Better Rate Than Never!

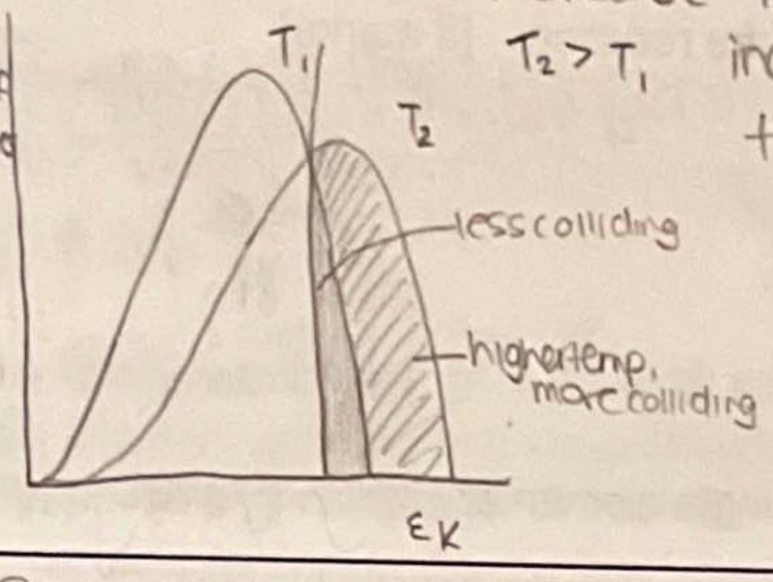
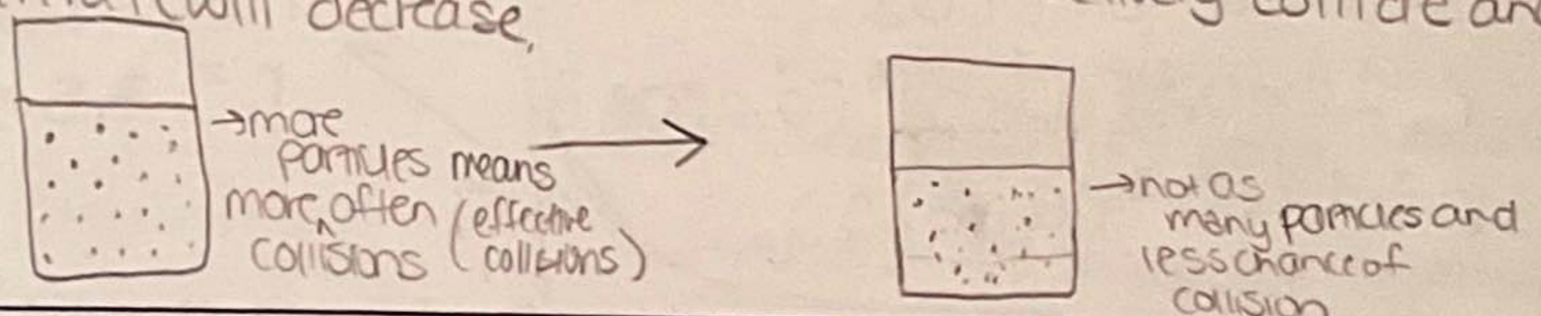
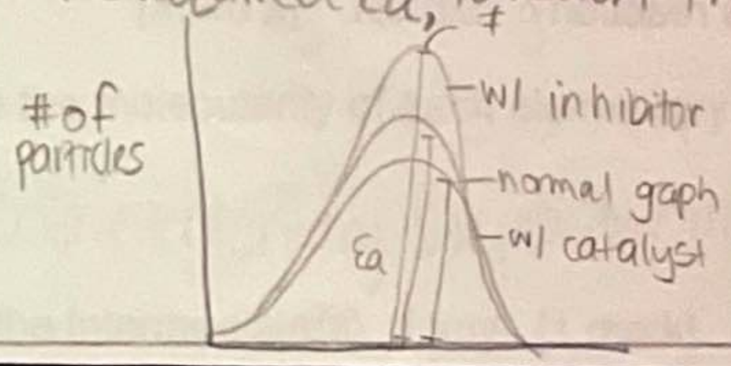
[58 marks]

