Station 1

1.) What variable over time, of a chemical reaction, is measured to determine reaction rate?

A.) Concentrations of reactants over time

B.) Concentrations of products over time

C.) Neither A or B

D.) Both A & B

E.) Something else not mentioned here

2.) How does an increase in pressure affect the rate of a gas phase reaction?

A.) Rate is proportional to concentration.

B.) An increase in pressure will decrease the number of collisions between molecules thus reducing the reaction rate.

C.) There will be increased collisions because of the increase in pressure, thereby increasing reaction rate.

D.) Rate is inversely proportional to concentration.

E.) Both A & C

3.) The slope of the straight line connecting any two points in a concentration versus time graph is:

A.) The average rate over that period.

B.) Just a line on a graph

C.) The instantaneous rate

D.) The initial rate

E.) The final rate

4.) The slope of the line tangent to the curve for any point on a concentration versus time graph is:

A.) The initial rate

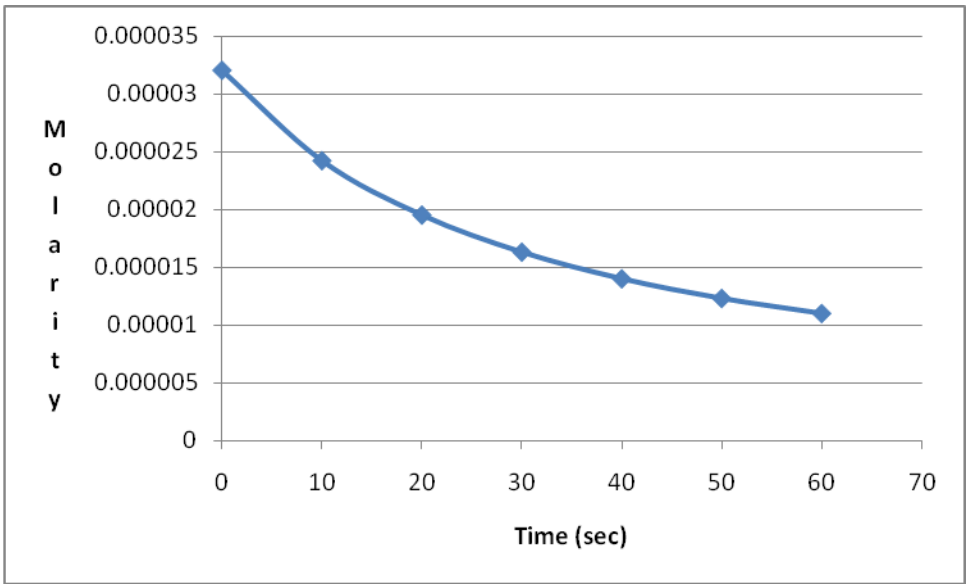
B.) The instantaneous rate

C.) The final rate

D.) The average rate

E.) The overall first order rate

Given the following graph :



Answer the following questions:

5.) The above graph shows:

A.) The reaction rate is constant over the 60 secs

B.) The reaction rate is changing with each 10sec interval

C.) The graph resembles a zero order reaction

D.) The graph resembles a ½ life reaction

E.) Both B & D

6.) The above graph shows:

A.) The formation of product

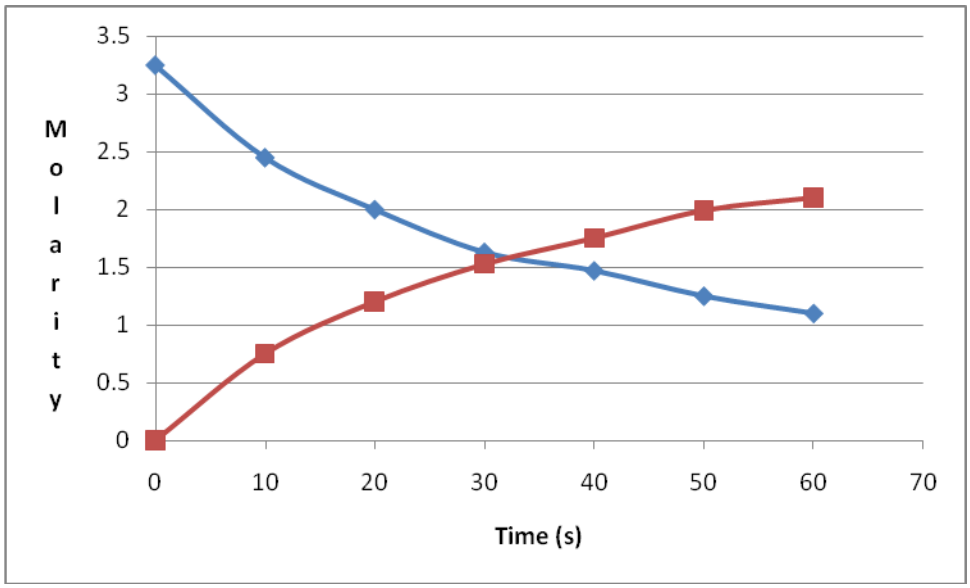
B.) The entire reaction

C.) The utilization of reactant

D.) A first order reaction

E.) A second order reaction

Given the following graph:



Answer the following questions:

7.) The curve shapes are nearly identical because

A.) The faster the reactant is used up the faster the product is formed

B.) The curve shapes are first order in reaction kinetics

C.) The curve shapes are identical because the reaction coefficients are identical

D.) Both A & C

E.) Both B & C

Given the following reaction & data:

$$A_{(g)} + B_{(g)} + C_{(g)} \rightarrow D_{(g)}$$

Experiment	Initial [A] (mol/L)	Initial [B] (mol/L)	Initial [C] (mol/L)	Initial Rate (mol/L·s)
1	0.0500	0.0500	0.1000	6.25×10^{-3}
2	**F**	**G**	0.1000	1.25×10^{-2}
3	0.1000	0.1000	**H**	5.00×10^{-2}
4	0.500	0.500	0.0200	6.25×10^{-3}

8.) What is the order with respect to reactant A?

