Mars Opposition – Thursday 8th Dec 2022

Mars is about 6,780 kilometres in diameter or roughly half the size of the Earth (diameter 12,742km). However, it only has about 11% of the Earth's mass and 38% of Earth's surface gravity. As they orbit the Sun, the minimum distance between the Earth and Mars is about 55 million kilometres, while the maximum distance is about 400 million kilometres. Thus, Mars can be as small as 3.5" in angular diameter or as large as 25.4".

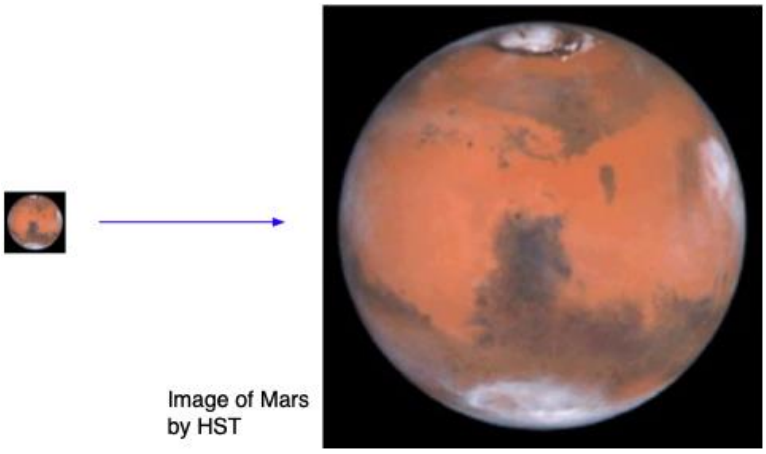


Image of Mars by HST

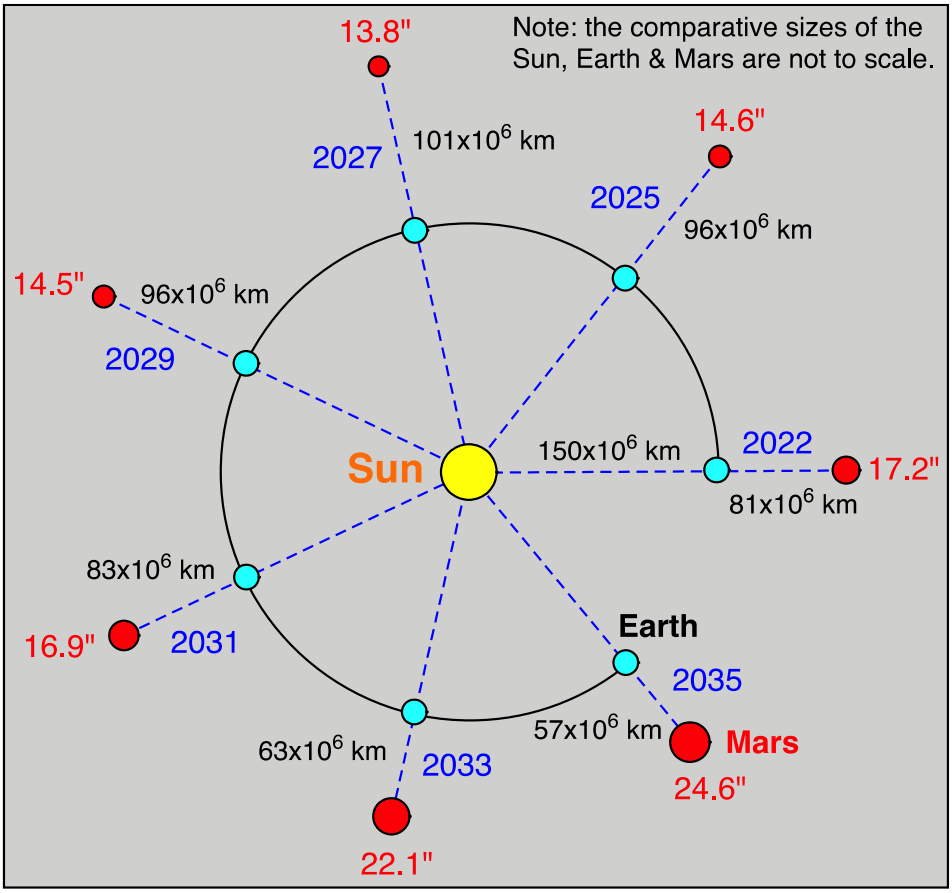
As the Earth travels around the Sun, it catches up with the slower Mars every 780 days (2 years and 50 days or about 2 years and 1.7 months). At this time, the Earth passes between Mars and the Sun, forming an angle of about 180 degrees with the other two. The term "**opposition**" derives from the fact that Mars and the Sun appear on opposite sides of the sky. At opposition, Mars is around the closest to the Earth in its orbit, taking into account that none of the planet's orbits are exactly coplanar. Also, the orbit of Mars about the Sun is much more elliptical than the Earth's and its eccentricity changes over time (0 to 0.14 over 96,000 years) due mainly to the influence of Jupiter. Its distance from the Earth and its angular size can vary markedly over successive oppositions.

