Gen. Chem.-1312; Quiz # 1; SP 2011

1) Nitrogen dioxide decomposes to nitric oxide and oxygen via the reaction: 1) _____

$$2NO_2 \rightarrow 2NO + O_2$$

In a particular experiment at 300°C, $[NO_2]$ drops from 0.0100 to 0.00650 M in 100 s. The rate of appearance of O_2 for this period is _____ M/s.

A) 7.0×10^{-3}
B) 1.8×10^{-5}
C) 3.5×10^{-5}
D) 7.0×10^{-5}
E) 3.5×10^{-3}

2) Consider the following reaction: 2) _____

$$A \rightarrow 2C$$

The average rate of appearance of C is given by $\Delta[C]/\Delta t$. Comparing the rate of appearance of C and the rate of disappearance of A, we get $\Delta[C]/\Delta t =$ _____ $\times (-\Delta[A]/\Delta t)$.

A) +2
B) +1
C) -1
D) +1/2
E) -1/2

A flask is charged with 0.124 mol of A *and allowed to react to form* B *according to the reaction* $A(g) \rightarrow B(g)$. *The following data are obtained for* [A] *as the reaction proceeds:*

Time (s)	0.00	10.0	20.0	30.0	40.0
Moles of A	0.124	0.110	0.088	0.073	0.054

3) The average rate of disappearance of A between 10 s and 20 s is _____ mol/s. 3) _____

A) 9.90×10^{-3}
B) 4.4×10^{-3}
C) 1.1×10^{-3}
D) 454
E) 2.2×10^{-3}

4) The average rate of disappearance of A between 20 s and 40 s is _____ mol/s. 4) _____

A) 1.7×10^{-3}
B) 8.5×10^{-4}
C) 590
D) 1.4×10^{-3}
E) 7.1×10^{-3}

5) The average rate of appearance of B between 20 s and 30 s is _____ mol/s. 5) _____

A) -1.5×10^{-3}
B) -7.3×10^{-3}
C) $+5.0 \times 10^{-4}$
D) $+1.5 \times 10^{-3}$
E) $+7.3 \times 10^{-3}$

6) The average rate disappearance of A between 20 s and 30 s is _____ mol/s. 6) _____

A) 670
B) 0.15
C) 5.0×10^{-4}
D) 1.5×10^{-3}
E) 1.6×10^{-2}

7) How many moles of B are present at 10 s? 7) _____

A) 0.110
B) 0.014
C) 1.4×10^{-3}
D) 0.220
E) 0.011

8) How many moles of B are present at 30 s? 8) _____

A) 2.4×10^{-3}
B) 0.051
C) 1.7×10^{-3}
D) 0.15
E) 0.073

The peroxydisulfate ion ($S_2O_8^{2-}$) *reacts with the iodide ion in aqueous solution via the reaction:*

$$S_2O_8^{2-}(aq) + 3I^- \rightarrow 2SO_4(aq) + I_3^-(aq)$$

An aqueous solution containing 0.050 M *of* $S_2O_8^{2-}$ *ion and* 0.072 M *of* I^- *is prepared, and the progress of the reaction followed by measuring* $[I^-]$. *The data obtained is given in the table below.*

Time (s)	0.000	400.0	800.0	1200.0	1600.0
$[I^-]$ (M)	0.072	0.057	0.046	0.037	0.029

9) The average rate of disappearance of I^- between 400.0 s and 800.0 s is _____ M/s. 9) _____

A) 2.8×10^{-5}
B) 1.4×10^{-5}
C) 3.6×10^{4}
D) 2.6×10^{-4}
E) 5.8×10^{-5}

10) The average rate of disappearance of I^- in the initial 400.0 s is _____ M/s. 10) _____

A) 3.8×10^{-5}
B) 1.4×10^{-4}
C) 2.7×10^{4}
D) 3.2×10^{-4}
E) 6.00

11) The average rate of disappearance of I^- between 1200.0 s and 1600.0 s is _____ M/s. 11) _____

