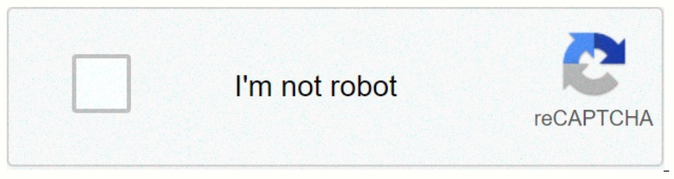

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15 chemical kinetics rate laws worksheet answers

Writing the percentage expression in terms of \(\Delta\)[reactant]/\(\Delta\)t and\Delta\)[product]/\(\Delta\))t for the reaction:\(N_2+3H_2\Right 2NH_3\The initial percentage of the reaction between \(A\) and \(B\) was measured. From the given data, determine the order of each reactant, determine the order of the reaction, write the rate law and calculate the rate constant, \(k\). Handlers\({A}\)\({B}\)Initial Rates #1\(0.20\,M\)\(0.10\,M\)\(3.50\Times 10^{-3}M/s\s\#2\(0.40\,M\)\(0.10\, M\)\(7.00\times 10^{-3}M/s\s\s #3\(0.40\,M\(0.40\,M\)\(7.00\Times 10^{{ -- 3} M/s\y) the decomposition of \(A_2B_3\ is second order with a \ (k = 6.5\times 10^{-5}M^{-1}s^{-1}) at 25oC. If the initial concentration is \(0.50\, M\), what is the concentration after \(3 min\)? What is life halfway for that reaction? Q4 What is the reactant concentration after 2.5 minutes if the first concentration was \(0.100\, M\) and \(k=6.93\times 10^{-3}s{{1}} for an initial order reaction? What is Half-Life's? For the first command reaction:\(SO_2Cl_2\right SO_2+Cl_2\) How long it will take to reach \(0.31\Times 10^{-3}, M\) if the initial concentration was \(1.25\times 10^{-3}; M\) and \(k= 0.17hr^{-1}\)? For the below reaction, if substance A is disappeared at a percentage of \(1.82\times10^{-2}; M/s\), at which percentage C appears? \(3A+3B\Straight 5C+2D\)Ozone,\(O_3\), is generated in the stratosphere by chemical reaction shown below. If in a given activation, molecular oxygen, \(O_2\), will react at a percentage of \(2.17\times10^{-5}; M/s\), at what rate of area are generated? \(3O_2(g)\right 2O_3(g)\) For the reaction, \(H_2O_2+3I^+2H^+\right 2H_2O+I_3^\) The rate law has been experimented to be Percentage = \({k[k[H_2O_2][I^]}) What is the term reaction order of \(H_2O_2\)? What is the reaction order in terms of \(I^-)? What is the reaction order in terms of \(H^+)? What is the overall reaction order in this reaction? If a reaction is second order in B and the concentration of B increases from \(0.0850M\\(0.2975M\), what should reach the rate? The data below has been collected for the reaction: \(BrO_3^- +5Br^-+H_3O^+\Straight 3Br_2+9H_2O\Experiment#Initial Conc({}(M)})First Rate\({{{{{{{ M /s}}}\(BrO_3^)\(Br^-\)\(Br^-\))\(H_3O^\))\(Br_2 1.0.10 0.10 0 0 0 1.2 2 0.0 0.0 0.10 0.0 0 2.4 3 0.1 0.30 0.10 0 3 6 4 0.20 0.0.15 0 5.4 Determine the rate law for this reaction. How does the initial percentage change if the initial concentration of \(Br_2\) were to be non-zero? It is known that the compound named klorofluorocarbons (CFC.s) (e.g.\(CFCl_3\)) will break into the presence of ultraviole radiation, such as found in the upper atmosphere, forming single chlorine atoms (radical):\ CFCl_2 +Cl\a\(Cl\) atom then React with ozone (\(O_3\) as description of this mechanism.step 1:\(Cl+O_3\straight ClO+O_2\Step 2:\(ClO+O\straight CL+O_2\) (one O atoms occur naturally in the atmosphere.) Write the equation for overall reactions. (Use steps 1 and 2) What is the catalyst in this reaction? Identifies an intermediary in this reaction. Explains how a small number of klowofluorokarbons can destroy a large number of ozone. What broke the bond of \(CFCl_3\) and releasing the free Kl atom? Provide this mechanism, answer the questions below: Step 1:\(O_3+NO\RIGHT NO_2+O_2\)(Slow) Step 2:\(NO_2+O\Right NO+O_2\(Fast) Give the equation for the overall reaction. What does the catalyst have to be in this mechanism? What is an intermediary of this mechanism? Extending that reaction in general is a