B B B B B B B B B B B B B

$$O_3(g) + NO(g) \rightarrow O_2(g) + NO_2(g)$$

6A

6. Consider the reaction represented above.

(a) Referring to the data in the table below, calculate the standard enthalpy change, ΔH°, for the reaction at 25°C. Be sure to show your work.

	$O_3(g)$	$NO(g)$	$NO_2(g)$
Standard enthalpy of formation, ΔH_f°, at 25°C ($kJ\ mol^{-1}$)	143	90.	33

(b) Make a qualitative prediction about the magnitude of the standard entropy change, ΔS°, for the reaction at 25°C. Justify your answer.

(c) On the basis of your answers to parts (a) and (b), predict the sign of the standard free-energy change, ΔG°, for the reaction at 25°C. Explain your reasoning.

(d) Use the information in the table below to write the rate-law expression for the reaction, and explain how you obtained your answer.

Experiment Number	Initial $[O_3]$ ($mol\ L^{-1}$)	Initial [NO] ($mol\ L^{-1}$)	Initial Rate of Formation of NO_2 ($mol\ L^{-1}\ s^{-1}$)
1	0.0010	0.0010	x
2	0.0010	0.0020	$2x$
3	0.0020	0.0010	$2x$
4	0.0020	0.0020	$4x$

(e) The following three-step mechanism is proposed for the reaction. Identify the step that must be the slowest in order for this mechanism to be consistent with the rate-law expression derived in part (d). Explain.

Step I: $O_3 + NO \rightarrow O + NO_3$

Step II: $O + O_3 \rightarrow 2\,O_2$

Step III: $NO_3 + NO \rightarrow 2\,NO_2$

a) $\Delta Hf^\circ = \Delta Hf$ products $- \Delta Hf$ reactants

$= (33 + 0) - (143 + 90) =$ **-200 kJ/mol**

b) ΔS° will be quite small for this reaction since all reactants/products are gases and the number of moles of reactants (2) and products (2) is