A.) Zero order with respect to A

B.) First order with respect to A

C.) Second order with respect to A

D.) The order cannot be determined

E.) Third order with respect to A

9.) What is the order with respect to reactant B?

A.) Zero order with respect to B

B.) First order with respect to B

C.) Second order with respect to B

D.) Third order with respect to B

E.) The order cannot be determined

10.) What is the order with respect to reactant C?

A.) Zero order with respect to C

B.) First order with respect to C

C.) Second order with respect to C

D.) Third order with respect to C

E.) The order cannot be determined

11.) Given the following rxn: $4NO_{(g)} + 2O_{2(g)} \rightarrow 4NO_{2(g)}$ rate = $k[NO]^2[O_2]$

A.) First order in NO, first order in O_2, & second order overall

B.) First order in NO, second order in O_2, & third order overall

C.) Second order in NO, first order in O_2, & third order overall

D.) Second order in NO, second order in O_2, & fourth order overall

E.) Fourth order in NO, second order in O_2, & sixth order overall

12.) Given the following rxn: $CH_3CHO_{(g)} \rightarrow CH_{4(g)} + CO_{(g)}$ rate = $k[CH_3CHO]^{3/2}$

A.) First order in CH_3CHO, first order in CH_4, & third order overall

B.) First order in CH_3CHO, second order in CH_4, & third order overall

C.) 3/4th order in CH_3CHO, 3/4th order in CO, & 3/2 order overall

D.) 3/4th order in CH_4, 3/4th order in CO, & 3/2 order overall

E.) 3/2th order in CH_3CHO, & 3/2 order overall

13.) Given the following rxn: $H_2O_{2(aq)} + 3I^-_{(aq)} + 2H^+_{(aq)} \rightarrow I_3^-{}_{(aq)} + H_2O_{(l)}$ rate = $k[H_2O_2][I^-]$

A.) First order in H_2O_2, first order in I^-, & first order overall

B.) First order in H_2O_2, first order in I^-, & second order overall

C.) First order in H_2O_2, third order in I^-, & second order overall

D.) Sixth order in H_2O_2, second order in I^-, & eigth order overall

E.) Third order in H_2O_2, second order in I^-, & fifth order overall

14.) Given the following rxn: $5Br^-_{(aq)} + BrO_3^-{}_{(aq)} + 6H^+_{(aq)} \rightarrow 3Br_{2(l)} + 3H_2O_{(l)}$ rate = $k[Br^-][BrO_3^-][H^+]^2$

A.) First order in Br^-, first order in BrO_3^-, second order in H^+, & third order overall

B.) Fifth order in Br^-, first order in BrO_3^-, sixth order in H^+, & twelth order overall

C.) Fifth order in Br^-, third order in Br_2, sixth order in H^+, & fourteenth order overall

D.) Fifth order in Br^-, first order in BrO_3^-, sixth order in H^+, & eighteenth order overall

E.) First order in Br^-, first order in BrO_3^-, second order in H^+, & fourth order overall

Given the following, answer questions 15 & 16 :

ABC + D ←→AB + CD ΔH = -55 kJ/mol $E_{a(fwd)}$ = 215 kJ/mol Assume one step.

15.) Draw the reaction energy diagram. A box has been provided on your answer sheet.

16.) Calculate $E_{a(rev)}$ for this particular reaction in kJ/mol.

A.) 215 **B.)** - 55 **C.)** 160 **D.)** 270 **E.)** -160 **F.)** -270

Given the following, answer questions 17 & 18.

$A_2 + B_2$ → 2AB $E_{a(fwd)}$ = 125 kJ/mol $E_{a(rev)}$ = 85 kJ/mol Assume one step.

17.) Draw the reaction energy diagram. A box has been provided on your answer sheet.

18.) Calculate ΔH_{rxn}. In kJ/mol.

A.) 125 **B.)** 40 **C.)** 85 **D.)** – 40 **E.)** -125 **F.)** – 85

Given the following, answer questions 19 & 20.

$NO_{(g)} + Cl_{2(g)}$ → $NOCl_{(g)} + Cl_{(g)}$ $Ea_{(fwd)}$ = 86 kJ/mol ΔH = 83 kJ Assume one step.

19.) Draw the reaction energy diagram. A box has been provided on your answer sheet.

20.) Calculate $Ea_{(rev).}$

A.) 86 **B.)** -3 **C.)** 83 **D.)** – 86 **E.)** -83 **F.)** 3

Station #2

Write out the formula for the following ions.

21.) Nitrate
22.) Acetate
23.) Sulfite
24.) Ammonium
25.) Hydroxide

Write out the names of the following ions.

26.) SO_4^{2-}
27.) PO_4^{3-}
28.) NO_2^-
29.) HCO_3^-
30.) CO_3^{2-}

Use the equation below to answer the following questions.

$$\underset{\textbf{2.50g}}{\mathbf{NaHCO_3}} + \underset{\textbf{0.600M}}{\mathbf{HCl}} \rightarrow \mathbf{NaCl + CO_2 + H_2O}$$

31.) If you start with 2.50g of $NaHCO_3$, how much HCl at 0.600M is required to react with all the $NaHCO_3$?

a.) 84.0mL

b.) 126mL

c.) 17.9mL

d.) 49.6mL

32.) Based on 2.50g of $NaHCO_3$, how many moles of reactant is this?

a.) 2.98×10^{-3}

c.) 2.98×10^{-2}

b.) 0.000149

d.) 1.49×10^{-2}

33.) What is the theoretical yield of NaCl, if you start with 2.50g $NaHCO_3$?

a.) 0.696g

c.) 0.870g

b.) 1.74g

d.) 1.39g

34.) In front of you is a vial labeled "**A**". This is the product NaCl. Use the balance to weigh the product. How much was produced?

