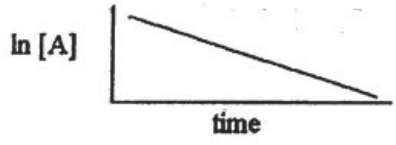
Kinetics Quiz B Name_____ Date_____ Class____

_____ 1. The rate law of a reaction is rate = k[D][X]. The units of the rate constant are _____.

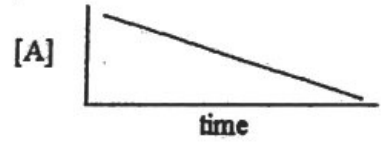
A) L $mol^{-1}s^{-1}$
B) mol^2 $L^{-2}s^{-1}$
C) mol $L^{-1}s^{-2}$
D) L^2 $mol^{-2}s^{-1}$
E) mol $L^{-1}s^{-1}$

_____ 2. Which one of the following graphs shows the correct relationship between concentration and time for a reaction that is zero order in [A]?

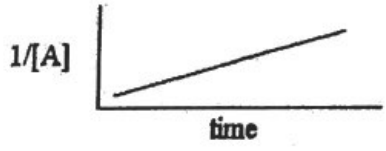
A)



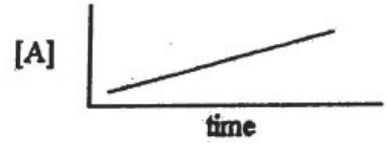
B)



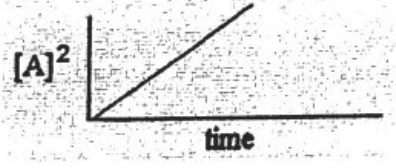
C)



D)



E)



_____ 3. Of the following, all are valid units for a reaction rate except _____.

A) mol/L
B) M/s
C) mol/hr
D) g/s
E) mol/L-hr

For questions 4 and 5, consider the following mechanism for the oxidation of bromide ions by hydrogen peroxide in aqueous acid solution.

(1) $H^+ + H_2O_2 \rightleftharpoons H_2O^+–OH$ (rapid equilibrium)
(2) $H_2O^+–OH + Br^- \rightarrow HOBr + H_2O$ (slow)
(3) $HOBr + H^+ + Br^- \rightarrow Br_2 + H_2O$ (fast)

_____ 4. What is the overall reaction equation for this process?

A) $2H_2O^+–OH + 2Br^- \rightarrow H_2O_2 + Br_2 + 2H_2O$
B) $2H^+ + 2Br^- + H_2O_2 \rightarrow Br_2 + 2H_2O$
C) $2H^+ + H_2O_2 + Br^- + HOBr \rightarrow H_2O^+–OH + Br_2 + H_2O$
D) $H_2O^+–OH + Br^- + H^+ \rightarrow Br_2 + H_2O$
E) None of these choices are correct.

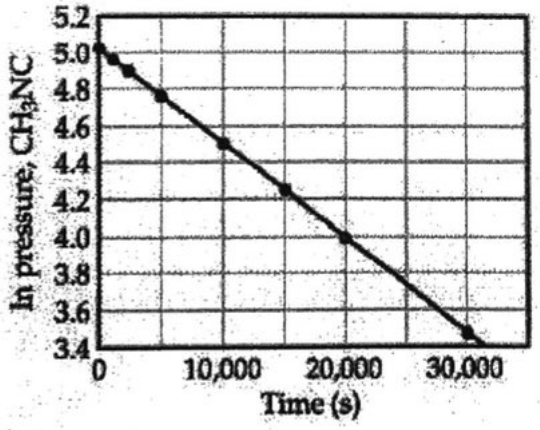
_____ 5. Which of the following rate laws is consistent with the mechanism?

A) Rate = $k[H_2O_2][H^+]^2[Br^-]$
B) Rate = $k[H_2O+–OH][Br^-]$
C) Rate = $k[H_2O_2][H^+][Br^-]$
D) Rate = $k[HOBr][H^+][Br^-][H_2O_2]$
E) Rate = k[Br

_____ 6. At elevated temperatures, methylisonitrile (CH_3NC) isomerizes to acetonitrile (CH_3CN):

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

The reaction is first order in methylisonitrile. The attached graph shows data for the reaction obtained at 198.9 °C.



What is the rate constant (s^{-1}) for the reaction?

A) -1.9×10^4
B) $+5.2 \times 10^{-5}$
C) $+1.9 \times 10^4$
D) -5.2×10^{-5}
E) +6.2

_____ 7. The reaction below is first order in $[H_2O_2]$:

$$2H_2O_2\ (l) \rightarrow 2H_2O\ (l) + O_2\ (g)$$

A solution originally at 0.600 M H_2O_2 is found to be 0.075 M after 54 min. The half-life for this reaction is _____ min.

