1. Consider the two reactions shown below. Assume that they are performed under conditions with the same collision frequency among reactants.

$$\text{Rxn 1}: \quad H(g) + H(g) \longrightarrow H_2(g)$$
$$\text{Rxn 2}: \quad SO(g) + O_2(g) \longrightarrow SO_2(g) + O(g)$$

Which one of these has the higher Arrhenius factor A? Briefly explain why.

Rxn 1 since it can collide in both orientations whereas Rxn 2 can only collide in one

2. The rate law for the iodine clock reaction is experimentally determined to be

$$v(t) = k[IO_3{}^-][HSO_3{}^-]$$

where $k = 6.3\,\frac{1}{M\cdot s}$ and the activation energy is $19.7\,\frac{kJ}{mol}$. Fill in the table with increases, decreases, or stays the same.

Reaction Condition	Rate	Rate Constant	Activation Energy
Water is added	↑	=	=
Temp is lowered	↓	↓	=
Catalyst is added	↑	↑	↓

3. The rate constants of a chemical reaction with a single reactant were measured at different temperatures. Circle the quantities that can be determined using the information provided.

Temperature (°C)	k ($\frac{1}{s}$)
189.7	2.52×10^{-5}
198.9	5.25×10^{-5}
230.3	6.30×10^{-4}
251.2	3.16×10^{-3}

- ■ the Arrhenius factor, A
- ■ $t_{1/2}$ at 198.9 °C
- ■ the activation energy, E_a
- □ the ΔG at 251.2 °C
- ■ the order of the reaction
- ■ the rate constant (k) at 298 K

4. A cancer patient's blood volume was measured by injecting 5.0 mL of Na_2SO_4 labeled with ^{35}S ($t_{1/2} = 87.4\,\mathrm{d}$). The injected sample had an activity of 300 µCi. After 23 min, a 11.6 mL blood sample was drawn and has activity 0.85 µCi. Determine the patient's total blood volume.

$$k = \frac{\ln 2}{t_{1/2}} = \frac{0.693}{87.4\,\mathrm{d}} = 7.93 \times 10^{-3}\,\frac{1}{\mathrm{d}}$$

$$A(t) = A_0 e^{-kt} = 300\,\mu\mathrm{Ci} \cdot e^{-(7.93\times10^{-3}\,\frac{1}{\mathrm{d}})(0.01597\,\mathrm{d})}$$

$$= 299.96\,\mu\mathrm{Ci} \quad \text{(amount in body)}$$

Concentration in body same as concentration in sample

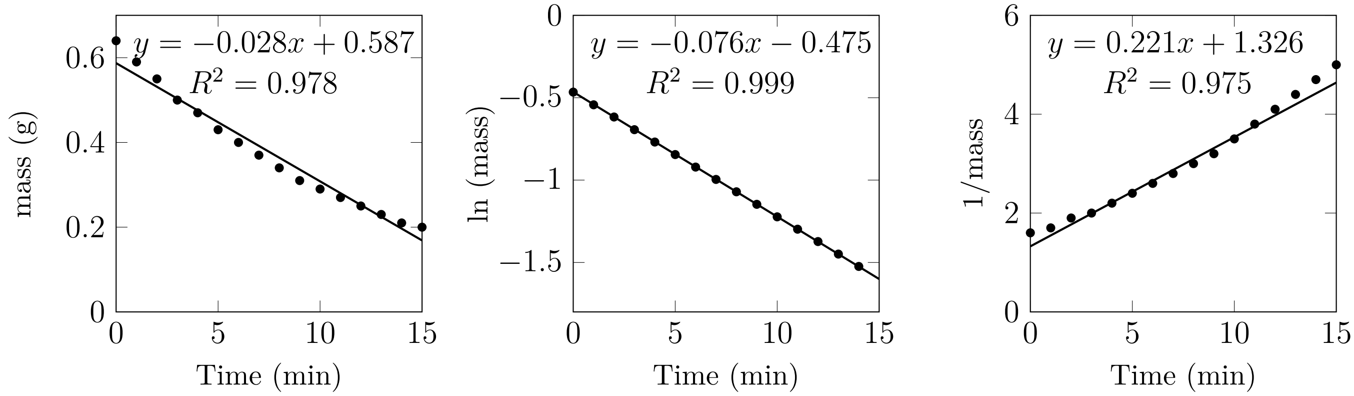
$$\frac{0.85\,\mu\mathrm{Ci}}{11.6\,\mathrm{mL}} = \frac{299.96\,\mu\mathrm{Ci}}{V}$$

$$V = \frac{299.96\,\mu\mathrm{Ci} \cdot 11.6\,\mathrm{mL}}{0.85\,\mu\mathrm{Ci}}$$

$$= 4.09 \times 10^3\,\mathrm{mL} = 4.09\,\mathrm{L}$$

Usually around 5 L for typical human.

5. Analyze the rate of reaction for the evaporation of hand sanitizer given the following plots.



(a) What is the order of the reaction with respect to the mass of the sanitizer? 1st order

(b) What was the initial mass of the sample?

$$\ln m = -0.475 \implies m = 0.622\,\mathrm{g}$$

(c) What is the half life of this reaction?

$$t_{1/2} = \frac{\ln 2}{k} = \frac{\ln 2}{0.076\,\frac{1}{\mathrm{d}}} = 9.12\,\mathrm{d}$$

Homework Problem 34

1. There's a rule of thumb in chemistry that a reaction rate approximately doubles for every $10\,^{\circ}\mathrm{C}$ increase in temperature. Use this to estimate a typical activation energy at SATP.