a.) 1.35g

c.) 1.55g

b.) 1.61g

d.) 1.47g

35.) What is the percent yield based on the amount you weighed?

a.) 84.5%

c.) 89.1%

b.) 92.5%

d.) 77.6%

Use the equation below to answer the following questions.

$$\underset{\textbf{3.79g}}{\mathbf{C_6H_5CHCHCO_2H}} + \underset{\textbf{0.500M}}{\mathbf{Br_2}} \rightarrow \mathbf{CO_2HCHBrCHBrC_6H_5}$$

36.) If you start with 3.79g of $C_6H_5CHCHCO_2H$, how much Br_2 at 0.500M is required to react with all the $C_6H_5CHCHCO_2H$?

a.) 41.2mL

c.) 61.2mL

b.) 51.2mL

d.) .0512mL

37.) Based on 3.79g of $C_6H_5CHCHCO_2H$, how many moles of reactant is this?

a.) $1.28x\ 10^{-3}$

c.) 2.56×10^{-2}

b.) 0.000256

d.) 1.28×10^{-2}

38.) What is the theoretical yield of $CO_2HCHBrCHBrC_6H_5$, if you start with 3.79g $C_6H_5CHCHCO_2H$?

a.) 0.787g

c.) 0.870g

b.) 1.74g

d.) 7.87g

39.) In front of you is a vial labeled "**B**". This is $CO_2HCHBrCHBrC_6H_5$. Use the balance to weigh the product. How much was produced?

a.) 5.20g

c.) 1.55g

b.) 2.50g

d.) 1.47g

40.) What is the percent yield based on the amount you weighed?

a.) 88.5%

c.) 66.1%

b.) 59.9%

d.) 77.6%

Please use the following equation(s) and/or information for questions 41 through 46.

$$BaCO_{3(s)} + CuO_{(s)} + Y_2O_{3(s)} \rightarrow YBa_2Cu_3O_{6.5(s)} + CO_{2(g)}$$

$$YBa_2Cu_3O_{6.5(s)} + O_{2(g)} \rightarrow YBa_2Cu_3O_{7(s)}$$

Please use the following equation(s) and /or information for questions 47 through 50.

$K_2Zr(C_2O_4)_3(H_2C_2O_4)\cdot H_2O$ was synthesized from $ZrOCl_2\cdot 8H_2O$ with $H_2C_2O_4\cdot 2H_2O$ & excess KOH.

$$ZrOCl_2\cdot 8H_2O_{(s)} + H_2C_2O_4\cdot 2H_2O_{(s)} + KOH_{(aq)} \rightarrow K_2Zr(C_2O_4)_3(H_2C_2O_4)\cdot H_2O_{(s)} + KCl_{(aq)} + H_2O_{(l)}$$

41.) Balance the equation by writing ONLY the coefficients on your answer sheet.

42.) If you have 1.60g of $BaCO_3$, 2.50g CuO, and 5.25g Y_2O_3, which is limiting the production of $YBa_2Cu_3O_7$ and how many moles of product would you get?

43.) What is the theoretical yield?

A) 5.60g	**B)** 16.40g	**C)** 2.70g
D) 13.8g	**E)** 8.22g	**F)** 10.0g

44.) How much CuO remains?

A) 9.27 **B)** 6.10 **C)** 4.88

D) 7.45 **E)** 1.53 **F)** 3.00

45.) What is the percent yield if the product produced is in the vial labeled "**C**"?

46.) What percentage of Y_2O_3 remains?

A) 8.76 **B)** 17.5 **C)** 26.3

D) 91.2 **E)** 82.5 **F)** 73.7

47.) Write the coefficients which would balance the equation on your answer sheet.

48.) If vial "**D**" is the Zr compound, vial "**E**" is $H_2C_2O_4 \cdot 2H_2O$, and you have 4.95g of KOH, which is limiting?

A) $ZrOCl_2 \cdot 8H_2O_{(s)}$ **B)** $H_2C_2O_4 \cdot 2H_2O_{(s)}$ **C)** KOH

D) $K_2Zr(C_2O_4)_3(H_2C_2O_4) \cdot H_2O_{(s)}$ **E)** KCl **F)** H_2O

49.) What is the theoretical amount possible, all things considered constant?

A) 12.0 **B)** 6.17 **C)** 5.58

D) 6.00 **E)** 2.79 **F)** 3.09

50.) If the amount produced was measured as 12.0 grams, then what would be the percent yield?

A) 215 **B)** 111 **C)** 100

D) 108 **E)** 50.0 **F)** 55.4

Station 3

Given the following reaction and data table, answer the following questions.

$$\mathbf{CO_{(g)} + Cl_{2(g)} \rightarrow COCl_{2(g)}}$$

Experiment	Initial [CO] (mol/L)	Initial [Cl_2] (mol/L)	Initial Rate (mol/L·s)
1	**I**	0.100	1.29×10^{-29}
2	0.100	0.100	1.33×10^{-30}
3	**J**	1.00	1.30×10^{-29}
4	**K**	0.0100	1.32×10^{-31}

51.) What is the order with respect to CO?

A.) Zero order with respect to CO

B.) First order with respect to CO

C.) Second order with respect to CO

D.) Third order with respect to CO

E.) The order cannot be determined

52.) What is the order with respect to Cl_2?

A.) Zero order with respect to Cl_2

B.) First order with respect to Cl_2

C.) Second order with respect to Cl_2

D.) Third order with respect to Cl_2

E.) The order cannot be determined

53.) What is the rate law for the formation of $COCl_2$?

A.) rate = $k[CO]^1[Cl]^2$

B.) rate = $k[CO]^2[Cl_2]^1$

C.) rate = $k[CO][Cl_2]$

D.) rate = $k[CO]^2[Cl_2]^2$

E.) rate = $k[COCl_2]^2$

54.) Calculate the average value for the rate constant.

