



The InSight Lander will arrive at Mars on September 20, 2016 according to Earth Time, but when will it arrive according to Mars Time?

One Earth Day is exactly 24 hours long, so that the time between two High Noons is exactly 24 hours. But Mars rotates a bit more slowly and by Earth units, one Mars Day (called a Sol) is 24 hours and 40 minutes long.

This photo was taken by the NASA Phoenix Lander on Sol 90, which is Earth date August 25, 2008

The Curiosity Rover can only safely move during the Martian daytime. This is when scientists on Earth can use TV cameras to watch where the rover is traveling. The Martian day is 40 minutes longer than the Earth day. That means scientists have to move their work schedule forward by 40 minutes each Earth day to keep up with sunrise and sunset on Mars. The rover landed on August 5, 2012 at about 10:30 pm Pacific Daylight Time (PDT), which was defined as Sol 0 for this mission. All of the navigation is performed by Navigation Engineers working at the Jet Propulsion Laboratory in Pasadena, California.

**Problem 1** - What time and date will it be on Earth on Sol 5?

**Problem 2** - Suppose that sunrise at the Curiosity lander happened on February 16, 2013 at 5:20 pm Pacific Standard Time (Sol 190 at 6:00 am Local Mars Time). A Navigation Engineer begins his work shift exactly at that moment. When will his shift have to start after 5 Sols have passed on Mars?

**Problem 3** – How many Sols have to elapse before his work shift once again starts at the same Earth time of 5:20 pm PST?

Mars Sunrise and Sunset Tables  
<http://www.curiosityrover.com/sundata/>

**Problem 1** - What time and date will it be on Earth on Sol 5?

Answer: This will be 5 x (1 day and 40 minutes) added to August 5 at 10:30 pm PDT.  
 5 days and 200 minutes = 5 days 3 hours and 20 minutes after August 5 at 10:30 pm, or  
**August 11 at 1:50 am PDT.**

**Problem 2** - Suppose that sunrise at the Curiosity lander happened on February 16, 2013 at 5:20 pm Pacific Standard Time (Sol 190 at 6:00 am Local Mars Time). A Navigation Engineer begins his work shift exactly at that moment. When will his shift have to start after 5 Sols have passed on Mars?

Answer: By his clock, each sunrise will happen 40 minutes later in Earth time, so after 5 Sols have passed, sunrise will happen 5 x 40 minutes = 200 minutes later or 3 hours and 20 minutes added to 5:20 pm PST, which becomes **8:40 pm PST on February 21.**

**Problem 3** – How many Sols have to elapse before his work shift once again starts at the same Earth time of 5:20 pm PST?

Answer: One day on Earth is 24 hours long and 1 Sol on Mars is 24 hours 40 minutes long, so we have to wait until the extra 40 minutes after each Sol adds up to exactly 24 hours. Every 3 Sols equals 120 minutes or 2 hours. The progression look like this

Sols	3	6	9	12	15	18...etc
Hours	2	4	6	8	10	12 ... etc

So if 18 Sols equals 12 hours, then 36 Sols equals 24 hours.

The answer is **36 Sols.**

Note to Teacher: 1 Earth day equals 24x60= 1440 minutes so 1 Sol = 1 day plus 40m/  
 1440m = 1.028 Earth Days.

We can then convert **36 Sols** to 36 x 1.028 = **37 Earth Days.**

So In the problem above, if the Navigation Engineer starts on February 16 at 5:20 pm for his first Sunrise shift, after 37 days he will start his next Sunrise shift at the same time on March 25, 2013.