



Comets are giant icebergs in space, sometimes over 50 miles across, that shed water vapor as they are heated while approaching the sun. Some comets only come around once and are never seen again. Others travel on elliptical paths called orbits, that take them far beyond the orbit of Jupiter before they, once again, loop back towards the sun.

Halley's Comet, which made a pass near the sun in 1986 is one of the most famous Periodic Comets, and will return to Earth's skies in the year 2061. This figure shows the orbit of Halley's Comet to the same scale as the orbits of the planets. Each dot is the position after one Earth year has elapsed.

**Problem 1** – What is the period of Halley's Comet in Years?

**Problem 2** – What is the longest diameter of the elliptical orbit in kilometers if the distance between the orbits of Jupiter and Saturn is 650 million km?

**Problem 3** – The distance between Saturn's orbit and the orbit of Venus is 1.3 billion km. About how fast is Halley's Comet traveling in km/year as it travels the Venus-Saturn distance?

**Problem 4** – The distance between the orbits of Uranus and Neptune is 1.6 billion km. From the diagram, about how many years does it take to travel this distance, and what is the average speed of Halley's Comet during this time in km/year?

**Problem 1** – What is the period of Halley's Comet in Years?

Answer:  $2061 - 1986 = 75$  years.

**Problem 2** – What is the longest diameter of the elliptical orbit in kilometers if the distance between the orbits of Jupiter and Saturn is 650 million km?

Answer: First determine the scale of this figure using a millimeter ruler and the actual Jupiter-Saturn distance. When printed on standard  $8\frac{1}{2} \times 11$  paper, the separation should be about 19 millimeters, so the scale is  $650 \text{ million km} / 19 \text{ mm} = 34 \text{ million km/mm}$ . The length of the ellipse is 143 mm, so the actual distance is  $143 \times 34 \text{ million} = 4.86 \text{ billion kilometers}$ .

**Problem 3** – The distance between Saturn's orbit and the orbit of Venus is 1.3 billion km. About how fast is Halley's Comet traveling in km/year as it travels the Venus-Saturn distance?

Answer: Counting the number of years, it takes 3 years to travel this distance, so the speed is  $1.3 \text{ billion km} / 3 \text{ years} = 433 \text{ million km/year}$ .

**Problem 4** – The distance between the orbits of Uranus and Neptune is 1.6 billion km. From the diagram, about how many years does it take to travel this distance, and what is the average speed of Halley's Comet during this time in km/year?

Answer: Counting the year marks, it takes 12.5 years, so the speed is about  $1.6 \text{ billion km} / 12.5 \text{ years} = 128 \text{ million km/year}$ .