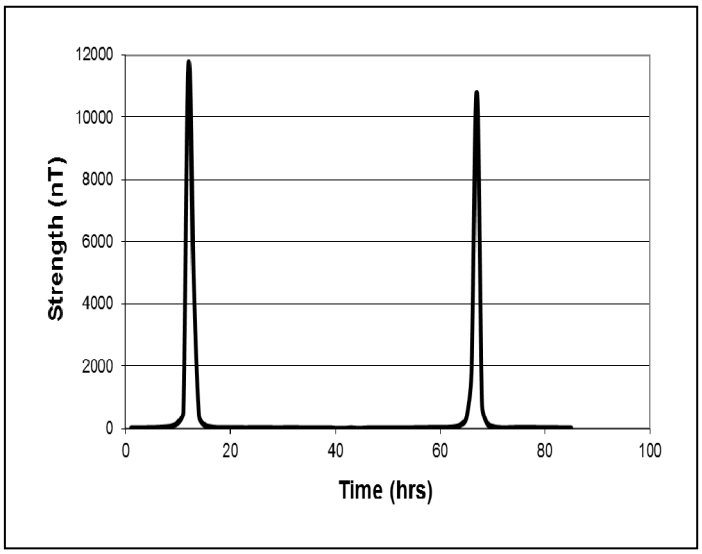

The Cluster satellite constellation consists of 5 satellites orbiting Earth in a close formation. They were designed to measure Earth's magnetic field, and particles in space such as protons and electrons.

This graph shows the strength of Earth's magnetic field measured by the Cluster C1 satellite as it orbited Earth between January 1 and January 6, 2010.

Problem 1 - About what is the highest magnetic field strength measured along the satellite's orbit?

Problem 2 - The satellite's orbit had a perigee (closest point to Earth) of 10,000 km and an apogee (farthest distance from Earth) of 140,000 km. About what was the strength of the magnetic field at A) Perigee? B) Apogee?

Problem 3 - How many hours did it take the satellite to complete one orbit? Explain how you determined this from the graph.

Problem 4 - Below is a table of data taken at specific distances from Earth during the orbit. Graph this data. Does the strength decrease as the inverse-square or inverse-cube of the distance?

Point	Distance (km)	Strength (nT)
1	10,000	10,000
2	30,000	370
3	40,000	160
4	50,000	83
5	60,000	44
6	70,000	30
7	140,000	6

Problem 1 - Answer: The two peaks are at 11,700 nT and 10,800 nT so the maximum value occurs for the first peak with **11,700 nT**.

Problem 2 - Answer: A) At perigee, the satellite is closest to Earth so the strength of the magnetic field should be at its highest point along the orbit or 11,700 nT. B) At apogee the spacecraft is farthest from Earth and the strength is lowest, which from the graph is near-zero.

Problem 3 - Answer: The time between perigee of one orbit and perigee of the next orbit is just the time between the maximum measured magnetic strengths of these two consecutive orbits. From the graph, and using a millimeter ruler to get the correct scale, the time between the peaks is about 54 hours.

Problem 4 - Below is a table of data taken at specific distances from Earth during the orbit. Graph this data. Does the strength of the magnetic field decrease as the inverse-square or inverse-cube of the distance from Earth?

Answer: Inverse-square: Example of this model would predict between Point 1 and Point 2 that the intensity would drop by $1/(3^2)$ so it would be 1,111 nT
Inverse-cube: it would be $10{,}000/(3^3)$ = 370 nT as shown in the table.

We see that the inverse-cube model fits the data much better than the inverse-square distance law.

Point	Distance (km)	Strength (nT)	**Inverse-square**	**Inverse-cube**
1	10,000	10,000	**10,000**	**10,000**
2	30,000	370	**1,111**	**370**
3	40,000	160	**625**	**156**
4	50,000	83	**400**	**80**
5	60,000	44	**278**	**46**
6	70,000	30	**204**	**29**
7	140,000	6	**51**	**4**