slowly existential reaction, tracing an energy diagram that shows the possible form of the curve for the uncatalyzed reaction. On the same diagram, show a possible curve for the catalyst reaction. What does that mean by the determining stage of a reaction mechanism? What does that mean by a reaction mechanism? How does the reaction mechanism be determined? Provide this energy diagram for a 3-step reaction, answer the questions below: What arrows indicate the activation energy for the first step of the reverse reaction? What arrows indicate the energy triggers for the first step in the reaction ahead? What arrows indicate the energy triggers for the second stage of the reaction ahead? What arrows indicate the healthy change (\\Delta{H})) for the overall reaction ahead? What arrows indicate the healthy change (\\Delta{H})) for the overall reaction? What arrows indicate the energy triggers for overall reactions? What steps could the rate determine stages of the reaction ahead? In a color line or another color catch a possible curve that would represent the way for overall reaction. Label the graph. Give the reaction: \(4HBr+O_2\Straight 2H_2O+2Br_2\) would you expect this reaction to take place in a single step? Why not? This reaction is thought to take place by means of this mechanism: Step 1:\(HBr+O_2\Straight HOOBr\) (Slow) Step 2: \ (HBr + HOOBr \ Straight 2HOBr \) (Fast) Step 3: \ (2HBr + 2HOBr \ Right 2H_2O + 2Br_2 \) (Fast) Identify the two intermediate ones. A discovery catalyst that increases the rate in Step 3. How will this affect the rate of overall reactions? Explain your answer. A discovery catalyst that increases the rate in Step 1. How will this affect the rate of overall reactions? Explain your answer. What are the steps of greater energy activation? How many piks will the potential energy diagram for the reaction mechanism have? What steps are called percentage determine the stage of this mechanism? In order to have successful collisions, the collision particles must have both the appropriate amount of energy and the appropriate _. (fill in blank) Draw an energy diagram showing the shape of the curve you might expect for the reaction to that question. The overall reaction is exotic. Make sure you get the correct relative size bumps. The equation for an overall reaction is: \(I^-OCl^-\straight IO^+Cl^^-) The following is a mechanism proposed for this reaction. One of the spaces stayed out. Determine what species is (in linked to the question mark). Make sure the load is correct if it has one. Step 1:\(OCl^+H_2O\HOCL right+OH^\)(Fast) Step 2:\(I^HOCL\ Right IOH+Cl^\) (Slow) Step 3:\(IOH + OH^\ Right ?+H_2O\)(Fast) What species of mechanism is above act as a catalyst? What three species of the mechanism above is intermediate? What rate steps determine the stage? Draw an energy diagram showing the shape of the curve you might expect for the reaction to that question. The overall reaction is andothermic. Make sure you get the correct relative size bumps. Reaction rates and law rates for these fuel phase reactions. \(NO(g)+O_3(g)\right NO_2(g)+O_2(g))\({[O_3]}=1.0\times 10^{14} molecules/cm^3\)\({[NO]}=2.0\Times 10 ^{14} {10} molecules/cm^3\Time(ms)\([NO])Time\([O_3]\0\(6.0\Times 10^8\0\(1.0\Times 10^{10}\100\(5.0\ times 10^8\)50\(8.4\times 10^9\)500\(2.4\times 10^8\100\(7.0\times 10^9\700\(1.7\Times 10^ 8\200\(4.9\times 10^9\1000\(9.9\times 10^7\300\(3.4\times 10^9\) Use the above data: Graph concentration vs time for each data series. Graphene ln[] vs time. Determines the average rate for the reaction between each data point. Use your graph to determine the instant reaction rate to 250 