A) 1.8×10^{-5}
B) 1.6×10^{-4}
C) 5.0×10^{4}
D) 1.2×10^{-5}
E) 2.0×10^{-5}

12) The concentration of $S_2O_8^{2-}$ remaining at 400 s is _____ M. 12) _____

A) +0.057
B) +0.035
C) +0.045
D) +0.015
E) -0.007

13) The concentration of $S_2O_8^{2-}$ remaining at 800 s is _____ M. 13) _____

A) 0.015
B) 0.046
C) 0.041
D) 0.076
E) 4.00×10^{-3}

14) The concentration of $S_2O_8^{2-}$ remaining at 1600 s is _____ M. 14) _____

A) 0.043
B) 0.036
C) 0.029
D) 0.014
E) 0.064

15) At elevated temperatures, methylisonitrile (CH_3NC) isomerizes to acetonitrile (CH_3CN): 15) _____

$$CH_3NC\ (g) \rightarrow CH_3CN\ (g)$$

At the start of an experiment, there are 0.200 mol of reactant and 0 mol of product in the reaction vessel. After 25 min, 0.108 mol of reactant (CH_3NC) remain. There are _____ mol of product (CH_3CN) in the reaction vessel.

A) 0.308
B) 0.022
C) 0.092
D) 0.540
E) 0.200

16) A reaction was found to be second order in carbon monoxide concentration. The rate of the reaction _____ if the [CO] is doubled, with everything else kept the same. 16) _____

A) increases by a factor of 4
B) remains unchanged
C) is reduced by a factor of 2
D) doubles
E) triples

17) If the rate law for the reaction 17) _____

$$2A + 3B \rightarrow \text{products}$$

is first order in A and second order in B, then the rate law is rate = _____.

A) $k[A][B]^2$
B) $k[A]^2[B]^2$
C) $k[A]^2[B]^3$
D) $k[A][B]$
E) $k[A]^2[B]$

18) The overall order of a reaction is 2. The units of the rate constant for the reaction are _____. 18) _____

A) $M^{-1}s^{-1}$
B) 1/M
C) s/M^2
D) M/s
E) 1/s

19) The kinetics of the reaction below were studied and it was determined that the reaction rate increased by a factor of 9 when the concentration of B was tripled. The reaction is _____ order in B. 19) _____

$$A + B \rightarrow P$$

A) zero
B) first
C) second
D) third
E) one-half

20) A reaction was found to be zero order in A. Increasing the concentration of A by a factor of 3 will cause the reaction rate to _____. 20) _____

A) remain constant
B) increase by a factor of 27
C) triple
D) decrease by a factor of the cube root of 3
E) increase by a factor of 9

The data in the table below were obtained for the reaction:

$A + B \rightarrow P$

Experiment Number	[A] (M)	[B] (M)	Initial Rate (M/s)
1	0.273	0.763	2.83
2	0.273	1.526	2.83
3	0.819	0.763	25.47

21) The order of the reaction in A is _____. 21) _____

A) 1
B) 2
C) 3
D) 4
E) 0

22) The order of the reaction in B is _____. 22) _____

A) 1
B) 2
C) 3
D) 4
E) 0

23) The overall order of the reaction is _____. 23) _____

A) 1
B) 2
C) 3
D) 4
E) 0

24) For a first-order reaction, a plot of _____ versus _____ is linear. 24) _____

A) $\frac{1}{[A]_t}$, t

B) t, $\frac{1}{[A]_t}$

C) $\ln [A]_t$, t

D) $[A]_t$, t

E) $\ln [A]_t$, $\frac{1}{t}$

25) The following reaction occurs in aqueous solution: 25) _____

$$NH_4^+ (aq) + NO_2^- \rightarrow N_2 (g) + 2H_2O (l)$$

The data below is obtained at 25°C.

$[NH_4^+]$ (M)	$[NO_2^-]$ (M)	Initial rate (M/s)
0.0100	0.200	3.2×10^{-3}
0.0200	0.200	6.4×10^{-3}

The order of the reaction in NH_4^+ is _____.