Dates of Mars Oppositions (2012-2035)

The angular diameter of Mars is shown in the following table for every opposition from 2012 through to 2035 (AEST). Note how the angular size cycles up then down repeatedly.

Year	Opposition Date	Angular Size
2012	4th March	13.9"
2014	9th April	15.2"
2016	22nd May	18.6"
2018	27th July	24.3"
2020	14th October	22.6"
2022	8th December	17.2"
2025	16th January	14.6"
2027	20th February	13.8"
2029	25th March	14.5"
2031	4th May	16.9"
2033	27th June	22.1"
2035	16th September	24.6"

At the opposition of 2003, Mars had come closer to the Earth than it had done for almost 60,000 years – a distance of 55.8 million kilometres and angular size 25.1”. It will be Aug 14th 2050 before Mars reaches 25” again. Distances between Earth at Mars for the 2022-2035 oppositions are shown in the diagram below. In that time the Earth has completed 13 orbits to Mar’s 6 orbits.



Mars Opposition 2022

In the 2022 opposition, Mars will be about 17” in apparent size, 7” less than the 2018 opposition. However, this is still considerably bigger than its smallest apparent size of 3.5”.

Of course, you don’t have to view Mars right on the opposition date. Its apparent size will be greater than 15” for about a month before and after opposition. See the table below. Times are DST with data sourced from SkySafari. Mars will be rising and at 30° altitude at each of the times given. It won’t get higher than about 32° on any of those nights.

Date (2022)	Distance of Mars	Angular Size	Vmag	Time when at 30° altitude
Oct 27	95.9 million km	14.6”	-1.1	3:04am
Nov 3	91.1 million km	15.4”	-1.3	2:41am
Nov 10	87.2 million km	16.1”	-1.4	2:15am
Nov 17	84.0 million km	16.7”	-1.6	1:47am
Nov 24	82.1 million km	17.1”	-1.7	1:14am
Dec 1	81.5 million km	17.2”	-1.8	12:39am
Dec 8	82.3 million km	17.0”	-1.9	11:55pm
Dec 15	84.5 million km	16.6”	-1.7	11:15pm
Dec 22	88.3 million km	15.9”	-1.5	10:35pm
Dec 29	93.3 million km	15.0”	-1.3	9:57pm
Jan 5	99.7 million km	14.1”	-1.1	9:23pm

Observing Mars and some of the other planets

Even at opposition, Mars will never look bigger than Jupiter (whose angular size can vary from about 30" to 50"). At the 2022 opposition, Mars will look about the same size as the main body of Saturn (16") but Mars (magnitude -1.9) will be much brighter than Saturn (magnitude 0.8).

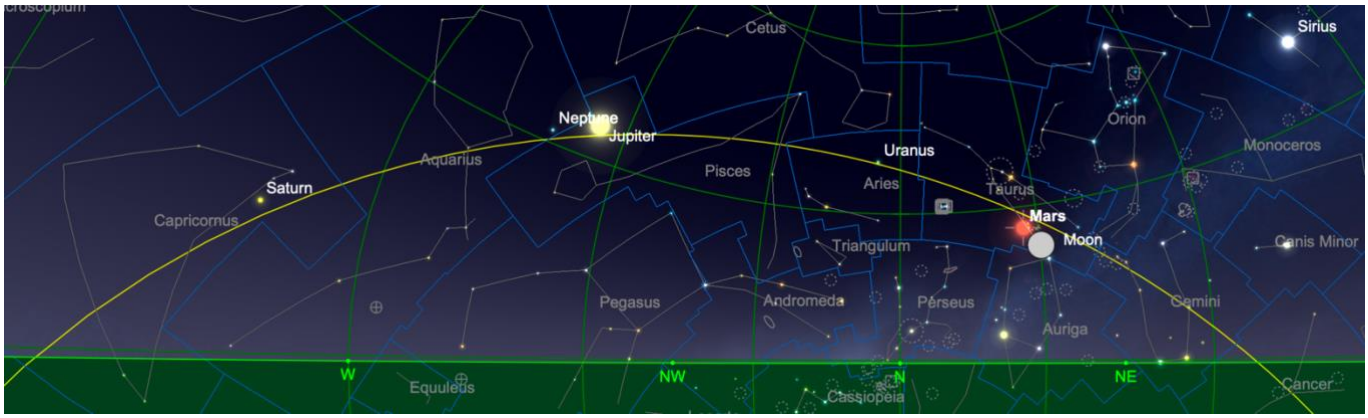
This diagram (clips from SkySafari) compares the apparent sizes of Mars 17", Jupiter 43" and Saturn 16" at 11pm DST on 8th December 2022.

