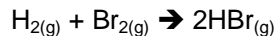


**Revised August 2009**

**AP WORKSHEET 15a: Orders of reaction & rate constants**

1. The following data were collected for the reaction below.

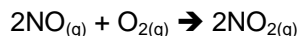


Experiment	[ H <sub>2</sub> ]	[ Br <sub>2</sub> ]	Rate in M s <sup>-1</sup>
1	0.25 M	0.0012 M	1.20 x 10 <sup>-4</sup>
2	0.50 M	0.0012 M	4.80 x 10 <sup>-4</sup>
3	0.50 M	0.0048 M	4.80 x 10 <sup>-4</sup>

(a) Write the rate equation and calculate the value of the rate constant, k and include units.  
(6)

(b) What is the overall order of this reaction? (1)

2. Nitrogen monoxide can be oxidized to nitrogen dioxide in the reaction below.



The following data were collected in a kinetics experiment.

Experiment	Initial [O <sub>2</sub> ] (M)	Initial [NO] (M)	Rate (M s <sup>-1</sup> )
1	0.20	0.10	1.0
2	0.80	0.10	4.0
3	0.80	0.30	36

(a) Write the rate law. (4)

(b) Calculate the rate constant and give its units. (2)

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3. In each of the following cases where the rate law and units used are described, suggest units for the rate constant,  $k$ .(6)
- (a) A third order reaction overall, where the rate is measured in  $\text{mol L}^{-1} \text{s}^{-1}$  and the concentrations of all reactants are measured in units of  $\text{mol L}^{-1}$ .
- (b) A rate law that has the concentration of two reactants measured in M, each first order and a rate that is measured in  $\text{mol L}^{-1} \text{min}^{-1}$ .
- (c) A reaction where there are multiple products but only a single reactant that is found to be zero order. The rate is measured in units of  $\text{g s}^{-1}$ .

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4. Describe how the orders with respect to two different reactants might be determined in a simple experiment where a gas is produced as a result of mixing two solutions together. Carefully describe the measurements that should be recorded and suggest a method of measuring the rate of the reaction. (4)