Chemistry2, HW9

The rate of a chemical reaction is determined by measuring either the amount of reactant consumed or the amount of product formed over a specific period. The **average rate** is calculated as:
Rate = Change in concentration / Time interval
Units: **mol/L·s**

The reaction rate at any given time can be determined from a graph of concentration versus time from the **slope of the tangent** at a specific point on the curve.

Consider the reaction:
A → 2D

To monitor the reaction, we measure the concentration of substances at different times and plot these values on a graph. The concentration of **A** decreases (lower graph), while the concentration of **D** increases (upper graph). Importantly, for this reaction, the rate at which **D** is produced is **twice** the rate at which **A** is consumed.
For example:

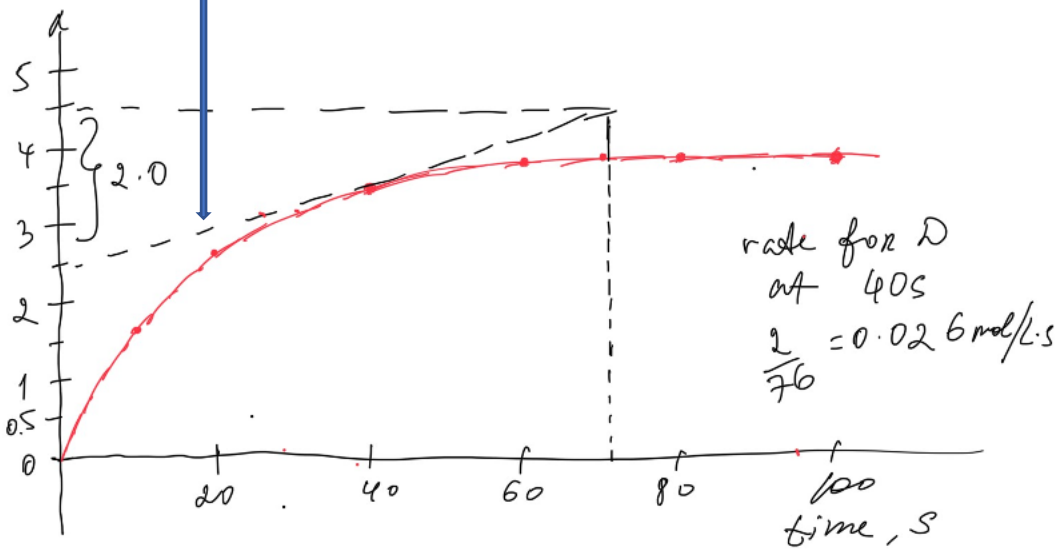
- If the rate of disappearance of **A** is **0.16 mol/L·s**,
- Then the rate of formation of **D** is **0.32 mol/L·s**.

The rate of a reaction at any specific time can be determined using a graph of concentration versus time by drawing a **tangent** to the curve at the chosen time.

- A **tangent** (slope) is a straight line that touches the curve at just one point without crossing it. This line represents the instantaneous rate of change of concentration at that specific moment.

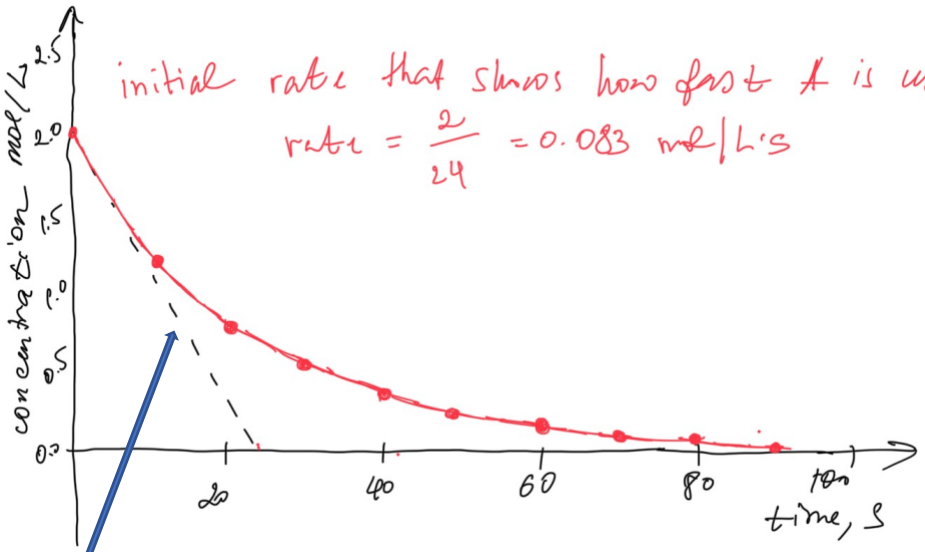
On the upper graph we chose data point at 40 s. We can see that change in concentration for D is 2 mol/L s at this point (it started from 2.5 and ended at 4.5, look at the y axe), change in time = 76 s.
The lower graph shows the change in A concentration over time. And it shows the slope that helps us to calculate the initial rate of the reaction. We draw the slope from the starting point of the curve.