A.) 1.31×10^{-28}

B.) 1.27×10^{-28}

C.) 1.35×10^{-28}

D.) 1.28×10^{-28}

E.) 1.34×10^{-28}

55.) If the integrated rate law is of the form: $\mathbf{\ln[A]_t = -kt + \ln[A]_0}$, this is the form for:

A.) Zero order rate reaction

B.) First order rate reaction

C.) Second order rate reaction

D.) y = mx + b

E.) B & D

F.) None of the above

56.) If the integrated rate law is of the form: $\mathbf{(1/[A]_t) = kt + (1/[A]_0)}$ **,** this is the form for:

A.) Zero order rate reaction

B.) First order rate reaction

C.) Second order rate reaction

D.) y = mx + b

E.) None of the above

F.) C & D

57.) If the integrated rate reaction is of the form: $\mathbf{[A]_t = -kt + [A]_0}$ this is the form for:

A.) None of the following

B.) Zero order rate reaction

C.) First order rate reaction

D.) B & E

E.) y = mx + b

F.) Second order rate reaction

58.) The plot for any integrated rate law yields:

A.) A graph resembling a straight line

B.) A graph resembling exponential growth

C.) A graph resembling exponential decay

D.) A graph resembling ½-life of reactants

E.) There is no plot for an integrated rate reaction

F.) A graph of products vs. time

59.) Consider the Arrhenius equation: $\mathbf{k = Ae^{(-Ea/RT)}}$. The larger the value is for Ea, the larger the value of k and the faster the reaction.

A.) True

B.) False

C.) No way to calculate

D.) No way to measure

E.) Irrelevant

60.) Catalysts are used to decrease Ea, this causes A to go down & k to inversely go up.

A.) This cannot be measured

B.) Maybe

C.) False

D.) True

E.) This cannot be calculated

61.) How does the central idea of collision theory explain the effect of concentration on reaction rate?

A.) This cannot be measured or explained

B.) Maybe one has to do with the other

C.) The rate depends on the dividend of reactant concentrations

D.) The rate depends on the product or reactant concentration

E.) The rate depends on the slope of the line

62.) Collision frequency is the only factor which affects the reaction rate.

A.) False

B.) True

C.) Maybe

D.) This cannot be measured

E.) This cannot be calculated

63.) Arrhenius suggested that each reaction has an energy limit which must be reached in order for the particles to react. The kinetic theory of gases also suggests that the average kinetic energy of the particles is proportional to

A.) The average pressure

B.) Ideal gas behavior

C.) The absolute pressure

D.) The average temperature

E.) None of the above

F.) The absolute temperature

64.) For a given reaction with a specific E_a, how would an increase in temperature affect the rate?

A.) This cannot be measured

B.) There would be no effect

C.) There would be an increase in reaction rate

D.) Reaction rate is inversely proportional to temperature

E.) There would be a decrease in reaction rate

65.) For a specific chemical reaction at a particular temperature, how does a decrease in E_a, affect the rate?

A.) There would be an increase in reaction rate

B.) Reaction rate is inversely proportional to E_a

C.) This cannot be measured

D.) There would be no effect

E.) There would be a decrease in reaction rate

66.) For the reaction **AB + CD ←→ EF** & there is $4x10^{-5}$ mol of AB colliding with $4x10^{-5}$ mol of CD, will $4x10^{-5}$ mol of EF form?

A.) Yes, there is the same amount of each reactant

B.) No, rxn is reversible & will reach a state where forward = reverse rates so []'s = 0.

C.) Some reactants are reformed from EF so final EF amount will be less than $4x10^{-5}$ mol

D.) No, rxn is reversible & will reach a state where forward = reverse rates so []'s ≠ 0.

E.) C & D

67.) Assume activation energies are equal, choose the correct statement(s) based upon, which of the following reactions will occur at a higher rate at the same heightened temperature?

(1) $NH_{3(g)} + HCl_{(g)} \rightarrow NH_4Cl_{(s)}$

(2) $N(CH_3)_{3(g)} + HCl_{(g)} \rightarrow (CH_3)_3NHCl_{(s)}$

A.) Both reactions will have the same average kinetic energy

B.) Reactants will have the same velocity

C.) HCl collisions with correct orientation are more likely to occur with ammonia

D.) HCl collisions with proper orientation are less likely to occur with trimethylamine

E.) All of the above

F.) Only A, C, & D are correct

68.) The rate constant of a reaction $4.7 \times 10^{-3}\ s^{-1}$ at 25°C and the activation energy is 33.6kJ/mol. What is k at 75°C?

A.) $0.066\ s^{-1}$ **B.)** $0.033\ s^{-1}$ **C.)** $0.132\ s^{-1}$ **D.)** $0.099\ s^{-1}$ **E.)** $0.165\ s^{-1}$ **F.)** $0.198\ s^{-1}$

69.) The rate constant of a reaction is 4.50×10^{-5} L/mol·s at 195°C and 3.2×10^{-3} L/mol·s at 258°C. What is the activation energy of the reaction?

A.) 4.2×10^4 J/mol

B.) 2.8×10^4 J/mol

C.) 1.40×10^5 J/mol

D.) 4.2×10^5 J/mol

E.) 2.8×10^5 J/mol

F.) 1.40×10^4 J/mol

70.) For a particular first order reaction, the rate constant is 0.76/s at 727°C and 0.87/s at 757°C. What is the activation energy of this reaction?

A.) 1.17×10^5 J/mol

B.) 7.8×10^4 J/mol

C.) 11.7×10^4 J/mol

D.) 3.90×10^4 J/mol

E.) 2.8×10^5 J/mol

F.) 1.95×10^4 J/mol

Station 4

Given the following equation: **aA + bB → cC + dD**, answer questions 71-73.

71.) Given the equation above & rate = $k[A]^m[B]^n$. What is the meaning of k?

A.) k is the rate constant

B.) k is just a number

C.) k is the proportionality constant

D.) k is reaction and temperature specific

E.) All of the above

72.) What are m & n?

