AP Chemistry
Reaction Practice
Day 6

Name Key 2011
Date _____ **Period** _____

For each of the following three reactions, in part (i) write a BALANCED equation and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction.

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1. Magnesium ribbon is burned in oxygen gas

(i) $2Mg + O_2 \rightarrow 2MgO$

(ii) What could you do to the magnesium to make the reaction go faster. Explain your answer.

cut it into small pieces to increase the surface ave. More effective collisions and a fasta reaction Rate.

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2. Dibromine pentoxide reacts with water

(i) $Br_2O_5 + H_2O \rightarrow 2HBrO_3$

(ii) Is the product formed a weak, strong or nonelecterolye? Explain your answer.

This is a weak electrolyte because it is a weak acid

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3. Excess hydrochloric acid solution is added to solid sodium phosphate.

(i) $3H^+ + Na_3PO_4 \rightarrow H_3PO_4 + 3Na^+$

(ii) Can the reactants be used to make a buffer solution? Explain.

this may be answered two ways.
If you have Excess HCl w/ Na_3PO_4 then No!
but if you use a smaller amount of HCl then you will have Na_3PO_4 left & have Formed H_3PO_4 a WA & its CB!!!

Kinetics

(1)

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Question 2

$$A(g) + B(g) \rightarrow C(g) + D(g)$$

For the gas-phase reaction represented above, the following experimental data were obtained.

Experiment	Initial [A] (mol L^{-1})	Initial [B] (mol L^{-1})	Initial Reaction Rate (mol L^{-1} s^{-1})
1	0.033	0.034	6.67×10^{-4}
2	0.034	0.137	1.08×10^{-2}
3	0.136	0.136	1.07×10^{-2}
4	0.202	0.233	?

(a) Determine the order of the reaction with respect to reactant A. Justify your answer.

Between experiments 2 and 3, [B] stays the same and [A] is quadrupled, but the initial reaction rate stays the same. This means that the initial reaction rate is not dependent on [A], so the reaction is zero order with respect to A. (May also justify using mathematics as shown in part (b).)	One point is earned for the correct order and for the justification.

(b) Determine the order of the reaction with respect to reactant B. Justify your answer.

$\frac{\text{rate}_2}{\text{rate}_1} = \frac{k\,[A]_2^x\,[B]_2^y}{k\,[A]_1^x\,[B]_1^y}$ $\frac{1.08 \times 10^{-2}}{6.67 \times 10^{-4}} = \frac{k\,(0.034)^x\,(0.137)^y}{k\,(0.033)^x\,(0.034)^y}$ where $x = 0$ $16.2 = (4.03)^y$ $y = 2$, so the reaction is second order with respect to B OR Between experiments 1 and 2, [A] stays the same, [B] is multiplied by 4, and the initial reaction rate is multiplied by 16. This means that the reaction is second order with respect to B.	One point is earned for the correct order and for the justification.

(c) Write the rate law for the overall reaction.

rate = $k\,[B]^2$	One point is earned for the correct rate law (or a rate law consistent with the answers in part (a) and part (b)).

Kinetics

(2)

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Question 2 (continued)

(d) Determine the value of the rate constant, k, for the reaction. Include units with your answer.

Using experiment 2: rate = $k\,[B]^2$ $k = \frac{\text{rate}}{[B]^2} = \frac{6.67 \times 10^{-4}\ \text{mol L}^{-1}\ \text{sec}^{-1}}{(0.034\ \text{mol L}^{-1})^2} = 0.577\ M^{-1}\ \text{sec}^{-1}$	One point is earned for the correct numerical value of the rate constant. One point is earned for the correct units.

(e) Calculate the initial reaction rate for experiment 4.

rate = $k\,[B]^2$ rate = $(0.577\ M^{-1}\ \text{sec}^{-1}) \times (0.233\ \text{mol L}^{-1})^2$ = $3.13 \times 10^{-2}\ \text{mol L}^{-1}\ \text{sec}^{-1}$	One point is earned for the correct answer, including units.

(f) The following mechanism has been proposed for the reaction.

Step 1: $B + B \rightarrow E + D$ *slow*

Step 2: $E + A \rightleftarrows B + C$ *fast equilibrium*

Provide two reasons why the mechanism is acceptable.

(1) When steps 1 and 2 are added together, the overall reaction is $A + B \rightarrow C + D$. This is the stoichiometry that was given for the overall reaction. (2) The rate-determining step (slow step) is consistent with the rate law because only reactant B occurs in the rate law and it occurs to the power of 2, which is the number of B molecules colliding in the rate-determining step. (3) The rate-determining step is consistent with the rate law because A is absent from the rate-determining step and the reaction is zero order—i.e., reactant A does not appear in the rate law.	One point is earned for each correct reason, with a maximum of 2 points.

(g) In the mechanism in part (f), is species E a catalyst, or is it an intermediate? Justify your answer.

Species E is an intermediate; it is formed in step 1 and consumed in step 2. AND/OR Species E is not a catalyst because a catalyst occurs as a reactant in an earlier step and is then reproduced as a product in a later step.	One point is earned for the correct answer with justification.