ms. Given that the reaction is first ordered at \(NO\) and in \(O_3\), determine the constant rate using the percentage you calculate for each data set Use graph ln[] vs. time to determine the percentage constant. What is the overall rate law? Convert the units to the percentage constant, liter, and seconds. Extend the following kinetic data for the reaction in Q19:T(K)\(K)\(M^{-1}s^{-1}))195\(1.08\Times 10^9\9\(2.95\Times 10^9\260\(5.6%\(5.9\(10\10%\260\(5.9 24\\Times 10^9\)298\(12.0\Times 10^9\369\(35.5\Times 10^9\Graph this data as ln(k) vs 1/T. Determine the activation energy and the frequency factor of the graph. What is the constant percentage of 150 K? Mark Draganjac (Arkansas State University) 1. The state of quantity must be measured to establish the rate of a chemical reaction and cite several factors affecting the rate of a chemical reaction. The percentage of a reaction is defined as the change in concentration as a two-time function. two quantities to be measured are the molarity of either a reactant or a product with the time. The factors that affect a reaction rate include the temperature, concentration of reactants, the surface area (if rigorous are involved in the reaction, and the presence or absence of a catalyst. 2. Explain why the percentage of extinction of NO and training rates in N2 are not the same in the reaction, 2CO(g)+2NO(g)→ 2CO2(g)+N2(g). Because of the ratio 2:1 stoichiometric ratio between NO and N2, the NO must use 2 moles per mole in N2 produced. This means that the percentage of THE NO consumption is twice as fast as the rate of N2 output. 3. What draws in experimental data can be used to assess the activation energy, Ea, in a reaction? How is Ea related to this receivers? The experimental data required to assess the energy triggers the constant rates as a function of absolute temperature. If lin is mapped against 1/T, a straight line should result with the slope of the equal line to -Ea/R, where R is the ideal fuel constant in energy units. 4. What are the chief conditions that must be met by a plausible reaction mechanism? Why do we say plausible mechanism rather than incorrect mechanism? A reaction mechanism must satisfy two criteria. 1) The sum of all the steps of the mechanism must match the observed reaction, i.e., the stoichiometry of the reaction must be satisfied. 2) The reaction mechanism must count for the observed reaction rate act. Reaction mechanisms are considered plausible rather than correct because different sequences of elementary reactions can satisfy the two requirements. 5. In a reaction mechanism, (a) what is the difference between a complex toggle and an intermediary? (B) What does it mean by the percentage step that is determined? What elementary reaction to a reaction mechanism often the rate stage is determined? (A) A complex toggle is the structure along the reaction paved into the higher energy, which determines the activation energy for the reaction. An intermediary can any structure found in the reaction path. (B) Rate steps that are determined are elementary reactions that control the mathematical form of rate laws in general. The determined rate stage is usually the slower elementary reaction. 