A.) m represents the order of the reaction with respect to [A]

B.) m & n are not necessarily the same as their stoichiometric coefficients in a balanced equation

B **C.)** n represents the order of the reaction with respect to [B]

D.) A, B, & C

E.) None of the above

73.) If the reaction is 1^{st} order in A & 2^{nd} order in B, & time is measured in min, what are the units of k?

A.) $L^3/mol^3 \cdot sec^2$

B.) $L^2/mol^2 \cdot min$

C.) L/mol·sec

D.) $L^2/mol^2 \cdot min^2$

E.) $L/mol \cdot sec^2$

Given the following equation: $NO_{2(g)} + CO_{(g)} \rightarrow NO_{(g)} + CO_{2(g)}$ and the table below:

Experiment	Int. Rate	Int. [NO_2]	Int. [CO]
1	0.0050	**L**	0.10
2	0.080	0.40	0.10
3	0.0050	0.10	**M**

Answer questions 74-77.

74.) What is the reaction order in NO_2?

A.) Zero order

B.) Cannot be calculated

C.) First order

D.) Concentrations are the same

E.) Second order

75.) What is the reaction order in CO?

A.) Zero order

B.) Cannot be calculated

C.) First order

D.) Concentrations are the same

E.) Second order

76.) The rate law for the above reaction is:

A.) $k[NO]^0[CO_2]^0$

B.) k

C.) $k\ [NO_2]^2$

D.) $k[NO]^1[CO_2]^2$

E.) $k[NO_2]^2[CO]^0$

F.) C & E

77.) What is the reaction order overall?

A.) Zero order

B.) First order

C.) Second order

D.) Third order

E.) Fourth order

Given: $\mathbf{O_{2(g)} + 2NO_{(g)} \rightarrow 2NO_{2(g)}}$

Experiment	Int. $[O_2]$	Int. [NO]	Int. Rate
1	0.0110	**N**	0.00321
2	0.0220	**O**	0.00640
3	0.0110	0.0260	0.01280
4	**P**	0.0130	0.00960
5	**Q**	0.0390	0.02880

Answer questions 78-80.

78.) The reaction order with respect to O_2 is:

A.) Zero order

B.) First order

C.) Second order

D.) Third order

E.) Fourth order

79.) The reaction order with respect to NO is:

A.) Zero order

B.) First order

C.) Second order

D.) Third order

E.) Fourth order

80.) Reaction orders cannot be deduced from a balanced chemical equation.

A.) True

B.) Science hasn't figured this out yet

C.) False

D.) Balanced equations and rates are the same

E.) Coefficients from balanced equations are the rate exponents

81.) A substance reacts according to a first order rate law and has $k = 5.0 \times 10^{-5}\ s^{-1}$. If the initial [A] = 1.00M, what is the rate after one hour?

A.) 2.1×10^{-3} M/s

B.) 0.835 M/s

C.) 4.2×10^{-5} M/s

D.) 2.1×10^{-5} M/s

E.) 8.35×10^{-3} M/s

F.) 4.2×10^{-4} M/s

82.) A particular substance reacts according to first order rate law, $k = 5.0 \times 10^{-5}\ s^{-1}$. What is the rate after three and a half hours if the substance started out as 1.00M?

A.) 1.00×10^{-5} M/s **B.)** 1.33×10^{-5} M/s **C.)** 2.00×10^{-5} M/s **D.)** 2.66×10^{-5} M/s

E.) 3.00×10^{-5} M/s **F.)** 3.33×10^{-5} M/s

Consider the reaction : $I^- + ClO^- \rightarrow IO^- + Cl^-$

83.) The above reaction occurs at 25°C, its second order rate reaction constant is $6.06 \times 10^{-2}\ M^{-1}\ s^{-1}$. If the solution is initially 3.50×10^{-3} M with respect to each reactant, what will be the [ ]'s of each species after 5 minutes?

A.) 3.30×10^{0} M/s **B.)** 3.03×10^{-2} M/s **C.)** 3.30×10^{-5} M/s **D.)** 3.03×10^{2} M/s

E.) 3.00×10^{-5} M/s **F.)** 3.29×10^{-3} M/s

84.) For a non-equilibrium process where A + B → products, the rate is first order with respect to A and second order with respect to B. If 1.0 mol of each reactant were introduced in a 1.0L vessel, and the initial rate was 1.0×10^{-2} mol/L·sec, calculate the rate when exactly half of the reactants are now products.

A.) 1.02×10^{0} M/s **B.)** 1.12×10^{-2} M/s **C.)** 1.21×10^{-5} M/s **D.)** 1.20×10^{-3} M/s

E.) 1.02 x 10^{-5} M/s **F.)** 1.12 x 10^{-3} M/s

Consider the following reaction : $PtCl_4^{2-} + H_2O \rightarrow Pt(H_2O)Cl_3^- + Cl^-$

The above reaction was observed kinetically from both directions at 25°C, 0.30 ionic strength, and at equilibrium;

$$-(\Delta[PtCl_4^{2-}]/\Delta t) = (3.9x10^{-5}s^{-1})[PtCl_4^{2-}]-(2.1x10^{-3}L/mol{\cdot}s^{-1})[Pt(H_2O)Cl_3^-][Cl^-]$$

85.) What is **$\Delta[PtCl_4^{2-}]$ with respect to time at equilibrium?**

A.) 0 **B.)** 0.3 **C.)** 0.5 **D.)** 1 **E**.) 1.33 **F.)** 2

86.) What is K_4 for the above reaction?

A.) 1.9x10^{-2} **B.)** 8.2x10^{-8} **C.)** 2.7x10^{0} **D.)** 3.7x10^{-4}

E.) 5.4x10^{1} **F.)** 1.4x10^{3}

87.) Calculate the time required for a first order reaction where k = 5.00 x $10^{-2}s^{-1}$ to proceed to 99% completion.