51/58 88%

Communication [9 marks] 5

1. Indicate how each listed action affects the rate of the reaction in the box below. Explain how each action works using as many of the following as possible: collision theory explanation, Maxwell-Boltzmann distributions and reaction profiles. [9 marks]

$$Br_2(l) + 2KI(aq) \rightarrow 2KBr(aq) + I_2(g)$$

Action	Full Collision Theory Explanation Including Diagrams or Graphs
Increase in the Temperature	According to the collision theory a collision between reactants must take place. And anything that ↑ the particle collision of the reactants will increase the rxn rate. So increasing temp. will increase the rate of the rxn because the E_K of the particles will increase and that will allow for more effective collisions and therefore ↑ the rxn rate. 
Decrease the Amount of Bromine	Because the collision theory states reactants must collide and anything that ↑ reactant collisions ↑ the rxn rate, ↑ concentration will ↑ the rxn rate but if you decrease it, it will ↓ the rxn rate. Decreasing [ ] (can't ↓ [ ]) of bromine. will be taking out the particles and not as many will be left for the particles to collide effectively, and because there isn't as many particles to collide with the reactants won't effectively collide and the rxn rate will decrease. can we say ↓ S.A? 
Addition of an Inhibitor	An Inhibitor is the opposite to that of a catalyst. A catalyst lowers Ea where an inhibitor increases Ea. Adding an Inhibitor will ↑ Ea and will ↓ the rxn rate because less reactants will be able to reach the transition state bc they don't have the required Ea, to reach the transition state.  } the Ea ↑ and less reactants collide to reach ‡ (transition state) pic

2

0

3

2

you're combining 2 pics

Inquiry [17 marks] (11) wow!

2. The following data have been measured for the reaction: $1A(g) + 2B(g) \rightarrow 2C(l) + D(g)$

Expt	[A] (M)	[B] (M)	Initial Rate (M/s)
1	0.100	0.200	4.8×10^{-4}
2	0.100	0.100	1.2×10^{-4}
3	0.200	0.100	1.2×10^{-4}

$2^{\square} = 4$

$2^{\square} = 1$

(a) What is the rate law for the reaction? [3 marks]

$r = k[A]^x[B]^y$

$r = k[A]^0[B]^2$

3

(b) Calculate the value of the rate constant for the reaction. [3 marks]

using Trial #1

$r = k[A]^0[B]^2$

$4.8\times10^{-4} = K[0.04]$

$0.012 = K$

$4.8\times10^{-4}\ M/s = K[0.100M]^0[0.200M]^2$

$1.2\times10^{-2}\ M^{-1}S^{-1} = K$

3

(c) Is it likely that this reaction proceeds by a single elementary step? Explain. [3 marks]

No, this rxn doesn't proceed by a single elementary step because the exponents that were found in the rate law were not the same as the coefficients in the given eqn. (A in the given equation had a coefficient of 1 while the exponent in the rate law was zero)

3

(d) What is the rate of the reaction when [A]=0.400M and [B]=0.250 M? [3 marks]

$r = 1.2\times10^{-2}[A]^0[B]^2$

$r = (1.2\times10^{-2}\ M^{-1}S^{-1})[0.400M]^0[0.250M]^2$

$r = 1.2\times10^{-2}(0.0625)$

$r = 0.00075$

$r = 7.5\times10^{-4}\ MS^{-1}$

3

(e) What is the order of the reaction w.r.t A, w.r.t B and overall? [3 marks]

A → 0th order

B → 2nd order

overall → 2nd order

3

(f) Is this a homogeneous or heterogeneous reaction? Explain. [2 mark]

This is a homogeneous rxn b/c the reactants are in the same state

2

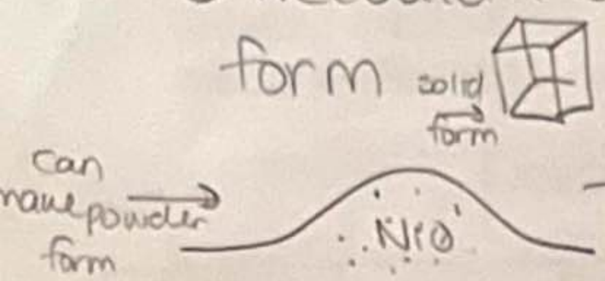
3

3

king Connections [4 marks] (4)