6. In reaction H2O2 (aq) → H2O(l) + 1/2 O2(g), the initial concentration of H2O2 is 0.2546 M, and the initial rate of reaction is 9.32×10-4 M–1. What will [H2O2] be in t = 35 s? Using percentage definition (the concentration change on the change in time), recognizes that the initial percentage for the loss of hydrogen peroxide is negative and of t=0 s,[H2O2]=0.2546M. [H2O2]=0.220 M7. For the reaction, a → product, a graph of [A] versus time is a curve. What can be concluded on this reaction order? The embedded rate laws, written as linear equations, are: For zero order For first command reaction: For second order reaction: Since [A]vs. t is a curve, the reaction cannot be order zero. 8. Following are two statements concerned in reaction to 2A+ B → 2C, for which the Law Rate Act is the percentage = which [A][B]. Identify which statement is true and false, and explain your reasoning. (A) The value of which is independent of the initial concentrations [A]0 and [B]0. (B) The constant rate unit for this reaction can be expressed as s-1 or min–1. The rate acts to the second overall order. The constant rate, by definition, is independent of concentration, first or otherwise, so (A) must be true. The units at the constant rate for a second order reaction are M-1s-1 or M-1min–1 (percentage MS–1 = which [M]]) so (b) is false. 9. This reaction rate in aqueous solutions is controlled by measuring the number of moles in Hg2Cl22 that are precisiated per liter per minute. The found data are listed in the table. 2 HgCl2 (aq) + C2O42–(aq) → 2 CL - (aq) + 2 CO2(g) + Hg2Cl2(s) Experience [H (M) [C2O42–] (M) Initial Rate (mol L–1 min–1) 10.105 0.15 1.8 ×10–5 0.105 0.15 1.8×10–5 3 0.052 0.30 7.0 1×10–5 4 0.05 20.15 8.9×10–6 (a) Determine the order of HgCl2-related reactions , with respect to C2O42 – and in general. (B) What is the constant rate constant value? (C) What would the initial rate of reaction if [HgCl2] = 0.094 M and [C2O42–] = 0.19M? (D) Are all four experiments needed to answer the part(a)-(c)? Explain. Use the method to rate initials to get the orders of reactions to each element. This will allow assessment of the rate constant and the initial rate of reaction to any other requirement. (A) Percentage = which [HgCl2] i [C2O42-]n Compare the rates of experience 1 and 2 (or 3 and 4) get the order of oxalate ion: Compare the rates of experience 2 and 3 (or 1 and 4) to get the order of mercury (II) chloride: therefore, the reaction is first ordered with respected mercury (II) chloride and second order related to oxalator. The overall order is the following sum, 2+1=3, third order. (B) To obtain the constant rate, use the equation rate and resolve for k: Experience [HgCl2](M)[C2O42–](M) First rate (mol L–1 min–1) which 10.105 0.0.0. 15.8×10–5 2 0.105 0.15 1.8×10–5 0.052 0.30 7.1×0–5 5 4 0.052 0.15 8.9×10-6 Middle = 7.6×10–3 M–2min–1 (c) Percentage = which [HgCl2]][C2O42–]2 Percent = (7.6×10–3 M–2min–1) [0.094M][0 .19 M]2=2.6×10–5 M-1(d) Since there are only two reactants, the three experiments are minimum needed to get the

rate equation and constant rate. Experience 1 – 3 would be sufficient to answer the questions posed. 10. In the reaction A → product, we find that when [A] has fallen to half of its initial value, the reaction continues at the same rate as its initial rate. Do order zero reaction, first order, or Order? Explain. Since the percentage has not changed as a two-time function, the reaction must be order zero. 11. In the reaction, a → product, and the initial concentration [A]0 = 1.512M, [A] were found to be 1.496M at t = 30 s. With the initial concentration [A]0= 2.584M, [A] was found to be 2,552 M at t = 1 min. What is the order of this reaction? First, get the rate of reaction in each experience, being sure to be consistent in their units. Then use the Initial Rate Method to get the order of reaction. Experience [A]0(M)[A](M) of t(s)Percent(s-1) 1,512 1,496 of 30 s 2,584<2,552 in 60 since rates are the same for both experiments, the reaction must be order zero. Mathematically: , which can only be true for i = 0. 