A) -1
B) -2
C) +2
D) +1
E) 0

26) The rate constant for a particular second-order reaction is 0.47 $M^{-1}s^{-1}$. If the initial concentration of reactant is 0.25 mol/L, it takes _____ s for the concentration to decrease to 0.13 mol/L. 26) _____

A) 1.4
B) 7.9
C) 0.13
D) 1.7
E) 3.7

27) The initial concentration of reactant in a first-order reaction is 0.27 M. The rate constant for the reaction is 0.75 s^{-1}. What is the concentration (mol/L) of reactant after 1.5 s? 27) _____

A) 3.8
B) 8.8×10^{-2}
C) 1.7
D) 0.135
E) 2.0×10^{-2}

28) Which one of the following is <u>not</u> a valid expression for the rate of the reaction below? 28) _____

$$4NH_3 + 7O_2 \rightarrow 4NO_2 + 6H_2O$$

A) $-\frac{1}{7}\frac{\Delta[O_2]}{\Delta t}$

B) $-\frac{1}{4}\frac{\Delta[NH_3]}{\Delta t}$

C) $\frac{1}{4}\frac{\Delta[NO_2]}{\Delta t}$

D) $\frac{1}{6}\frac{\Delta[H_2O]}{\Delta t}$

E) All of the above are valid expressions of the reaction rate.

29) The rate law of a reaction is rate = k[D][X]. The units of the rate constant are _____. 29) _____

A) $mol^2\ L^{-2}s^{-1}$

B) $mol\ L^{-1}s_{-2}$

C) $L^2\ mol^{-2}s^{-1}$

D) $mol\ L^{-1}s^{-1}$

E) $L\ mol^{-1}s^{-1}$

The data in the table below were obtained for the reaction:

$A + B \rightarrow P$

Experiment Number	[A] (M)	[B] (M)	Initial Rate (M/s)
1	0.273	0.763	2.83
2	0.273	1.526	2.83
3	0.819	0.763	25.47

30) The rate law for this reaction is rate = _____. 30) _____

A) $k[A]^2$

B) $k[A][B]$

C) $k[A]^2[B]$

D) $k[A]^2[B]^2$

E) $k[P]$

31) The magnitude of the rate constant is _____. 31) _____

A) 0.278

B) 38.0

C) 13.2

D) 42.0

E) 2.21

The data in the table below were obtained for the reaction:

$2\ ClO_2\ (aq) + 2\ OH^-\ (aq) \rightarrow ClO_3^-\ (aq) + ClO_2^-\ (aq) + H_2O\ (1)$

Experiment Number	$[ClO_2]$ (M)	$[OH^-]$ (M)	Initial Rate (M/s)
1	0.060	0.030	0.0248
2	0.020	0.030	0.00276
3	0.020	0.090	0.00828

32) What is the order of the reaction with respect to ClO_2? 32) _____

A) 4

B) 0

C) 2

D) 3

E) 1

33) What is the order of the reaction with respect to OH^-? 33) _____

A) 0
B) 1
C) 2
D) 3
E) 4

34) What is the overall order of the reaction? 34) _____

A) 3
B) 4
C) 2
D) 1
E) 0

35) What is the magnitude of the rate constant for the reaction? 35) _____

A) 230
B) 4.6
C) 1.15×10^4
D) 713
E) 115

36) The rate law for a reaction is 36) _____

$$\text{rate} = k\,[A][B]^2$$

Which one of the following statements is false?

A) k is the reaction rate constant
B) The reaction is first order in A.
C) The reaction is second order in B.
D) The reaction is second order overall.
E) If [B] is doubled, the reaction rate will increase by a factor of 4.

37) The reaction 37) _____

$$2NOBr\,(g) \rightarrow 2\,NO\,(g) + Br_2\,(g)$$

is a second-order reaction with a rate constant of 0.80 $M^{-1}s^{-1}$ at 11°C. If the initial concentration of NOBr is 0.0440 M, the concentration of NOBr after 10.0 seconds is _____.

