AHL Worksheet – Chapter 6

1 Consider the following data for the reaction:

$A + 2B \rightarrow C$

Experiment	[A] / mol dm^{-3}	[B] / mol dm^{-3}	Rate / mol dm^{-3} s^{-1}
1	0.400	0.100	2.50×10^{-3}
2	0.400	0.200	5.00×10^{-3}
3	0.200	0.200	2.50×10^{-3}

a Deduce the order of reaction with respect to A and with respect to B. [4]

b What is the overall order of reaction? [1]

c Work out a value for the rate constant of this reaction with units. [3]

d What will be the rate of reaction when the concentration of A is 0.100 mol dm^{-3} and that of B is 0.0500 mol dm^{-3}? [1]

2 Consider the following data for the reaction:

$2X + Y \rightarrow 2Q + B$

Experiment	[X] / mol dm^{-3}	[Y] / mol dm^{-3}	Rate / mol dm^{-3} s^{-1}
1	2.20×10^{-3}	4.40×10^{-3}	1.28×10^{-5}
2	6.60×10^{-3}	4.40×10^{-3}	1.15×10^{-4}
3	8.80×10^{-3}	8.80×10^{-3}	2.05×10^{-4}

a Work out the order of reaction with respect to X. [2]

b Work out the order of reaction with respect to Y. [3]

c What is the rate expression for the reaction. [1]

d Work out a value with units of k, the rate constant, for this reaction. [3]

e What is the rate of reaction when the concentration of X and Y are both 2.20×10^{-2} mol dm^{-3}? [1]

3 **a** Write down the expression for the Arrhenius equation. [1]

b State the effect of increasing the temperature on the value of the rate constant. [1]

c Use the following data to calculate a value for the activation energy for the reaction:

$A + B \rightarrow C$ [5]

T / K	k / s^{-1}
300	0.0000174
350	0.000229
400	0.00158
450	0.00713
500	0.0237

T / K	k / s^{-1}
550	0.0636
600	0.144
650	0.289
700	0.524

The value of the gas constant is 8.31 J K^{-1} mol^{-1}.

4 For each of the following mechanisms give the overall stoichiometric equation for the reaction and the rate equation: [6]

a $C + A \rightarrow Y + B$ SLOW

$C + Y \rightarrow D$ FAST

b $B + P \rightarrow X + C + E$ FAST

$P + X \rightarrow S$ SLOW

c $D + D \rightarrow Z + Y$ FAST

$P + Z \rightarrow S + T$ SLOW

$P + S \rightarrow X$ FAST

5 The rate of the reaction:

$$H_2O_2(aq) + 2H^+(aq) + 2I^-(aq) \rightarrow 2H_2O(l) + I_2(aq)$$

may be measured by determining how long it takes to produce a certain amount of iodine. The results of a series of experiments in which the concentration of the iodide ion was varied are shown below. (All other concentrations remained constant.)

Concentration of I^-(aq)	Time / s
0.100	24
0.080	30
0.060	39

Concentration of I^-(aq)	Time / s
0.040	58
0.020	120

Plot a graph of rate ($\propto$ 1/time) against concentration of I^-(aq) and use this to determine the order of reaction with respect to I^-(aq). [5]

6 Hydrogen peroxide decomposes according to the equation:

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

Concentration of hydrogen peroxide solution / mol dm^{-3}	**Rate of reaction / mol dm^{-3} s^{-1}**
0.04	2.9×10^{-5}
0.08	5.9×10^{-5}
0.12	8.9×10^{-5}
0.16	1.21×10^{-4}
0.20	1.51×10^{-4}
0.24	1.77×10^{-4}

a Use a graphical method to determine: [7]

i the order of reaction with respect to hydrogen peroxide at this temperature and

ii the rate constant at this temperature.

b Explain the effect of introducing a catalyst on the value of the rate constant. [2]

c A student suggested that this data shows that the decomposition of hydrogen peroxide occurs via a simple single-step mechanism whereby two hydrogen peroxide molecules collide in the rate-determining step. Comment on this hypothesis. [2]