12. A reaction first order, A product →, has a percentage of reactions 0.00250 M s-1 when [A]=0.484 M.(A) What is the constant constant, k, for this reaction? (B) Does t3/4 depend on the initial concentration? Is t4 / 5? Explain. (A) For an initial order reaction, Percentage = which [A]. Since the rate and concentration are known, resolve the equation to give the requested response. Ki = Percentage/[A] = 0.00250M s - 1/0.0484M = 5.17×10–3 s -1. (b) Neither t3/4 or t4/5 depends on intial concentration because this is a first order reaction, which means that the associated time reaction is simply related to the percentage constant. 13. In the first-order decomposition of dinitrogen pentoxid of 335 K, N2O5(g)→ 2 NO2(g)+1/2 O2(g) if we start with a 2.50-g sample of N2O5 at 335 K and have 1.50 g remaining after 109 s, (a) What is the value of the constant constant? (B) What is the half-life reaction? (C) Which mass N2O5 will remain after 5.0 min? Since the concentration unit is canceled out, we can work directly in grams for this issue.(A)[N2O5]0=2.50g,[N2O5]t=1.50g, t = 109 s, so that = 4.69×10-3 s-1 (b)t1/2=0.693/ki=0.693/4.69×10–3=148 s.(c)=5.0 min=300. so is 14. Smog constituent peoxycetyl nitate (PAN) dissociates of radical peroxyacetyl and NO2(g) in a first order reaction with a half-life in 32 min. If the initial concentration of panes in a sample when the 2.7×1015 molecule/L, what will be the 2.24h concentration later? For a first order reaction, the integrated rate law is and the constant rate can be found in half the lifetime: . So that =0.693/t1/2=0.693/32=0.022 min-1. For an initial concentration [PAN]0=2.7×1015 molecule/L and at t = 2.24h = 134 min: [PAN]=[PAN]oe –kt = (2.7×1015)e-(0.022)(134) = 1.4×1014 molecules / L. 15. The following data were found in two separate experiences of the reaction: a → product. Determine the rate law for this reaction, including the value of k. Experience 1 Experience 2 [A] Time(M) Time(s)[A] Time(s) 0.800 0.400 0.775 40 0.390 64 0.0750 0.380 132 0.725 129 0.370 203 0.700 179 0.360 278 Act of General Rate is Percentage = The method of initial rates can be used to establish the order of reaction and provide an estimate of the percentage constant. The initial percentage is found in the first two points of each experience: Use the initial concentrations and the initial rates: So this is a second order reaction. The rate constant can be estimated from which = – Missed/[A]2 per experience: which (OS 1) = –(–6.25×10–4) / [0.800] 2 = 9.8×10–4 M–1–1 and (display. 2) =–(–1.56×10–4)/[0.400]2=9.8×10–4 M–1 s–1. Which = 9.8×10–4 M–1 s–1 Confirm this and get a better value for the percentage constant, a tablet of [A]-1 vs. t should be linear with a slope equal to the constant rate: the slopes in these polls show that a better value for the constant is that = 1.0×10–3 M–1 s–1. 16. The list below are first rates, expressed in terms of the rate of decreased partial pressure of a reaction reaction to this reaction to 826°C. Determine the rate law for that reaction, including the value for k.NO(g)+H2(g)→ 1/2N2(g)+H2O(g) With first PH2 = 400 mmHg and first PNO = 400 mmHg In Initial PNO(mmHg) Percentage(mmHg/s) First PH2(mmHg) Percentage (mmHg) Percent (mmHg) Percent (mmHg/s) Percentage(mmHg) Percentage(mmHg/s) Percentage(mmHg)First PH2(mmHg) Rate(mmHg/s) Percent (mmHg/s) Percent (mmHg)Percent (mmHg) Percentage(mmHg) Percentage(mmHg)Rate(mmHg)Rate(mm) Percent (mmHg) Rate(mm) Percent (mmHg) Percent (mm) Percentage(mmHg) Percentage(mmHg)Rate(mm)Percent (mmHg) Percentage(mmHg)Percent (mmHg) Percent (mmHg) Percentage(mmHg/s) Prime PH2 (mmHg) Percentage (mmHg) Percentage (mmHg/s) Initial