It's a great time to look at all three of those planets! Uranus and Neptune will be in the sky as well. At 11pm DST on 8th December, Mars will be roughly 5 degrees from a near Full Moon.

You don't need a dark sky to observe these planets. Even a smaller telescope will show you some major features of these planets – albedo (dark and light) features on Mars, the equatorial belts and Galilean moons of Jupiter and the rings of Saturn. However, larger telescopes will allow more magnification and resolve finer features.

Of course, good seeing conditions are required to bump up the magnification on your telescope. More often than not, average seeing will only allow good views to about 250x even if your telescope's manual says it can go to 500x. Having said that, one of the best views of Saturn I've ever had was through a 12-inch Dob at 600x on a night of excellent seeing at Penrith Observatory. If you can score a night with really good seeing conditions, you might get some unforgettable views of Mars and its features.

Positions of Mars, Jupiter, Saturn at 11pm on Thu 8th December.



SkySafari screen clip.

Some of the surface features of Mars

The northern hemisphere of Mars consists mainly of smooth, low-lying lava plains covered in dust (dust storms can cover the entire planet for weeks) while the southern hemisphere is mostly rocky highlands with exposed craters. Hellas Planitia is a plain located in the huge **Hellas** crater. About 2,000km in diameter and 7,000m deep, it was formed from a massive impact 4 billion years ago. Hellas is the largest known visible impact crater in the solar system.

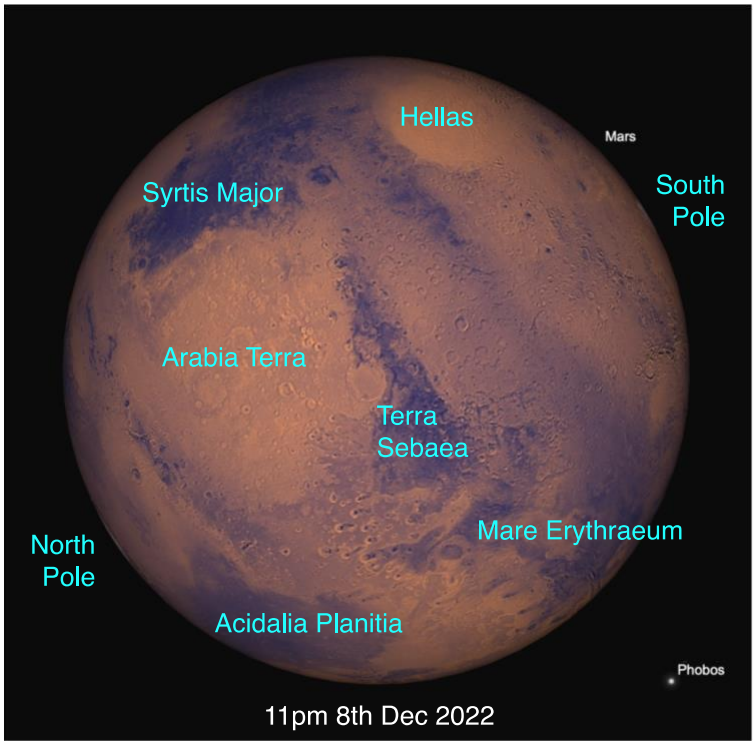
Olympus Mons, near the eastern edge of Amazonis Planitia, is one of 20 huge volcanos that dominate the landscape. It is one of the largest volcanos in the entire solar system (the largest on a planet), standing at 22km in height with a base some 600km wide. However, despite its size, you won't see the volcanoes through your home telescope.

Bright and dark areas visible through a telescope are albedo features. The brighter plains were thought to be continents and the darker areas thought to be seas (Mare). The plains are covered in dust and sand rich in reddish oxides. Amazonis Planitia is one of the smoothest plains on Mars.

Note: *Planitia is the IAU descriptor for a low, often smooth, plain. Terra is an IAU descriptor for a large land mass, most often rugged and heavily cratered e.g.* ***Arabia Terra.*** *Mare are large darker regions thought to have been seas, a term also commonly used for features on the Moon.*

The dark grey areas are exposed rock (mostly basalt) blown clear of dust by winds e.g. **Acidalia Planitia** and **Syrtis Major Planum**. The largest dark feature seen from the Earth is Syrtis Major Planum (named after a Libyan gulf). *Planum is the IAU descriptor for a plateau or high plain.*

The following screen clip from SkySafari shows some of the features on Mars at 11pm 8th Dec 2022. My labelling.



Mars has an axial tilt of about 25degrees to its orbital plane. In the 2014 and 2016 oppositions, only the North Polar Cap was visible. In the 2018 and 2020 oppositions only the South Polar Cap was visible. In the 2022 opposition, it may be possible to see some of both Caps.

 Rob Horvat (WSAAG).