TRAPPIST-1 Activities

Calculating TRAPPIST-1 Planet Densities

To calculate the average density of a sphere (ρ), you simply divide the mass (m) of the sphere by it's volume (v).

$\rho = m/v$

If you have the radius of the sphere (r), then the volume is given by the formula:

$v = (4/3)\pi r^3$

For example, the mass of Earth is 5.972×10^{24} kg. To find the volume of Earth we use the formula $v=(4/3)\pi r^3$. Earth's radius is 6.371×10^6 meters. Therefore, volume = $(4/3)(3.14)(6.371 \times 10^6 \text{ m})^3 = 1.083 \times 10^{21} \text{ m}^3$. Then to find the density we divide mass by volume = $5.972 \times 10^{24} \text{ kg}/1.083 \times 10^{21} \text{ m}^3 = 5514 \text{ kg/m}^3 = 5.51 \text{ g/cm}^3$.

The density of water is 1 g/cm^3. Planets with a density of less than 1 g/cm^3 would float if dropped in a giant bathtub!

Use the table below to calculate the approximate densities for the 7 Earth-like worlds of the TRAPPIST-1 System.

Planet	Radius	Mass	Density
TRAPPIST-1b	6.94×10^6 m	5.076×10^{24} kg	-
TRAPPIST-1c	6.75×10^6 m	8.24×10^{24} kg	-
TRAPPIST-1d	4.90×10^6 m	2.45×10^{24} kg	-
TRAPPIST-1e	5.86×10^6 m	3.70×10^{24} kg	-
TRAPPIST-1f	6.63×10^6 m	4.06×10^{24} kg	-
TRAPPIST-1g	7.20×10^6 m	8.00×10^{24} kg	-

Answers: Trappist-1b 3.63 g/cm^3, Trappist-1b 6.45 g/cm^3, Trappist-1b 4.90 g/cm^3, Trappist-1b 4.41 g/cm^3, Trappist-1b 3.31 g/cm^3, Trappist-1b 5.18 g/cm^3

TRAPPIST-1 System Travel Time

How long would it take to travel from Earth to the 7 potentially Earth-like worlds of the TRAPPIST-1 System? We know that the TRAPPIST-1 system is 39 light-years away from Earth. That means that if we could travel at the speed of light, it would take 39 years to get there. According to Einstein's theory of general relativity, nothing can travel faster than the speed of light. We currently have no spacecraft that can travel at the speed of light or anywhere close to it.

To calculate the travel time to the TRAPPIST system, you take the distance to TRAPPIST-1 (39 light-years) and divide it by the distance your spacecraft covers in one year. Ensure that the number you are dividing has the same units as the number you are dividing by.

TRAPPIST-1 Distance = 39 light-years = 229 trillion miles = 369 trillion kilometers

Travel Time = Distance to TRAPPIST-1 / distance spacecraft travels in 1 year

or:

Travel Time (in miles) = 229,000,000,000,000 miles / (vehicle speed in mph x 24 (hours) x 365 (days))

Travel Time (in kilometers) = 365,000,000,000,000 km / (vehicle speed in km/h x 24 (hours) x 365 (days))

Spacecraft	Speed	Info
Car	60 mph (100 km/h)	Safe highway speed.
Spaceshuttle	17,500 mph (28,160 km/h)	Capable of carrying humans.
New Horizons Spacecraft	32,000 mph (52,000 km/h)	Fastest spacecraft ever launched.
Juno Spacecraft	165,000 mph (265,000 km/h)	Fastest ever speed achieved by a spacecraft.

Use the table above to calculate how long it would take to travel to TRAPPIST-1 with today's transportation technology.

1. How many years would it take to travel by car to TRAPPIST-1?
2. How many years would it take in the Spaceshuttle to travel to TRAPPIST-1?
3. How many years would it take in the New Horizons spacecraft to travel to TRAPPIST-1?
4. How many years would it take in the Juno spacecraft to travel to TRAPPIST-1?
5. With today's technology, do you think it's practical to travel to TRAPPIST-1?

Answers: 1. 436 million years, 2. 1.5 million years, 3. 817,000 years, 4. 159, 000 years, 5. no

How Much Would You Weigh on a TRAPPIST-1 Planet

You might be curious as to how much you would weigh on the other planets in the TRAPPIST-1 system. Would you be gambolling on the surface like the astronauts do on the Moon or would you feel heavier on the surface?

We used Newton's gravitational law to calculate the ratio between Earth's surface gravity and that of the other planets in the TRAPPIST-1 system. Multiply your weigh on Earth by each planet surface gravity ratio to find out how much you would weigh on each planet compared to Earth.

Planet	Surface Gravity Ratio
Earth	1.00
TRAPPIST-1b	0.72
TRAPPIST-1c	1.23
TRAPPIST-1d	0.69
TRAPPIST-1e	0.73
TRAPPIST-1f	0.63
TRAPPIST-1g	1.05

Answers: Will vary per student.