PH2(mmHg/s) 359 0.750 289 0.800 300 0.515 205 0.550 152 0.125 147 0.395 The Unknown Law provided by Percentage=K[NO][M][H2]n. Use the Method of Initial Rate shall be awarded the percentage law and the value of the percentage constant. Since units are canceled in Initial Rate Methods, we do not need to convert to molarities. To get the order of NO, use the first set of data where the pressure of H2 is maintaining constants. Experience 2 and 3 are on a factor of 2 differences at first pressure in NO, so will provide easier numbers to work with: In experimental errors, i=2, or second order in NO. To get the order of H2, use handlers 1 and 3 for the easiest numbers: In experimental error, n=1, or first order of H2. The rate constant can now be found from the rate law: ki = Rate/[NO]2[H2] for each experiment: Initial PH2 (mmHg) Initial PNO (mmHg) Initial Rate (mmHg/s) ki (mmHg–2 s–1) 400 359 0.750 (0.750)/(400)(359)2 = 1.45×10–8 400 300 0.515 (0.515)/(400)(300)2 = 1.43×10–8 400 152 0.125 (0.125)/(400)(152)2 = 1.35×10–8 289 400 0.800 (0.800)/(289)(400)2 = 1.73×10–8 205 400 0.550 (0.550)/(205)(400)2 = 1.68×10–8 147 400 0.395 (0.395)/(147)(400)2 = 1.68×10–8 Averaging all of the ki values gives ki = 1.55×10–8 mmHg–2 s–1 17. Constant rate for the first-order decomposition of acetonedicarboxylic acid CO (CH2COOH) 2 (aq) → CO(CH3)2(aq) +2 CO2(g)acetonedicarboxy Asdacetone s are = 4.75 ×10-4 s–1 of 293 K and 1.63 ×10-3 in 303 K. Which activation energy, Ea, for that reaction Use the two-point form of the Arhenius equation to answer this question: where k2=1.63×10–3 in T2=303 K and k1=4.75×0–4 of T1=293 K.18. The following is proposed as a plausible reaction mechanism: Abe B<8> my → (slow) i + B → C + D (fast) What is the permanent reaction described by this mechanism and (b) a plausible rate law for the reaction? (A) To get the net reaction, sum up all the reactions of the mechanism and eliminate common species on each side of the equation: A + B + I + B + B →I + C + D net: A + 2B → C + D (B) is the rate law determined by the slow step of the reaction mechanism. Since it is a composite reaction mechanism of elementary reactions, the rate law for steps slowly can be written by inspection, and the orders of reactions have been the stoicometric coefficient: percentage = which [A][B]19. This reaction exposes the rate law: Percentage = which [NO]2[Cl2]. 2 NO (g) + Cl2(g) → NOCL(g) Explain why this mechanism is not plausible for this reaction. NAME(g) + Cl2 → ← NOCL(g) + CL(g) Fast NO(g) + CL(g) → NOCL(g)Slow The Slow Act determined by the slow step: Percentage = Kslow[NAME][Cl] However, This law includes and intermediates who cannot be part of the rate law for overall reactions – only NO or Cl2 may be part of the rate law. The term [Cl] can be eliminated using the fast, reversible step where the percentage of the front reaction is the same as the percentage of the reverse reaction: Rateforward =Rateverse Rateforward=kforward[NO][Cl2] Ratereverse=Premierrevers Premiereverse [NOCl] [Cl] so kforward [NO][Cl2]=kreverse[NOCl] replacement for [Cl] at the slow stage rate provided: This rate doesn't match the experimental law so this may not be a plausible mechanism. 