad K_P = ??$$

✓A. 1.3×10^{-29}

B. 2.5×10^{-30}

C. 3.9×10^{32}

D. 2.1×10^{30}

Question #: 16

The reaction

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3\ H_2(g)$$

has $K_p = 7.7 \times 10^{24}$ at 298 K.
At the same temperature, K_c = __1__.
Report your answer with **two** significant figures, using the format 2.2E2 or 2.2E-2 for scientific notation.

1. 1.3E22|1.3e22|1.3 E 22|1.3 e 22|1.3 E22|1.3 e22|

Question #: 17

Elemental silicon reacts with fluorine gas according to this equation.

$$Si(s) + 2\ F_2(g) \rightleftharpoons SiF_4(g)$$

What is the K_p expression for this reaction?

A. $K_p = (P_{F_2})^2$

B. $K_p = \dfrac{(P_{Si})(P_{F_2})^2}{(P_{SiF_4})}$

✓C. $K_p = \dfrac{(P_{SiF_4})}{(P_{F_2})^2}$

D. $K_p = (P_{F_2})^{-2}$

Question #: 18

Consider the reaction at right.
A sealed flask is charged with 0.0290 M H_2 and 0.0290 M I_2. When the system reaches equilibrium, the concentration of HI is 0.0460 M.

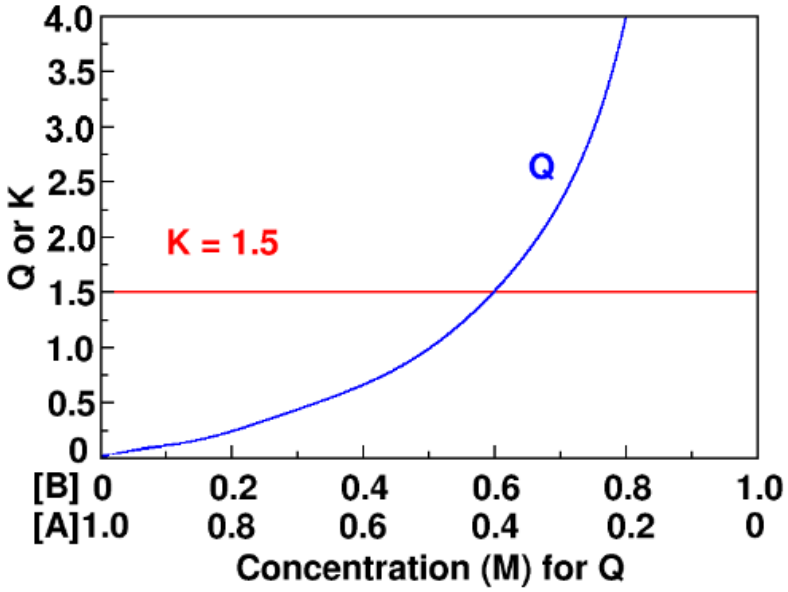
$$H_2(g) + I_2(g) \rightleftharpoons 2\ HI(g)$$

What is the value of K_c at this temperature?
Report your answer to **two** significant figures and do **not** use scientific notation.
K_c = __1__

1. 59|58|60|59.|58.|60.|

Question #: 19

Consider the diagram at right displaying the equilibrium constant (K) and the reaction quotient (Q) at the same temperature for the reaction **A** ⇌ **B**.
Which of the following statements is **true**?



✓A. When [**A**] = 0.3 M and [**B**] = 0.7 M, the reaction will proceed to the left (towards reactants).

B. When [**A**] = 0.6 M and [**B**] = 0.4 M, the reaction will proceed to the left (towards reactants).

C. When [**A**] = 0.5 M and [**B**] = 0.5 M, the reaction is at equilibrium.

D. The direction that the reaction will proceed cannot be determined from this diagram.

Question #: 20

Consider the equilibrium decomposition of ammonium hydrosulfide below.

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

At a certain temperature, $K_c = 8.5 \times 10^{-3}$. At this temperature, there are concentrations of $[NH_3] = [H_2S] = 0.166$ M above a sample of solid NH_4HS.
Which of the following statements is **correct**?

A. The system is at equilibrium.

B. More $NH_4HS(s)$ will decompose in order to reach equilibrium.

✓C. More $NH_4HS(s)$ will form in order to reach equilibrium.

