

Name: \_\_\_\_\_

Date: \_\_\_\_\_



## Astronomical Units



Talking and writing about distances in our solar system can be cumbersome. The Sun and Neptune are on average 4,500,000,000 (or four billion, five hundred million) kilometers apart. Earth's average distance from the Sun is 150,000,000 (one hundred fifty million) kilometers. It can be difficult to keep track of all the zeroes in such large numbers. And it's not easy to compare numbers that large.

Astronomers often switch to astronomical units (abbreviated AU) when describing distances in our solar system. One astronomical unit is 150,000,000 km—the same as the distance from Earth to the Sun.

Neptune is 30 AU from the Sun. Not only is 30 an easier number to work with than 4,500,000,000; but using astronomical units allows us to see immediately that Neptune is 30 times as far from the Sun as Earth.

In this skill sheet, you will practice working with astronomical units.

### EXAMPLE

- Jupiter is 778 million kilometers from the Sun, on average. Find this distance in astronomical units.

**Solution:** Divide 778 million km by 150 million km:  $778,000,000 \div 150,000,000 = 5.19$  AU

- The average distance from Mars to the Sun is 1.52 AU. Find this distance in kilometers.

**Solution:** Multiply 1.52 AU by 150 million km:  $1.52 \times 150,000,000 = 228,000,000$  km

### PRACTICE

1. The average distance from Saturn to the Sun is 1.43 billion kilometers. Find this distance in astronomical units.
2. The average distance from Venus to the Sun is 108 million kilometers. Find this distance in astronomical units.
3. Mercury's average distance from the Sun is 0.387 astronomical units. How far is this in kilometers?
4. The average distance from Uranus to the Sun is 19.13 astronomical units. How far is this in kilometers?
5. Is the distance from Earth to the moon more or less than one astronomical unit? How do you know?
6. Which planet is almost 20 times as far away from the Sun as Earth?
7. Which planet is less than half as far away from the Sun as Earth?
8. Which planet is almost twice as far from the Sun as Jupiter?
9. An unmanned spacecraft launched from Earth has traveled 10 astronomical units in the direction away from the Sun. It most recently passed through the orbit of which planet?
10. An unmanned spacecraft launched from Earth has traveled 0.5 astronomical units toward the Sun. Has it passed through the orbit of Venus yet?

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## Understanding Light Years

How far is it from Los Angeles to New York? Pretty far, but it can still be measured in miles or kilometers. How far is it from Earth to the Sun? It's about one hundred forty-nine million, six hundred thousand kilometers (149,600,000, or  $1.496 \times 10^8$  km). Because this number is so large, and many other distances in space are even larger, scientists developed bigger units in order to measure them. An Astronomical Unit (AU) is  $1.496 \times 10^8$  km (the distance from Earth to the sun). This unit is usually used to measure distances within our solar system. To measure longer distances (like the distance between Earth and stars and other galaxies), the light year (ly) is used. A light year is the distance that light travels through space in one year, or  $9.468 \times 10^{12}$  km.

### EXAMPLES

#### 1. Converting light years (ly) to kilometers (km)

Earth's closest star (Proxima Centauri) is about 4.22 light years away. How far is this in kilometers?

**Explanation/Answer:** Multiply the number of kilometers in one light year ( $9.468 \times 10^{12}$  km/ly) by the number of light years given (in this case, 4.22 ly).

$$\frac{(9.468 \times 10^{12}) \text{ km}}{1 \text{ ly}} \times 4.22 \text{ ly} \approx 3.995 \times 10^{13} \text{ km}$$

#### 2. Converting kilometers to light years

Polaris (the North Star) is about  $4.07124 \times 10^{15}$  km from the earth. How far is this in light years?

**Explanation/Answer:** Divide the number of kilometers (in this case,  $4.07124 \times 10^{15}$  km) by the number of kilometers in one light year ( $9.468 \times 10^{12}$  km/ly).

$$4.07124 \times 10^{15} \text{ km} \div \frac{9.468 \times 10^{12} \text{ km}}{1 \text{ ly}} = \frac{4.07124 \times 10^{15} \text{ km}}{1} \times \frac{1 \text{ ly}}{9.468 \times 10^{12} \text{ km}} \approx 430 \text{ light years}$$

### PRACTICE

Convert each number of light years to kilometers.

1. 6 light years
2.  $4.5 \times 10^6$  light years
3.  $4 \times 10^{-3}$  light years

Convert each number of kilometers to light years.

4.  $5.06 \times 10^{16}$  km
5. 11 km
6. 11,003,000,000,000 km

**Solve each problem using what you have learned.**

7. The second brightest star in the sky (after Sirius) is Canopus. This yellow-white supergiant is about  $1.13616 \times 10^{16}$  kilometers away. How far away is it in light years?
8. Regulus (one of the stars in the constellation Leo the Lion) is about 350 times brighter than the sun. It is 85 light years away from the earth. How far is this in kilometers?
9. The distance from earth to Pluto is about 28.61 AU from the earth. Remember that an AU =  $1.496 \times 10^8$  km. How many kilometers is it from Pluto to the earth?
10. If you were to travel in a straight line from Los Angeles to New York City, you would travel 3,940 kilometers. How far is this in AU's?
11. Challenge: How many AU's are equivalent to one light year?