20. Show that the proposed mechanism is consistent with the rate law for this reaction to aqueous solutions, Hg22+ (aq) + Tl3 + (aq) → 2 Hg2+ (aq) + Tl+ (aq) for which rate laws observe the proposed Mechanism: Hg2+ (aq) → ← Hg2 + (aq) + Hg(s) Fast Hg(s) + Tl3 + (aq) → Hg2 + (aq) + Tl + (aq) Slow First, check to see that the proposed mechanism matches the experimental stoichiometry. Add two reactions together provided: Hg22+(aq) + Hg(s) + Tl3 + (aq) → Hg2 + (aq) + Hg(s) + Hg2 + (aq) + Tl + (aq) Hg(s) common to both sides of the equation are canceled out and the two moles of Hg2+ (aq) can be collected to provide the observed reaction, so matches the stoichiometry. The proposed mechanism can be recruited as Hg22+(aq) → K1 Hg2+ (aq) + Hg(s) Percentage = k1 [Hg22+](Fast) Hg2+(aq) + Hg(s) → k-1 Hg22+(aq) Rates = k-1 [Hg2+ [Hg2+ [Hg] (fag](fa)Hg(s)+Tl3+(aq)→ k2 Hg2+(aq)+Tl+(aq) Percentage=k2[Hg2+[Hg](slow) Percentage in general determined by the slow stage, but this has an intermediary ([Hg]) that must be eliminated in order to evaluate the mechanism. This can be done using the following two fast steps, which must have roughly the same rate, or:k1[Hg22+]=k-1 [Hg2+[Hg] so [Hg]=k1[Hg22+]/k-1[Hg2+] using the following expression in law the rate slows =k2[Hg2]+]k1[Hg22+]/k-1[Hg2+] or Percentage =(k2k1/k-1) [Hg22+ [Hg22+]/[Hg22+] which matches the observed law when wa == 21. Benzenediazonium chlorium decomposed in water bay N2(g). C6H5N2Cl(aq) → C6H5Cl(aq) + N2(g) The data set below is found for the decomposition of a solution 0.071M to 50°C (t = ∞ match the completed reaction). To get [C6H5N2Cl] as a two-time function, remember that during the first 3 min, the volume of N2(g) generated was 10.8 mL at a total of 58.3 mL, corresponding to this fraction of the total reaction: 10.8 mL/58.3 mL = 0.185. An equal fraction of the available C6H5N2Cl was consumed during the same time.time(min)N2(g)(mL) 00 310.8 619.3 926.3 1232.4 1537.3 1841.3 3 2144.3 2446 5.2748.4 3050.4 ∞58.3(a) Plot Graphs showing extinction of C6H5N2Cl and the training of N2(g) as a function of time. (b) What is the initial rate of formation N2(g)? (C) What is the rate of extinction of C6H5N2Cl in t = 20 min? (D) What is the half-life, t1/2, of the reaction? (e) Write the rate law for this reaction, including a value for k. (a) First, find the concentrations of C6H5N2Cl remaining at each time: time (min)N2(g) (mL) fraction N2 = mL/58.3 mL C6H5N2Cl (M) = 0.071×(1 – fraction) 00 0/58.3 = 0.00 0.071(1 – 0) = 0.071 310.8 10.8/58.3 = 0.185 0.071(1 – 0.185) = 0.058 619.3 19.3/58.3 = 0.331 0.071(1 – 0.331) = 0.047 926.3 26.3/58.3 = 0.451 0.071(1 – 0.451) = 0.039 1232.4 32.4/58.3 = 0.556 0.071(1 – 0.556) = 0.032 1537.3 37.3/58.3 = 0.640 0.071(1 – 0.640) = 0.026 1841.3 41.3/58.3 = 0.708 0.071(1 – 0.708) = 0.021 2144.3 44.3/58.3 = 0.760 0.071(1 – 0.760) = 0.017 2446.5 46.5/58.3 = 0.798 0.071(1 – 0.798) = 0.014 2748.4 48.4/58.3 = 0.830 0.071(1 – 0.830) = 0.012 3050.4 50.4/58.3 = 0.864 0.071(1 – 0.864) = 0.0097 ∞58.3 58.3/58.3 = 1.00 0.071(1 – 1.00) = 0.00 The plots are : (B) From the definition of percentage, (c) Again, using percentage definition and approximation t = 20 min using the t = 18 min and t = 21 min points, (D) The initial concentration of benzenediazonium chloride is 0.071 M, so the first half-life occurs when the concentration occurred at 0.0355 M. Use the graph from part(a) to give t1/2~10 min. (e) The order of the reaction can be determined by looking at the time of the second half-life, when the concentration of benzenzenediaum chloride was reduced to 1/2 of its initial value, 0.018 M. This happens at ~21 min, just twice the time for the first half of life. Since t1/2 is the same for the two different time intervals, it means that the reaction is first ordered. Percentage = K[C6H5N2Cl] Plotting ln [C6H5N2Cl] vs. t confirms this with the slope of the trace given the percentage constant, k. The slope of the vote = - 0.0664, so that = 0.0664 min -1. (This allows a better estimate of half the life to be t1/2=0.693/ki=0.693/0.0664=10.4 min.) 22. Hydroxide ion involves the mechanism, but