3. For the following reaction, **NiO(s) + CO(g) → Ni(s) + CO_2(g)**, list two methods of increasing the reaction rate (other than temperature change or catalyst addition). Be sure to include an explanation of why each method leads to a reaction rate increase. [4 marks]

① We could increase the S.A of NiO because having it in a solid form → there's only 6 faces exposed to collide with whereas



→ when you ↑ the S.A there is now more area of interphase for particles to collide

4 ② we could increase the concentration of CO gas because when you ↑ the concentration there are more particles which allows for ↑ more often collisions and effective collisions which would help ↑ the rxn rate

1 + 18

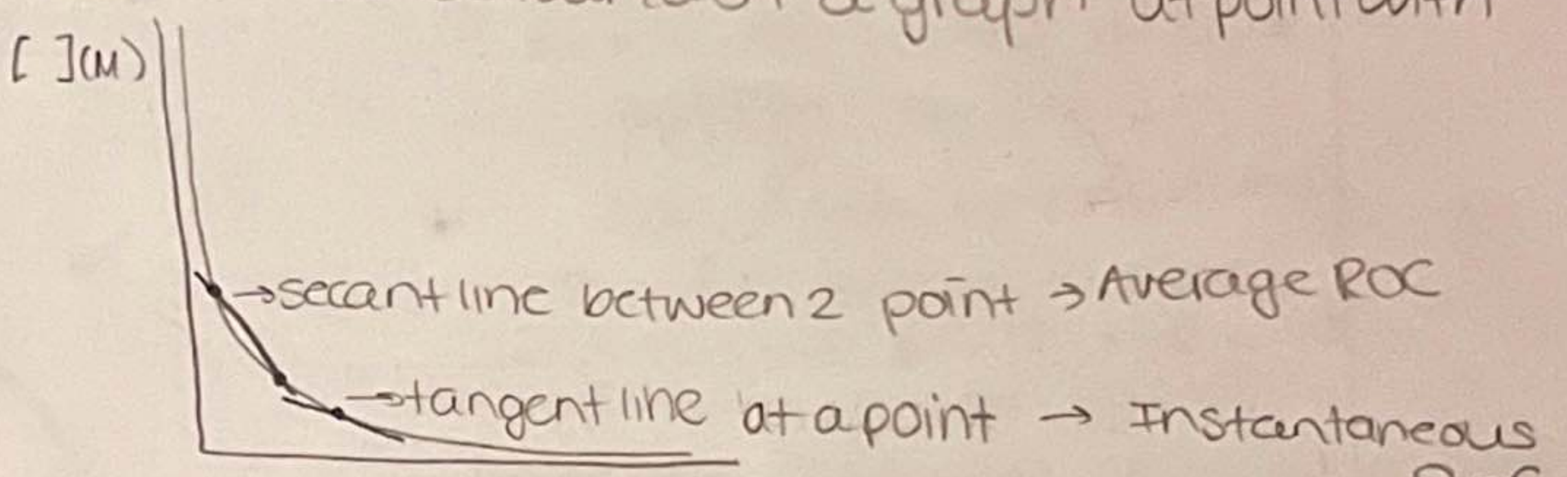
Knowledge & Understanding [8 + 20 = 28 marks]

5. Differentiate between average and instantaneous rate of reaction. Explain how to calculate average rate given a [ ] vs t graph. [3 marks]

over a given interval → Average rate of a reaction can be found on a graph with 2 points connected by a "secant line" → slope

at a specific time → Instantaneous rate of reaction can be found on a graph at point with a "tangent line".

2



6. The following reaction occurs in two elementary steps, by this reaction mechanism:

$NO_2(g) + NO_2(g) \rightarrow NO_3(g) + NO(g)$ (slow)

$NO_3(g) + CO(g) \rightarrow NO_2(g) + CO_2(g)$ (fast)

(a) What is the overall reaction? [2 marks]

$NO_{2(g)} + CO_{(g)} \rightarrow NO_{(g)} + CO_{2(g)}$ ✓ B10

(b) Describe the molecularity of each elementary step. [2 mark]

5 Both elementary steps are Bimolecular ✓ B10

(c) Identify the intermediate(s), if any. [1 mark]

$NO_{3(g)}$ ✓