



As the ISS orbits Earth every 90 minutes, Earth rotates 'underneath' the orbit of the ISS once every 24 hours. This means that each ISS orbit advances in longitude by a fixed amount in longitude. The figure above shows the ground track of the ISS for two orbits. Each square is 10 degrees on a side, with the Equator running horizontally across the middle of the diagram. The squares are shown at intervals of 5 minutes.

Problem 1 - If Earth rotates 360 degrees in 24 hours, by how many degrees does it shift during the orbit of the ISS?

Problem 2 – How many sunsets and sunrises will the SAGE-III instrument on the ISS observe each 24-hour day?

Problem 3 – How many orbits will it take before the ISS passes over the same spot on the Equator?

Problem 4 - During each orbit, the ISS will cross the Equator traveling north to south, then after $\frac{1}{2}$ orbit (45 minutes) it will cross the Equator traveling south to north. How long will you wait before you see the ISS from the ground traveling north-to-south across the sky directly overhead?

Problem 1 - If Earth rotates 360 degrees in 24 hours, by how many degrees does it shift during the orbit if the ISS?

Answer: $360/24 = X/1.5$ so **X = 22.5 degrees**.

Problem 2 – How many sunsets and sunrises will the SAGE-III instrument on the ISS observe each 24-hour day?

Answer: $24 \text{ h} / 1.5 \text{ h} =$ **16 sunrises, and an equal number of sunsets** for a total of 32 events. A sunrise is followed by a sunset every $90/2 = 45$ minutes!

Problem 3 – How many orbits will it take before the ISS passes over the same spot on the Equator?

Answer: The orbit advances 22.5 degrees in longitude every orbit, so it will take $360/22.5 = 16$ orbits or one full day to return to the same longitude. However, because the ISS crosses the equator twice every orbit, it actually takes only **8 orbits or 12 hours**.

Problem 4 - During each orbit, the ISS will cross the Equator traveling north to south, then after $\frac{1}{2}$ orbit (45 minutes) it will cross the Equator traveling south to north. How long will you wait before you see the ISS from the ground traveling north-to-south across the sky directly overhead?

Answer: Every **16 orbits** as seen from the ground, the ISS is traveling in the same direction, so you will have to wait **24 hours**.