not consumed in this reaction to aqueous solutions. OCl–(aq) + I–(aq) → OH– OI–(aq)+ (A) From the data in the table, determine the order of reaction with respect to OCl-, I-, and OH-, and the overall order. [OCl–] (M) [I-] (M) [OH–] (M) Rate of formation of OI– (mol L–1 s–1) 0.00400.0020 1.00 4.8×10–4 0.00200.0040 1.00 5.0×10–4 0.00200.0020 1.00 2.4×10–4 0.00200.0020 0.50 4.6×10–4 0.00200.0020 0.25 9.4×10–4 (b) Write the rate law, and determine the value of the rate constant, k. (c) Show that the following mechanism is consistent with the net equation and with the rate law. Which is the rate-determining stage? OCl –(aq) + H2O(l) → ← HOCL(aq) + OH -(aq)-I(aq) + HOCL(aq) → HOI(aq) + Cl –(aq HOI(aq) + OH -(aq) → H2O(l) + OI -(aq) (d) Is it appropriate to refer to the OH - as a catalyst to this reaction? Explain. (A) Use the initial percentage method for a general law rate = which [OCl–m[I][n[OH–]p. Experience 1 and 3 order the order of hypocrites ion (iodroxide and hydroxide are constant): doubling the concentration of hypocrites doubles the initial rate, meaning that the reaction is 1st order in hypocrites ion, i = 1. Experience 2 and 3 can be used to find the order of iodide ion (hypochlority and hydroxide are changed): duplicates concentration of iodide double the rate for the reaction is also the first order of iodide ion, n = 1. Experiments 3 and 4 can be used to find the order of hydroxide (hypochlority and iod are changed): doubling half the concentration, so the order of hydroxide must be -1, p = –1. Mathematically: The overall order is the sum of each individual order = 1 + 1 + -1 = 1 (b) Based on order found above, The percentage law is: The constant rate case using the Rate Act and the data: [OCl–](M)(M)[OH–](M) Percentage of OI– (mol L–1 s–1) 0.04 billion20.020 1.48× 0.00–00–0. 4 60.0 s–10.0020.00 1.00 5.0×10–4 62.5 s–10.0020.0020 1.00 2.4×10–460.0–1 0.02020.020 0.50 4.6×10–4 57.5 s–10.0020.0020 0.020.020.020 25.4×10–4 58.75s – 1 Constant average (at the correct number of important figures) = 60. s-1(c) first, add all the equations of the mechanism together to see if the stoichiometry of the mechanism is correct: OCl–(aq →) + H2O(l) + I–(aq) + HOCL (aq) + HOI(aq) + OH(aq) (aq) (aq) + HOC LL(aq)K)+OH-(aq)+HOI(aq)+Cl-(aq)+H2O(l)+OI–(aq) After eliminating common species: OCl–(aq)+I-(aq) → OI–(aq) + Cl–(aq) which is the correct stoicometry. To obtain the rate-determining step, consider the percentage law for each elementary reaction: Step 1, Forward reaction: Percentage = kforward [OCl–][H2O] Step 1, reverse reaction: Percentage = kreverse [HOCl][OH-] Step 2: Percentage = k2[I][HOCL] Step 3: Percentage = K3I[HOI][OH]Step 1, ahead there are not enough terms of the rate act. Step 1, reverse and Step 3 both have hydroxide in the numerator but the experimental law in the denominator. This left Step 2 as the step is likely to slow down, but this has an intermediary that must be eliminated using Step 1, suppose it to be a fast step: For step 1, Rateforward = Ratereverse is so kforward [OCl-][H2O]=kreverse[HOCl][OH-] Resolve for the intermediary, [HOCl] provided: This replacement of the law for step 2 , the proposed slow step, provided: Since the water is solvent, its concentration has not changed and should be grouped with the constants: This currently matched the experimental rate law. (D) Since hydroxide is found in the denominator of the rate law, an increase in concentrations slows the reaction down so OH – is an inibitor, not a catalyst. Compare handlers 3, 4, and 5 to see how to reduce the hydroxide to increase the reaction rate.rate.

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