

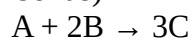
Kinetics exam.

IB11

Name:

Unless stated otherwise, explain all your answers and use 3 sf in all numerical answers.

1. (for SL): State the definition of rate of reaction and apply it to all compounds involved in the reaction (3)(+1bonus)



1. (for HL): Explain the differences between a reaction intermediate and a transition state. (3)
(+1bonus)

2. Given these statements (2)

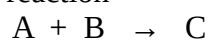
- i) If we increase the amount of the reactants, the rate of reaction will be higher
- ii) The rate of the reaction increases at first and then decreases as the reactants run out.
- iii) In a reaction involving gas, increasing pressure increases also the rate of reaction.
- iv) The reaction rate always depend on the concentration of the reactants.

- a) Only ii and iv are true
- b) Only iii is true
- c) Only iii and iv are true
- d) All are false

3. Wheat is combustible, but it doesn't burn that well. Wheat flour however is very flammable, even explosive. Explain, based on collision theory, why this is so. (2)

4. Explain, using an energy graph, what activation energy is. (3)

5. The reaction



is followed using a device that measures the intensity of colour.

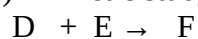
Show in a graph how this intensity of colour is supposed to change over time if:

a) A and C are transparent and B is red (1.5)

b) A and B are transparent and C is purple (1.5)

6. Explain, using a drawing of the Maxwell-Boltzmann distribution, why the presence of a catalyst increases the rate of reaction. (3)

7. (HL) A kinetic study was done for the reaction

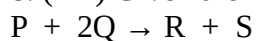


Three experiments were done and the reaction rate measured. These were the results. (All concentrations in M and rate in M/s)

Experiment	[D]	[E]	rate
1	0.1	0.12	0.0108
2	0.1	0.06	0.0054
3	0.01	0.06	$5.4 \cdot 10^{-5}$

- Find the orders of reaction for D and E (3)
- Find k and express it with the correct unit (2)

8. (HL) Given the reaction:



Four mechanisms have been proposed for it:

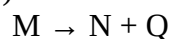
i) $Q + Q \rightarrow X$ (slow) $P + X \rightarrow R + S$ (fast)	ii) $Q + P \leftrightarrow Z + R$ (fast) $Q + Z \rightarrow S$ (slow)	iii) $Q + P \rightarrow Y + S$ (slow) $Q + Y \rightarrow R$ (fast)	iv) $Q + P \rightarrow Y + S$ (slow) $Q + Z \rightarrow R$ (fast)
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a) Write the reaction rate equation that would be consistent with mechanism i). (2)

b) Explain why mechanism 4 cannot possibly be the mechanism of this reaction. (2)

c) The experimental reaction rate equation found is $\text{rate} = k \cdot [P] \cdot [Q]$
Which mechanism is consistent with this equation? (2)

9. (HL) An activation energy study is made for a reaction of first order:



The kinetic constant is determined at several different temperatures. This is the data found.

Temperature (K)	k (s ⁻¹)
200	$1.7851 \cdot 10^{-3}$
220	$1.5900 \cdot 10^{-2}$
240	$9.8374 \cdot 10^{-2}$
260	0.45981
280	1.72428

a) With this information, find the activation energy and the preexponential coefficient A (3)

Bonus question.

The reaction in section a is entirely gaseous, that is, M, N and Q are gases.

In a syringe a test is run in which the rate of reaction is measured by means of a special laser device.

When the syringe plunger is pressed so that the volume of the reaction is halved, the researcher notices that the reaction rate doesn't double but goes about 5x as fast. Explain this using your chemical knowledge and collision theory. (2)