A) 0.0300 M
B) 0.0350 M
C) 0.0400 M
D) 0.0325 M
E) 0.0275 M

38) The following reaction is second order in [A] and the rate constant is 0.039 $M^{-1}s^{-1}$: 38) _____

$$A \rightarrow B$$

The concentration of A was 0.30 M at 23 s. The initial concentration of A was _____ M.

A) 1.2×10^{-2}
B) 2.4
C) 3.7
D) 0.27
E) 0.41

The reaction A → B *is first order in* [A]. *Consider the following data.*

time (s)	[A] (M)
0.0	1.60
10.0	0.40
20.0	0.10

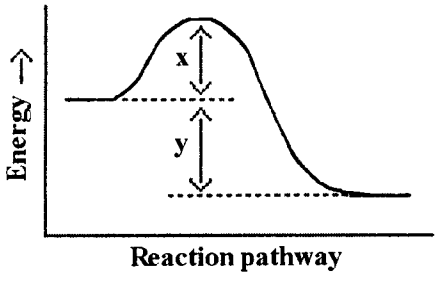
39) The rate constant for this reaction is _____ s^{-1}. 39) _____

A) 3.1×10^{-3}
B) 0.013
C) 0.14
D) 0.030
E) 3.0

40) As the temperature of a reaction is increased, the rate of the reaction increases because the _____. 40) _____

A) activation energy is lowered
B) reactant molecules collide less frequently
C) reactant molecules collide less frequently and with greater energy per collision
D) reactant molecules collide more frequently with less energy per collision
E) reactant molecules collide more frequently and with greater energy per collision

41) Which energy difference in the energy profile below corresponds to the activation energy for the forward reaction? 41) _____



A) x
B) y
C) y - x
D) x - y
E) x + y

42) The mechanism for formation of the product X is: 42) _____

$A + B \rightarrow C + D$ (slow)
$B + D \rightarrow X$ (fast)

The intermediate reactant in the reaction is _____.

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

43) For the elementary reaction 43) _____

$$NO_3 + CO \rightarrow NO_2 + CO_2$$

the molecularity of the reaction is _____, and the rate law is rate = _____.

A) 2, $k[NO_3][CO]$
B) 2, $k[NO_3][CO]/[NO_2][CO_2]$
C) 4, $k[NO_3][CO][NO_2][CO_2]$
D) 2, $k[NO_2][CO_2]$
E) 4, $k[NO_2][CO_2]/[NO_3][CO]$

44) A possible mechanism for the overall reaction 44) _____

$$Br_2\,(g) + 2NO\,(g) \rightarrow 2NOBr\,(g)$$

is

$$NO\,(g) + Br_2\,(g) \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} NOBr_2\,(g) \qquad \text{(fast)}$$

$$NOBr_2\,(g) + NO\,(g) \xrightarrow{k_2} 2NOBr \qquad \text{(slow)}$$

The rate law for formation of NOBr based on this mechanism is rate = _____.

A) $(k_2k_1/k^{-1})[NO][Br_2]^2$
B) $k_1[Br_2]^{1/2}$
C) $k_1[NO]^{1/2}$
D) $(k_1/k^{-1})^2[NO]^2$
E) $(k_2k_1/k^{-1})[NO]^2[Br_2]$

45) The rate law of the overall reaction 45) _____

$$A + B \rightarrow C$$

is rate = $k[A]^2$. Which of the following will not increase the rate of the reaction?

A) increasing the concentration of reactant B
B) increasing the temperature of the reaction
C) adding a catalyst for the reaction
D) increasing the concentration of reactant A
E) All of these will increase the rate.

46) A catalyst can increase the rate of a reaction _____. 46) _____

A) by lowering the activation energy of the reverse reaction
B) by changing the value of the frequency factor (A)
C) by providing an alternative pathway with a lower activation energy
D) by increasing the overall activation energy (E_a) of the reaction
E) All of these are ways that a catalyst might act to increase the rate of reaction.