Slope



rate for D at 40s

$\frac{2}{76} = 0.026$ mol/L·s



initial rate that shows how fast A is used

rate $= \frac{2}{24} = 0.083$ mol/L·s

Slope

$Mg + 2HCl \Rightarrow MgCl_2 + H_2\uparrow$

time, s	volume, ml H_2
0	0
10	32
20	48
30	48
40	48
50	48
60	48

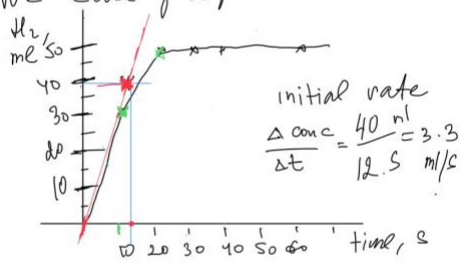
Average rate of the reaction 0 to 10 s and from 0 to 20 s
from 10 to 20 s

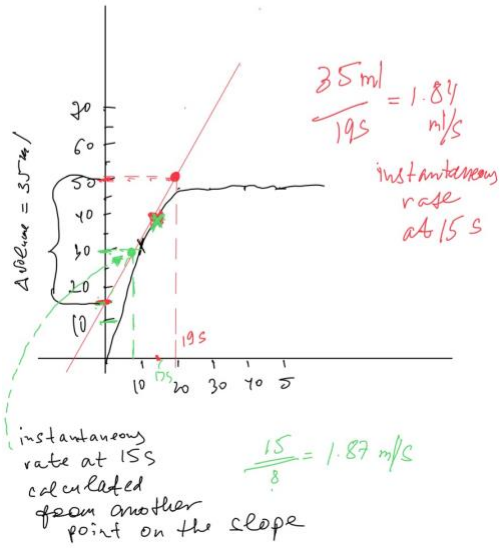
1. $32/10 = 3.2$ ml/s
2. $48/20 = 2.4$ ml/s
3. $\frac{48-32}{20-10} = \frac{16}{10} = 1.6$ ml/s

Instantaneous rate (at any point in time)

Initial rate (at the beginning of the process)

We can graph our data





Calculations done in class. We calculated different rates (average rates for the time intervals, initial rate and instantaneous rates at certain time points) of hydrogen gas production

Questions

1. How much grams of MgCl2 in 100 ml of solution you have to dissolve to get 0.5 mol/L concentration of MgCl2..
2. The following reaction was monitored $Mg + 2HCl \rightarrow MgCl_2 + H_2$

The volumes of hydrogen gas were recorded at different times. The data:

Time, s	Volume of gas/ ml
0	0.0
15	18.6
30	32.2
45	44.3
60	54.8
75	62.7
90	68.4
105	72.6
120	74.9
135	75.4
150	75.6
165	75.6
180	75.6

Draw a graph of these data. How the rate of the reaction changes over time?
Calculate the initial rate of the reaction. Calculate the average rate of reaction at 15 sec.
Calculate the instantaneous rate of the reaction at 120 s.