Reaction Rate Pre-Lab

The formation of nitrogen dioxide from nitrogen monoxide and oxygen gas is summarized by the following balanced chemical equation.

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

A chemist measured the concentration of the three gases at various time intervals. Her data is contained in the table below.

Time (min)	**Concentration** (mol/L)		
	$[O_2]$	$[NO]$	$[NO_2]$
0	0.000343	0.000514	0
2	0.000317	0.000461	0.000053
4	0.000289	0.000406	0.000108
6	0.000271	0.000368	0.000146
10	0.000242	0.000311	0.000204
16	0.000216	0.000259	0.000256
26	0.000189	0.000206	0.000308
41	0.000167	0.000162	0.000353
51	0.000158	0.000143	0.000372
61	0.000150	0.000127	0.000387
71	0.000144	0.000116	0.000399

Construct a graph to represent this data. Plot gas concentration on the y-axis and time on the x-axis. **(4 marks)**

Use your graph to answer the questions on the following pages. **Show all of your work for full marks.**

Questions

The average rate of reaction over a period of time is calculated by connecting two points on your graph (one at the starting time, the other at the ending time) with a straight line and determining the slope.

1. Determine the average rate of reaction in $mol/L \cdot min$ for each gas for the entire 71 minute interval.

   a) Nitrogen monoxide **(1 mark)**

b) Oxygen gas **(1 mark)**

c) Nitrogen dioxide **(1 mark)**

2. Determine the average rate of reaction in $mol / L \cdot min$ for each gas over the first 10 minutes.

   a) Nitrogen monoxide **(1 mark)**

   b) Oxygen gas **(1 mark)**

   c) Nitrogen dioxide **(1 mark)**

3. Determine the average rate of reaction in $mol / L \cdot min$ for each gas over the last 10 minutes.

   a) Nitrogen monoxide **(1 mark)**

b) Oxygen gas **(1 mark)**

c) Nitrogen dioxide **(1 mark)**

The instantaneous reaction rate at a specific time is determined by drawing a tangent line to the curve at that time and determining the slope.

4. Determine the instantaneous reaction rate in $mol / L \cdot min$ for each gas at 4 minutes. Show your tangent lines on the graph.

   a) Nitrogen monoxide **(1 mark)**

   b) Oxygen gas **(1 mark)**

   c) Nitrogen dioxide **(1 mark)**

5. Determine the instantaneous reaction rate in $mol / L \cdot min$ for each gas at 41 minutes. Show your tangent lines on the graph.

   a) Nitrogen monoxide **(1 mark)**

   b) Oxygen gas **(1 mark)**

   c) Nitrogen dioxide **(1 mark)**

6. By examining your answers to question 1 and 2, state how the rate of consumption of nitrogen monoxide compares to the rate of production of nitrogen dioxide. **(1 mark)**

7. By examining your answers to question 1 and 2, state how the rate of consumption of oxygen gas compares to the rate of production of nitrogen dioxide. **(1 mark)**