D. The answer cannot be determined from the information given.

Question #: 21

A system described by the reaction 

is at equilibrium at a fixed temperature and volume with $P_{CO} = 0.015$ atm and $P_{CO_2} = 60.$ atm.
Additional $CO_2(g)$ is added to increase the partial pressure of $CO_2(g)$ from 60. atm to 80. atm.
What is the partial pressure of $CO(g)$ after the system returns to equilibrium?

✓A. 0.020 atm

B. 0.011 atm

C. 0.0060 atm

D. 5.0 atm

Question #: 22

At a fixed temperature

$$2\ NO(g) + 2\ H_2(g) \rightleftharpoons N_2(g) + 2\ H_2O(g) \quad K_P = 3.5 \times 10^3$$

If $P_{NO} = P_{H_2} = 0.63$ atm and $P_{N_2} = 23$ atm at equilibrium, what is the equilibrium partial pressure of H_2O?

A. 7.8 atm
B. 5.7×10^{-10} atm
✓C. 4.9 atm
D. 24 atm

Question #: 23

Consider the reaction below at equilibrium at a fixed temperature.

$$Xe(g) + 2\ F_2(g) \rightleftharpoons XeF_4(g)$$

Select **all** of the following disturbances that will cause the reaction to shift to the **right** (towards products) in order to reestablish equilibrium.

✓A. decrease in volume
B. increase in volume
✓C. increase in the number of moles of F_2
✓D. decrease in the number of moles of XeF_4
E. pressure increase by addition of an inert gas

Question #: 24

Coal, which is primarily carbon, can be converted to natural gas by the following endothermic reaction.

$$C(s) + 2\ H_2(g) \rightleftharpoons CH_4(g)$$

Heat is added to the system at equilibrium (i.e., the temperature is raised).
Select **all** of the following statements that are **true** in order for the system to return to equilibrium.

✓A. More $CH_4(g)$ is produced.
✓B. More $C(s)$ is consumed.
C. More $H_2(g)$ is produced.
D. Raising the temperature does not alter the equilibrium pressures.

Question #: 25

Reaction 1: $KOH(aq) \rightarrow K^+(aq) + OH^-(aq)$
Reaction 2: $NH_3(aq) + HCl(aq) \rightarrow NH_4^+(aq) + Cl^-(aq)$
Reaction 1 is best described by the ____ acid-base theory; KOH is a ___ .
Reaction 2 is best described by the ____ acid-base theory; ___ is the base and ___ is the acid.

✓A. Arrhenius; base
Brønsted-Lowry; NH_3; HCl

B. Brønsted-Lowry; base
Arrhenius; HCl; NH_3

C. Arrhenius; base
Brønsted-Lowry; HCl; NH_3

D. Arrhenius; acid
Arrhenius theory; NH_3; HCl

Question #: 26

According to Brønsted-Lowry acid-base theory, in this reaction

$$N(CH_3)_3(aq) + H_2O(l) \rightleftharpoons HN(CH_3)_3^+(aq) + OH^-(aq)$$

$N(CH_3)_3$ acts as a(n) __1__ [acid, base].
OH^- is the conjugate base of __2__.
Enter a chemical formula without using superscripts or subscripts (e.g., enter NH_4^+ as NH4+).

1. base
2. H2O

Question #: 27

For the acids listed in the table below, __1__ is the **strongest** acid and __2__ is the **weakest** acid. Write the names of the acids as they appear in the table.

Acid	K_a
phenol	1.3×10^{-10}
formic acid	1.8×10^{-4}
nitrous acid	4.6×10^{-4}
benzoic acid	6.5×10^{-5}

1. nitrous acid|nitrousacid|nitros acid|nitrus acid|nitrous|nitros|nitrus|
2. phenol|phnol|phenyl|fenol|

Question #: 28

$[H_3O^+]$ in a glass of cherry juice is 4.2×10^{-4} M.
pH of the juice = __1__.
Report your answer with two digits to the right of the decimal.

1. 3.38

Question #: 29

What is $[H^+]$ in an aqueous solution at 25 °C with pOH = 4.36?
At 25 °C, $K_w = 1.0 \times 10^{-14}$.

✓A. 2.29×10^{-10} M
B. 1.28×10^{-2} M
C. 4.37×10^{-5} M
D. 2.31×10^{-6} M

Question #: 30

For the autoionization of water, which statement is true at **all** temperatures?

✓A. $K_w = [H_3O^+][OH^-]$
B. $K_w = 1.0 \times 10^{-14}$
C. $[H_3O^+] = 1.0 \times 10^{-7}$ M
D. Statements **a**—**c** are all true at all temperatures.