A.) 4.5sec **B.)** 9.6sec **C.)** 23sec **D.)** 29ec

E.) 46sec **F.)** 92sec

88.) Find the first order rate constant for a reaction which is sixty-six and six tenths percent complete in 1.0 x 10^{-2} secs.

A.) 17.7 L/mol·s **B.)** 40.6 s^{-1} **C.)** 17.7 mol/s **D.)** 40.6 L/mol·s

E.) 17.7 s^{-1} **F.)** 40.6 mol/s

89.) If a reaction were 17.7% complete in ten minutes, what would the first order rate constant be?

A.) 1.73x10^{-1} L/mol·s **B.)** 7.52x10^{-2} s^{-1} **C.)** 2.89x10^{-3} 1/s **D.)** 1.73x10^{-3} 1/s

E.) 7.52x10^{-2} L/mol·s **F.)** 2.89x10^{2} mol/s

90.) A reaction takes eight and eighty-six hundredths of a nanosecond to be sixty-six and six tenths percent complete. What is the rate constant? **(1.00 sec = 1.00x10^{9} nanoseconds)**

A.) 4.06x10^{1} L/mol·s **B.)** 2.29x10^{2} s^{-1} **C.)** 4.59x10^{5} mol/s

D.) $4.06 \times 10^{5}\ s^{-1}$ **E**.) 4.59×10^{7} 1/s **F.)** 2.29×10^{2} mol/s

Station 5

Reaction rate is expressed in terms of changes in concentration of reactants & products. Write a balanced equation for the following:

91.) Rate = $-1/2\ (\Delta[N_2O_5]/\Delta t) = ¼\ (\Delta[NO_2]/\Delta t) = (\Delta[O_2]/\Delta t)$

92.) Rate = $-(\Delta[CH_4]/\Delta t) = -1/2\ (\Delta[O_2]/\Delta t) = ½\ (\Delta[H_2O]/\Delta t]) = (\Delta[CO_2]/\Delta t)$

Write the rate expression for the following:

93.) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

94.) $3O_{2(g)} \rightarrow 2O_{3(g)}$

95.) With respect to question 94, in a particular instant, the reaction rate in terms of $[O_2]$ is $2.17x10^{-5}$ mol/L·s. What is it in terms of $[O_3]$?

Given the following: $\mathbf{2AX_{2(g)} \rightarrow 2AX_{(g)} + X_{2(g)}}$ & the experimental data:

Time (secs)	**$[AX_2]$**
0.0	0.0500
2.0	0.0448
6.0	0.0300
8.0	0.0249
10.0	0.0209
20.0	0.0088

96.) Write the rate expression.

97.) Calculate the average rate for the overall reaction.

98.) Graph the Data

99.) Is the initial rate higher or lower than the average rate?

100.) Why? (1-2 sentence maximum!!)

For questions 101 – 105, calculate the number of lifetimes required for a pseudo-first-order reaction to achieve the following levels of completion:

101.) 10.0%

A.) 0.0460 **B.)** 0.0590 **C.)** 0.0920 **D.)** 0.105 **E.)** 0.151 **F.)** 0.210

102.) 50.0%

A.) 0.173 **B.)** 0.347 **C.)** 0.693 **D.)** 0.866 **E.)** 1.04 **F.)** 1.21

103.) 90.0%

A.) 0.072 **B.)** 0.144 **C.)** 0.288 **D.)** 0.576 **E.)** 1.15 **F.)** 2.30

104.) 99.0%

A.) 4.61 **B.)** 6.91 **C.)** 9.21 **D.)** 11.5 **E.)** 13.8 **F.)** 16.1

105.) 99.99%

A.) 4.61 **B.)** 6.91 **C.)** 9.21 **D.)** 11.5 **E.)** 13.8 **F.)** 16.1

Balance the following equations by writing just the coefficients on your answer sheet!!

106.) ___ $Cu_{(s)}$ + ___ $S_{8(s)}$ → ___ $Cu_2S_{(s)}$

107.) ___ $C_8H_{18(l)}$ + ___ $O_{2(g)}$ → ___ $CO_{2(g)}$ + ___ $H_2O_{(l)}$

108.) ___ $I^-_{(aq)}$ + ___ $O_{2(g)}$ + ___ $H_2O_{(l)}$ → ___ $I_{2(s)}$ + ___ $OH^-_{(aq)}$

109.) __ $KMnO_{4(aq)}$ + __ $NaNO_{2(aq)}$ + __ $H_2O_{(l)}$ →__ $MnO_{2(s)}$ + __ $NaNO_{3(aq)}$ + __ $KOH_{(aq)}$

110.) ___ $KOH_{(aq)}$ + ___ $H_2O_{2(aq)}$ + ___ $Cr(OH)_{3(s)}$ → ___ $K_2CrO_{4(aq)}$ + ___ $H_2O_{(l)}$

111.) __ $Mn^{2+}_{(aq)}$ +__ $Br_{2(l)}$ + __$H_2O_{(l)}$ →__$MnO^{4-}_{(aq)}$ + __$Br^-_{(aq)}$ + __$H^+_{(aq)}$

112.) __$Cr_2O_7^{2-}{}_{(aq)}$ + __$Cd_{(s)}$ + __$H^+_{(aq)}$ →__$Cr^{3+}_{(aq)}$ + __$Cd^{2+}_{(aq)}$ + __$H_2O_{(l)}$

113.) __$AgCl_{(s)}$ + __$NO_{(g)}$ + __$H_2O_{(l)}$ →__$Ag_{(s)}$ + __$Cl^-_{(aq)}$ +__$NO_3^-{}_{(aq)}$ + __$H^+_{(aq)}$

