



This sequence of images shows the launch of the INSAT-1B Indian communications satellite from the Challenger Space Shuttle cargo bay (STS-8) on August 30, 1983.

The sequence begins at the top frame and progresses downwards to the last frame showing the launch. The image times in seconds from top to bottom are: 36.3, 37.0, 37.7, and 39.2. The blue rectangular panel is 2 meters tall and is located on only one side of the satellite. The satellite is launched in a spinning mode to help stabilize it as it orbits Earth.

See the NASA video at the National Space Society:
<http://www.nss.org/resources/library/shuttlevideos/shuttle08.htm>

Table of Image Metrology

Image	Time (sec)	Height (meters)	Speed (m/s)
1	36.3	0.9	
2	37.0	1.5	
3	37.7	2.4	
4	39.2	3.9	

Problem 1 - From the table above, determine the average speed in meters/sec between: A) Image 1 and 2; B) Image 2 and 3; C) Image 3 and 4.

Problem 2 - What is the average speed of the satellite between Image 1 and Image 4?

Problem 3 - What is the rotation period of the satellite in seconds?

Problem 4 - How many revolutions per minute (RPM) was the satellite spinning after it was launched?

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Answer: Speed = distance/time. The time interval between Image 1 and 2 is $37.0 - 36.3 = 0.7$ seconds. During this time, the satellite moved vertically a distance of $1.5 \text{ meters} - 0.9 \text{ meters} = 0.6 \text{ meters}$, so the speed was $0.6 \text{ meters} / 0.7 \text{ seconds} = 0.9 \text{ meters/sec}$. Similarly the answers for the other 2 time intervals are shown in the above table.

Problem 2 - What is the average speed of the satellite between Image 1 and Image 4?

Answer: Distance = $3.9 - 0.9 = 3.0$ meters. Time interval = $39.2 - 36.3 = 2.9$ seconds, so speed = **1.0 meters/sec**.

Problem 3 - What is the rotation period of the satellite in seconds?

Answer: We see from Image 3 and 4 that the satellite has made one full revolution. The time interval between the two frames is $39.2 - 37.7 = 1.5$ seconds, so the period is **1.5 seconds**.

Problem 4 - How many revolutions per minute (RPM) was the satellite spinning after it was launched?

Answer: There are 60 seconds in 1 minute, so the RPM is just $60 \text{ seconds} / 1.5 = 40$ RPM.

$$1 \text{ revolution} / 1.5 \text{ seconds} \times (60 \text{ seconds} / 1 \text{ minute}) = \mathbf{40 \text{ revolutions/sec}}$$