A) 54
B) 14
C) 28
D) 18
E) 6.8

_____ 8. The mechanism for formation of the product X is:

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

The intermediate reactant in the reaction is _____.

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

_____ 9. The rate of disappearance of HBr in the gas phase reaction

$$2HBr\ (g) \rightarrow H_2\ (g) + Br_2\ (g)$$

is 0.190 M s^{-1} at 150 °C. The rate of appearance of Br_2 is _____ M s^{-1}.

A) 2.63
B) 0.095
C) 0.0361
D) 0.380
E) 0.436

_____ 10. A second-order reaction has a half-life of 18 s when the initial concentration of reactant is 0.71 M. The rate constant for this reaction is _____ $M^{-1}s^{-1}$.

A) 7.8×10^{-2}
B) 3.8×10^{-2}
C) 2.0×10^{-2}
D) 1.3
E) 18

_____ 11. For the elementary reaction

$NO_3 + CO \rightarrow NO_2 + CO_2$

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

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

_____ 12. The rate law of the overall reaction

$A + B \rightarrow C$

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

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

The data in the table below were obtained for the reaction: *(Use to answer 13 and 14)*

$A + B \rightarrow C$

Experiment Number	[A] (M)	[B] (M)	Initial Rate (M/s)
1	0.451	0.885	1.13
2	0.451	1.77	1.13
3	1.35	0.885	10.17

_____ 13. What is the order of the reaction in A?

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

_____ 14. What is the order of the reaction in B?

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

Use the information below to answer 19 and 20

_____ 15. The rate law for the reaction shown below is $R = k[NO][Cl_2]$

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

Which of the following gives a reaction mechanism that is consistent with these data?

A) Step 1: $NO(g) + Cl_2(g) \rightarrow NOCl_2(g)$
   Step 2: $NOCl_2(g) + NO(g) \rightarrow 2\,NOCl(g)$

B) Step 1: $2\,NO(g) + Cl_2(g) \rightarrow (NO)_2Cl(g) + Cl(g)$
   Step 2: $(NO)_2Cl(g) + Cl(g) \rightarrow 2\,NOCl(g)$

C) Step 1: $Cl_2(g) \rightarrow 2\,Cl(g)$
   Step 2: $2\,NO(g) + 2\,Cl(g) \rightarrow 2\,NOCl(g)$

D) Step 1: $2\,NO(g) \rightarrow N_2O_2(g)$
   Step 2: $N_2O_2(g) + Cl_2(g) \rightarrow 2\,NOCl(g)$

_____ 16. The kinetics of a reaction $A + 3B \rightarrow C + 2D$ were studied and the rate law was determined to be

$$Rate = k[A][B]^2$$

For a run where $[A]_o = 1.0 \times 10^{-3}$ M and [B] = 5.0 M, a plot of ln[A] versus time was found to give a straight line with a slope of $-5.0 \times 10^{-2}\ s^{-1}$.
What is the value of k? (ignore units)

A) 5.0×10^{-2}
B) 2.0×10^{-3}
C) 1.0×10^{-2}
D) 1.0
E) 2.0

_____ 17. The radioactive isotope tritium decays with a first-order rate constant *k* of 0.056 $year^{-1}$. What fraction of the tritium initially in a sample is still present 30 years later?

A) 0.19
B) 0.60
C) 0.15
D) 2.8×10^{-38}
E) None of these choices are correct.

_____ 18. What are the units of k for the rate law: $Rate = k[A][B]^2$, when the concentration unit is mol/L?

A) s^{-1}
B) s
C) $L\ mol^{-1}\ s^{-1}$
D) $L^2\ mol^{-2}\ s^{-1}$
E) $L^2\ s^2\ mol^{-2}$

Use the information below to answer 19 and 20.

A flask is charged (filled) with 0.124 mol of A *and allowed to react to form* B *according to the reaction* A(g) →2B(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

_____ 19. The average rate of disappearance of A between 10 s and 20 s is _____ mol/s.

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

_____ 20. How many moles of B are present at 30 s?

A) 0.102
B) 0.073
C) 1.7×10^{-3}
D) 0.051
E) 2.4×10^{-3}

_____ 21. The decomposition of dinitrogen pentoxide in carbon tetrachloride (shown below) is first order.

$$2\ N_2O_5 \rightarrow 4\ NO_2(g) + O_2(g)$$

A student initially measures the concentration of N_2O_5 as 0.80 M. 140 seconds later the concentration is 0.20 M. What is the value of the rate constant?

A) 0.005
B) 0.01
C) 0.12
D) 0.25
E) None of the above.