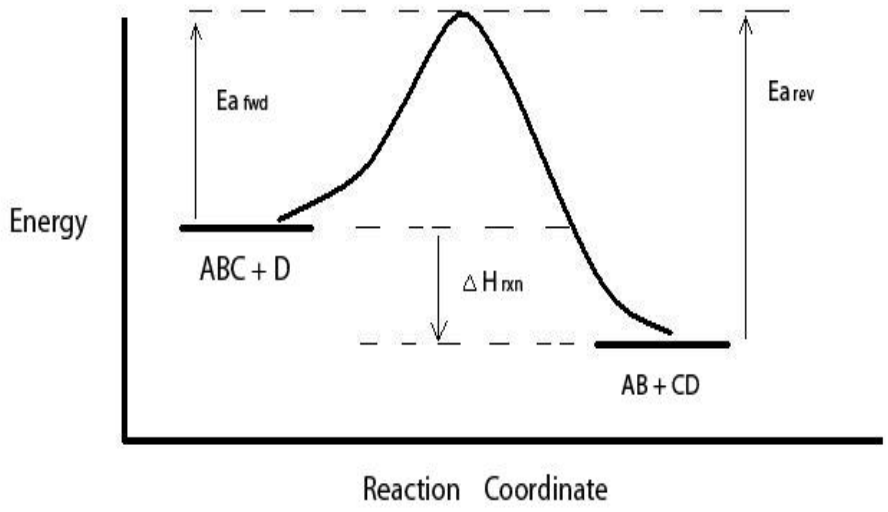
114.) __$H_2O_{2(aq)}$ + __$Ni^{2+}_{(aq)}$ →__$H^+_{(aq)}$ + __$O_{2(g)}$ + __$Ni_{(s)}$

115.) $__Cu^{+}_{(aq)} + __PbO_{2(s)} + __H^{+}_{(aq)} + __SO_4^{2-}{}_{(aq)} \rightarrow __Cu^{2+}_{(aq)} + __PbSO_{4(s)} + __H_2O_{(l)}$

Chem Lab Key

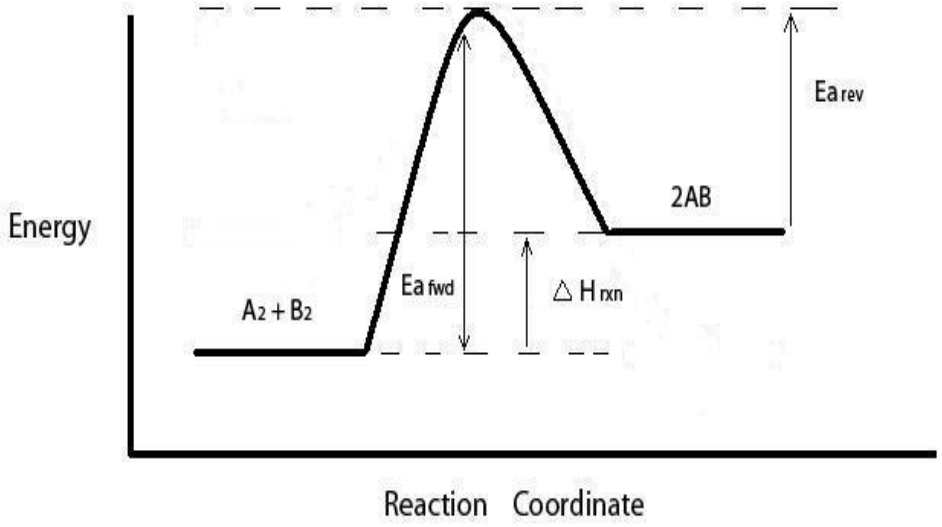
1	A	B	C	**D**	E	F
2	A	B	C	D	**E**	F
3	**A**	B	C	D	E	F
4	A	**B**	C	D	E	F
5	A	B	C	D	**E**	F
6	A	B	**C**	D	E	F
7	A	B	C	**D**	E	F
8	A	**B**	C	D	E	F
9	A	B	**C**	D	E	F
10	**A**	B	C	D	E	F
11	A	B	**C**	D	E	F
12	A	B	C	D	**E**	F
13	A	**B**	C	D	E	F
14	A	B	C	D	**E**	F

15



16	A	B	C	**D**	E	F

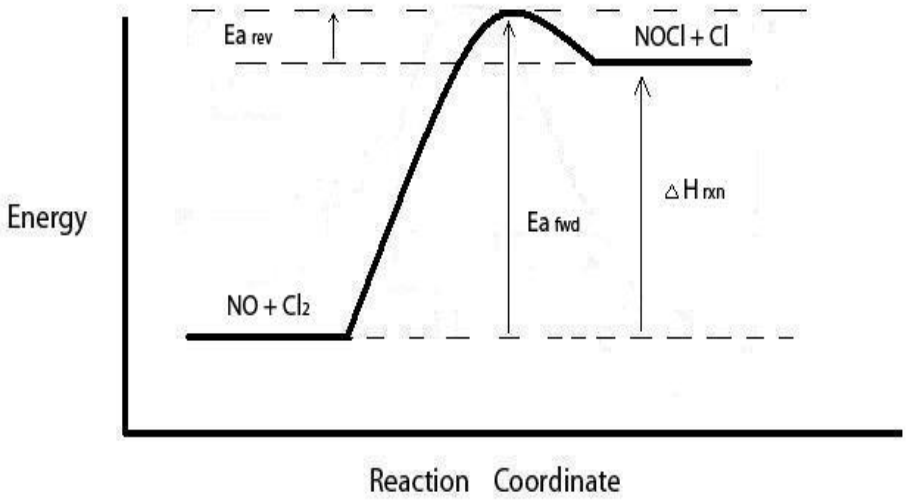
17



18

A	B	C	D	E	F

19



20

A	B	C	D	E	F

21 NO_3^-

22 CH_3COO^-

23 SO_3^{2-}

24	NH_4^+
25	OH^-
26	sulfate
27	phosphate
28	nitrite
29	bicarbonate
30	carbonate

31	A	B	C	**D**	E	F
32	A	B	**C**	D	E	F
33	A	**B**	C	D	E	F
34	A	B	C	**D**	E	F
35	**A**	B	C	D	E	F
36	A	**B**	C	D	E	F
37	A	B	**C**	D	E	F
38	A	B	C	**D**	E	F
39	**A**	B	C	D	E	F
40	A	B	**C**	D	E	F

