Carbon Uptake in Sun and Shade Leaves

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

Two groups of the same plant species grow in a greenhouse. One group develops in full light and the other under shade cloth. Students measure the rate of carbon dioxide exchange per square meter of leaf at the same temperature. A positive value means the leaf removes CO_2 from the air. A negative value means it releases CO_2.

Measurement light level	**Sun leaf: net CO_2 uptake ($\mu mol/m^2/s$)**	**Shade leaf: net CO_2 uptake ($\mu mol/m^2/s$)**
Dark	−2.0	−1.0
Low	2.0	3.0
High	16.0	9.0

1 Which result describes the measurement in low light?

(1) The sun leaf removes more CO_2 per unit area than the shade leaf.

(2) The shade leaf removes more CO_2 per unit area than the sun leaf.

(3) Both leaves release CO_2 at the same rate.

(4) Both leaves remove CO_2 at the same rate.

2 Explain why measuring CO_2 release from a leaf in darkness does not show that the leaf stopped all chemical activity. [1]

Answer and work

For the next calculation, use a simplified model in which each leaf respires at the same rate in light as in darkness. The measured net uptake is gross photosynthetic uptake minus the rate of CO_2 release by respiration.

3 Calculate the gross rate of photosynthetic CO_2 uptake for the sun leaf in high light. Show how you used the measurement in darkness. [1]

Answer and work

4 A student says the shade leaf removes CO_2 faster per unit area under every measured light level. Use two light levels to evaluate that claim. [1]

Answer and work

5 The students want to test whether the temperature of the air changes the sun leaves' net CO_2 uptake in high light. Describe what to vary, what to measure, and one condition to keep the same. [1]

Answer and work