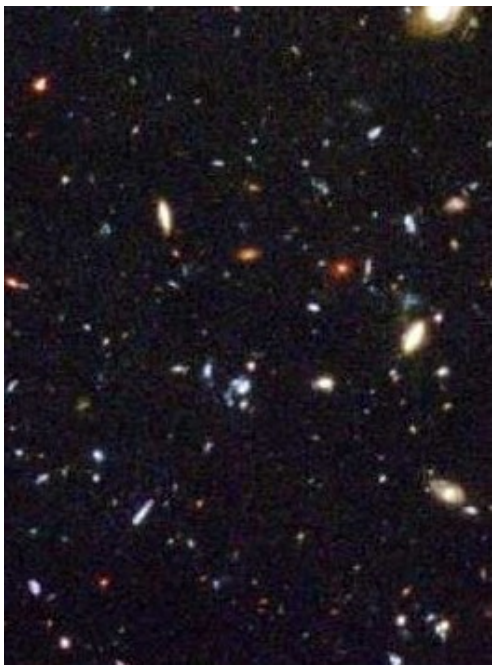
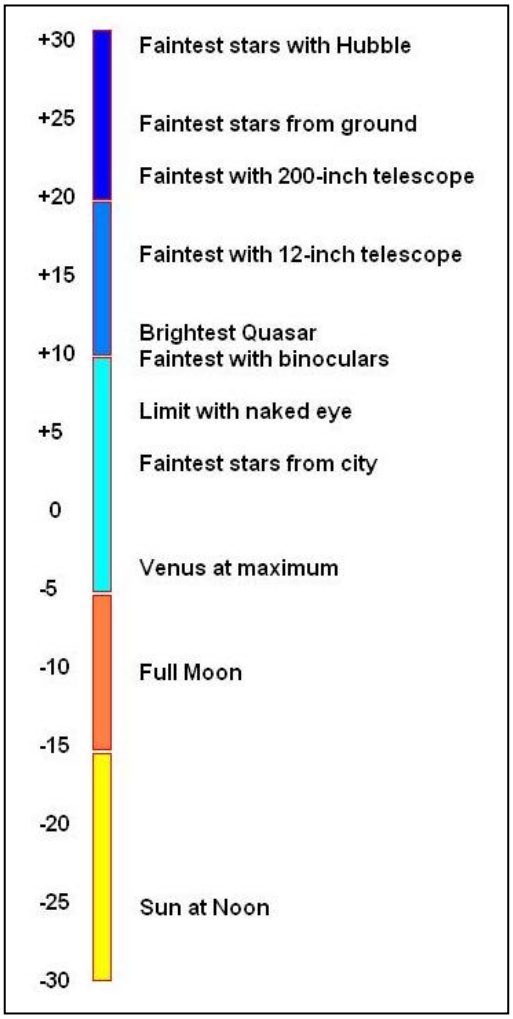
The Stellar Magnitude Scale





Astronomers measure the brightness of a star in the sky using a magnitude scale. On this scale, the brightest objects have the SMALLEST number and the faintest objects have the LARGEST numbers. It's a 'backwards' scale that astronomers inherited from the ancient Greek astronomer Hipparchus.

The image to the left taken by the Hubble Space Telescope shows hundreds f faint galaxies beyond the Milky Way. The faintest are of magnitude +25.0.

1 – At its brightest, the planet Venus has a magnitude of -4.6. The faintest star you can see with your eye has a magnitude of +7.2. How much brighter is Venus than the faintest visible star?

2 – The full moon has a magnitude of -12.6 while the brightness of the Sun is about -26.7. How many magnitudes fainter is the moon than the Sun?

3 – The faintest stars seen by astronomers with the Hubble Space Telescope are about +30.0. How much fainter are these stars than the Sun?

4 - Jupiter has a magnitude of –2.7 while its satellite, Callisto, has a magnitude of +5.7. How much fainter is the Callisto than Jupiter?

5 – Each step by 1 unit in magnitude equals a brightness change of 2.5 times. A star with a magnitude of +5.0 is 2.5 times fainter than a star with a magnitude of +4.0. Two stars that differ by 5.0 magnitudes are 100-times different in brightness. If Venus was observed to have a magnitude of +3.0 and the full moon had a magnitude of -12.0, how much brighter was the moon than Venus?

Answer Key

1 – At its brightest, the planet Venus has a magnitude of -4.6. The faintest star you can see with your eye has a magnitude of +7.2. How much brighter is Venus than the faintest visible star?

Answer: +7.2 – (-4.6) = +7.2 + 4.6 = **+11.8 magnitudes**

2 – The full moon has a magnitude of -12.6 while the brightness of the sun is about -26.7. How many magnitudes fainter is the moon than the sun?

Answer: -12.6 – (-26.7) = -12.6 + 26.7 = **+14.1 magnitudes fainter.**

3 – The faintest stars seen by astronomers with the Hubble Space Telescope is +30.0. How much fainter are these stars than the sun?

Answer: +30.0 – (-26.7) = +30.0 + 26.7 = **+56.7 magnitudes fainter.**

4 - Jupiter has a magnitude of –2.7 while its satellite, Callisto, has a magnitude of +5.7. How much fainter is the Callisto than Jupiter?

Answer: +5.7 – (-2.7) = +5.7 + 2.7 = **+8.4 magnitudes fainter than Jupiter.**

5 – Each step by 1 unit in magnitude equals a brightness change of 2.5 times. A star with a magnitude of +5.0 is 2.5 times fainter than a star with a magnitude of +4.0. Two stars that differ by 5.0 magnitudes are 100-times different in brightness. If Venus was observed to have a magnitude of +3.0 and the full moon had a magnitude of -12.0, how much brighter was the moon than Venus?

Answer: The magnitude difference between them is +15.0, since every 5 magnitudes is a factor of 100 fainter, +15.0 is equivalent to 100x100x100 = 1 million times, so the moon is **1 million times brighter** than Venus.