3. Answer the following questions related to chemical reactions involving nitrogen monoxide, $NO(g)$.

The reaction between solid copper and nitric acid to form copper(II) ion, nitrogen monoxide gas, and water is represented by the following equation.

$$3\,Cu(s) + 2\,NO_3^-(aq) + 8\,H^+(aq) \rightarrow 3\,Cu^{2+}(aq) + 2\,NO(g) + 4\,H_2O(l) \qquad E^\circ = +0.62\ V$$
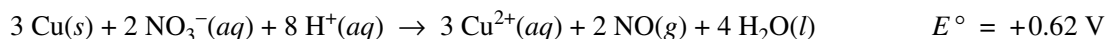
(a) Using the information above and in the table below, calculate the standard reduction potential, E°, for the reduction of NO_3^- in acidic solution.

Half-Reaction	Standard Reduction Potential, E°
$Cu^{2+}(aq) + 2\,e^- \rightarrow Cu(s)$	+0.34 V
$NO_3^-(aq) + 4\,H^+(aq) + 3\,e^- \rightarrow NO(g) + 2\,H_2O(l)$	?

(b) Calculate the value of the standard free energy change, ΔG°, for the overall reaction between solid copper and nitric acid.

(c) Predict whether the value of the standard entropy change, ΔS°, for the overall reaction is greater than 0, less than 0, or equal to 0. Justify your prediction.

Nitrogen monoxide gas, a product of the reaction above, can react with oxygen to produce nitrogen dioxide gas, as represented below.

$$2\,NO(g) + O_2(g) \rightarrow 2\,NO_2(g)$$
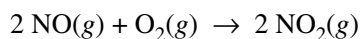
A rate study of the reaction yielded the data recorded in the table below.

Experiment	Initial Concentration of NO (mol L^{-1})	Initial Concentration of O$_2$ (mol L^{-1})	Initial Rate of Formation of NO$_2$ (mol L^{-1} s^{-1})
1	0.0200	0.0300	8.52×10^{-2}
2	0.0200	0.0900	2.56×10^{-1}
3	0.0600	0.0300	7.67×10^{-1}

(d) Determine the order of the reaction with respect to each of the following reactants. Give details of your reasoning, clearly explaining or showing how you arrived at your answers.

   (i) NO

   (ii) O$_2$

(e) Write the expression for the rate law for the reaction as determined from the experimental data.

(f) Determine the value of the rate constant for the reaction, clearly indicating the units.

S T O P
**If you finish before time is called, you may check your work on this part only.
Do not turn to the other part of the test until you are told to do so.**