Timing a Reusable Photochromic Label

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

An exhibit uses reusable labels that darken under a lamp. In a simplified model the lamp changes some molecules of form A into colored form B. In darkness, B changes back to A. A color reading of 100 units represents the same starting amount of B for each label. Lower readings mean less B remains.

Time in darkness (min)	Label at 18 °C (color units)	Label at 28 °C (color units)
0	100	100
2	71	50
4	50	25
6	35	13
8	25	6

1 What conclusion about the return to form A is supported by the readings?

(1) It occurs faster at 18 °C.

(2) It occurs faster at 28 °C.

(3) It occurs only at 18 °C.

(4) The rate is the same at both temperatures.

2 The exhibit can reuse a label when its reading reaches 25 units. Use the table to determine how many minutes earlier the warm label reaches that value. [1]

Answer and work

3 A student concludes that the warmer label must have started with less form B. Use one piece of numerical evidence to evaluate that conclusion. [1]

Answer and work

A third label stays under the lamp at constant temperature. Its color reading becomes steady. In the model the lamp continues converting A to B, and B still converts to A.

4 Explain how the color reading can remain steady while both changes continue. [1]

Answer and work