41 8,12,2,4,8,4,1,4 // 4,6,1,2,4,2,0.5,2

42 BaCO3 & 0.00405 moles

43	A	B	**C**	D	E	F
44	A	B	C	D	**E**	F

45 63.00%

46	A	B	C	**D**	E	F

47 1,4,4,1,2,1,4

48	A	**B**	C	D	E	F
49	A	B	**C**	D	E	F
50	**A**	B	C	D	E	F

51	A	**B**	C	D	E	F
52	A	**B**	C	D	E	F
54	A	B	**C**	D	E	F
54	**A**	B	C	D	E	F
55	A	B	C	D	**E**	F
56	A	B	C	D	E	**F**
57	A	B	C	**D**	E	F
58	**A**	B	C	D	E	F
59	A	**B**	C	D	E	F
60	A	B	**C**	D	E	F
61	A	B	C	**D**	E	F
62	**A**	B	C	D	E	F
63	A	B	C	D	E	**F**
64	A	B	**C**	D	E	F
65	**A**	B	C	D	E	F
66	A	B	C	D	**E**	F
67	A	B	C	D	E	**F**
68	A	**B**	C	D	E	F
69	A	B	**C**	D	E	F
70	A	B	C	**D**	E	F
71	A	B	C	D	**E**	F
72	A	B	C	**D**	E	F
73	A	**B**	C	D	E	F
74	A	B	C	D	**E**	F
75	**A**	B	C	D	E	F
76	A	B	C	D	E	**F**
77	A	B	**C**	D	E	F
78	A	**B**	C	D	E	F
79	A	B	**C**	D	E	F
80	**A**	B	C	D	E	F
81	A	B	**C**	D	E	F
82	A	B	C	**D**	E	F
83	A	B	C	D	E	**F**
84	A	B	C	**D**	E	F
85	**A**	B	C	D	E	F

86	A	B	C	D	**E**	F
87	A	B	C	D	E	**F**
88	A	**B**	C	D	E	F
89	A	B	**C**	D	E	F
90	A	B	C	D	**E**	F

91 $2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$

92 $CH_{4(g)} + 2O_{2(g)} \rightarrow 2H_2O_{(g)} + CO_{2(g)}$

93 rate = $-(\Delta[N_2]/\Delta t) = -1/3(\Delta[H_2]/\Delta t) = 1/2(\Delta[NH_3]/\Delta t)$

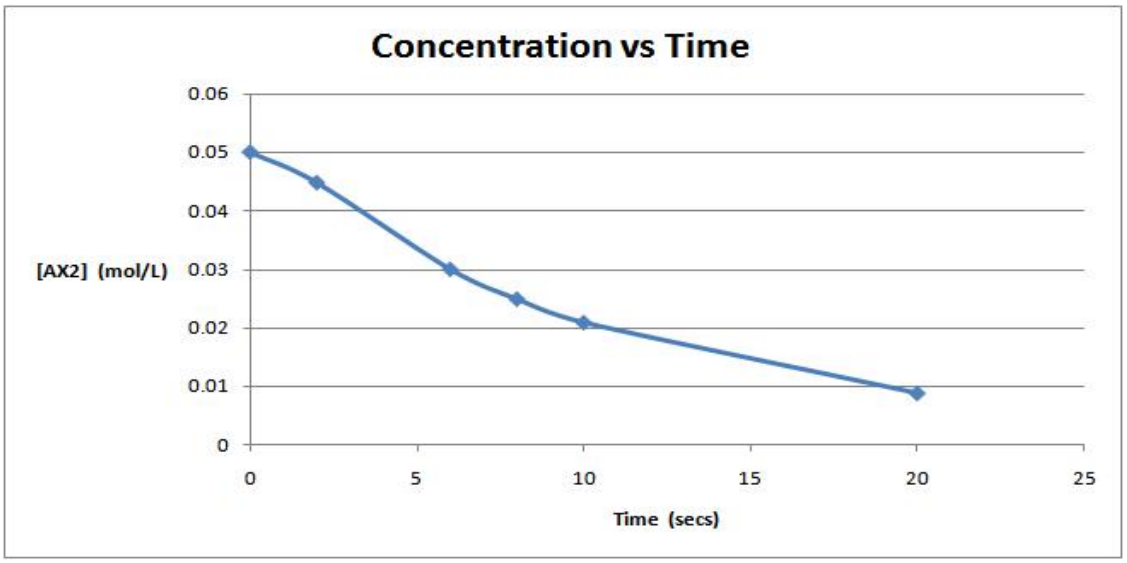
94 rate = $-1/3(\Delta[O_2]/\Delta t) = 1/2(\Delta[O_3]/\Delta t)$

95 1.45×10^{-5} mol/L·s

96 rate = $-1/2(\Delta[AX_2]/\Delta t)$

97 0.0010 mol/s or 1.0×10^{-3} mol/s

98



99 Higher

100	The rate decreases as [reactants] decreases
	or direct relationship between rate & reactant [ ] 's

101	A	B	C	**D**	E	F
102	A	B	**C**	D	E	F
103	A	B	C	D	E	**F**
104	**A**	B	C	D	E	F
105	A	B	**C**	D	E	F

106	16 , 1 , 8
107	2 , 25 , 16 , 18
108	4 , 1 , 2 , 2 , 4
109	2 , 3 , 1 , 2 , 3 , 2
110	4 , 3 , 2 , 2 , 8
111	2 , 5 , 8 , 2 , 10 , 16
112	1 , 3 , 14 , 2 , 3 , 7
113	3 , 1 , 2 , 3 , 3 , 1 , 4
114	1 , 1 , 2 , 1 , 1
115	2 , 1 , 4 , 1 , 2 , 1 , 2