KINETICS II: DETERMINATION OF ACTIVATION ENERGY SMART WORKSHEET

PART A: DETERMINATION OF THE ORDER OF THE REACTION IN CV^+ AND OF THE RATE CONSTANT (RUN 1, AT ROOM TEMPERATURE)

GRAPH DATA FROM LABQUEST

	Value
Absolute value of the correlation factor from graph of A vs. time (from LabQuest, A is absorbance)	0.99823 ✔
Absolute value of the correlation factor from graph of $\ln(A)$ vs. time (from LabQuest, A is absorbance)	0.99989 ✔
Absolute value of the correlation factor from graph of $1/A$ vs. time (from LabQuest, A is absorbance)	0.99647 ✔

Order of the reaction in CV^+: 1 ✔

CALCULATING THE RATE CONSTANT, k''

For the slope, record the value from the labQuest screen, do not worry about significant figures.

	Unrounded	Rounded	Units
Slope of straight line from graph of $\ln(A)$ vs. time		-0.19711 ✔	s^{-1} ✔
1. Rate constant, k''	0.19711 ✔	0.197 ✔	s^{-1} ✔

Quality of data: Well done, k'' is positive 5

	Value	Unit
Mean temperature of run 1	23.0 ✔	°C ✔

YOUR PROGRESS ON 'PART A: DETERMINATION OF THE ORDER OF THE REACTION IN CV^+ AND OF THE RATE CONSTANT (RUN 1, AT ROOM TEMPERATURE)'

CORRECT	POINTS AWARDED	AUTOSOLVED	NOT FINISHED
7 / 7	26 / 26	0 / 7	0 / 12

PART B

TEMPERATURE CALCULATIONS

- $\text{Temperature}\,(\text{K}) = \text{Temperature}\,(^\circ\text{C}) + 273.15$
- The gas constant, R is 8.314 $\text{J}\,\text{mol}^{-1}\,\text{K}^{-1}$

Temperature range (°C)	Mean temperature (°C)	1. $T(\text{K})$		2. $1/T(\text{K}^{-1})$	
		Unrounded	Rounded	Unrounded	Rounded

5 to 10	8.5	281.65	281.7	0.0035505	0.003551
15 to 20	16.0	289.15	289.2	0.0034584	0.003458
25 to 30	29.3	302.45	302.5	0.0033063	0.003306
35 to 40	41.5	314.65	314.7	0.0031781	0.003178
45 to 50	43.6	316.75	316.8	0.0031571	0.003157

RATE CONSTANT CALCULATIONS

Temperature range (°C)	Mean slope value (LabQuest)	3. k'' value		4. $\ln(k'')$	
		Unrounded	Rounded	Unrounded	Rounded
5 to 10	-0.888415	0.888415	0.888	-0.118316	-0.118
15 to 20	-0.2705975	0.2705975	0.271	-1.3071	-1.307
25 to 30	-0.110749	0.110749	0.111	-2.2005	-2.201
35 to 40	-0.64862	0.64862	0.649	-0.4329	-0.433
45 to 50	-0.05770383	0.05770383	0.0577	-2.8524	-2.852

CALCULATING THE ACTIVATION ENERGY OF REACTION

- Now graph (with Excel) $\ln(k'')$ vs $1/T(\mathrm{K}^{-1})$. Graph must be properly done and labelled.
- Graph must display fitted trendline, end equation of the line. Slope and intercept must both be ≥ 6 significant figures.

	Unrounded	Rounded	Units
5. Trendline slope	3521.02	3.52×10^3	K
6. Activation energy of reaction	-29.274	-29.3	$\mathrm{kJ\,mol^{-1}}$

YOUR PROGRESS ON 'PART B'

CORRECT 45 / 45 POINTS AWARDED 223 / 223 AUTOSOLVED 0 / 45 NOT FINISHED 0 / 55

PART C: ADDITIONAL QUESTIONS

QUESTION 1

1. The overall order of the reaction between $\mathrm{CV^+}$ and $\mathrm{OH^-}$ is 2

QUESTION 2

2. For a certain reaction, $k = 0.0253\ \mathrm{s^{-1}}$ at 25.0 °C and $E_a = 123\ \mathrm{kJ\,mol^{-1}}$. Use the 2 point form of the Arrhenius equation to calculate k at 80.0 °C.

2 Point Form Equation

$$\ln\left(\frac{k_2}{k_1}\right) = \frac{-E_a}{R} \times \left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

	Unrounded	Rounded	Units
k at 80.0 °C	57.454	57.5	$\mathrm{s^{-1}}$