



Problem 1 – The graph above shows the orbit of the Van Allen Probes spacecraft. Each division, (1.0, 2.0, etc) is given in terms of Earth's radius, which is 6,378 kilometers. For example, '2.0' = twice Earth's radius or 12,756 kilometers. Suppose that the spacecraft move along their orbit from point (+5.6, +1.8) to point (+6.2, +3.0). Plot these two points on the graph, and convert their coordinates into kilometers.

Problem 2 – Using which ever method you like, determine the distance in kilometers that the spacecraft traveled between the two points in their orbit.

Problem 3 – Suppose the spacecraft reached the point (+5.6, +1.8) at a time of 11:22:30 and point (+6.2, +3.0) at a time of 11:50:00 what was the elapsed time to travel this distance in seconds?

Problem 4 – What was the speed of the spacecraft in kilometers/hour?

Problem 1 – The graph above shows the orbit of the Van Allen Probes spacecraft. Each division, 1.0, 2.0, etc) is given in terms of Earth's radius, which is 6,378 kilometers. For example, '2.0' = twice Earth's radius or 12,756 kilometers. Suppose that the spacecraft move along their orbit from point (+5.6, +1.8) to point (+6.2, +3.0). Plot these two points on the graph, and convert their coordinates into kilometers.

Answer: $5.6 \times 6378 = 35,717$ km, $1.8 \times 6378 = 11,480$; $6.2 \times 6378 = 39,544$, $3.0 \times 6378 = 19,134$ so (35717 , 11480) and (39544 , 19134).

Problem 2 – Using which ever method you like, determine the distance in kilometers that the spacecraft traveled between the two points in their orbit.

Answer: Determine the scale of the graph using a millimeter ruler in km/mm, then measure the distance between the two points in millimeters and convert to kilometers. For advanced students use the 2-point distance formula. $D^2 = (39544-35717)^2 + (19134-11480)^2 = 3827^2 + 7654^2$, so **D = 8,557 kilometers**.

Problem 3 – Suppose the spacecraft reached the point (+5.6, +1.8) at a time of 11:22:30 and point (+6.2, +3.0) at a time of 11:50:00 what was the elapsed time to travel this distance in seconds?

Answer: Elapsed time = 11:50:00 – 11:22:30 = 27m 30 s or $27 \times 60 + 30 =$ **1650 seconds**.

Problem 4 – What was the speed of the spacecraft in kilometers/hour?

Answer: Time, in hours, = $1650 \text{ seconds} \times (1 \text{ minute}/60 \text{ sec}) \times (1 \text{ hr}/60 \text{ min}) = 0.46$ hours.

Speed = distance/time = $8557 \text{ km} / 0.46 \text{ hours} =$ **18,602 km/hr**.