Jet Propulsion Laboratory
California Institute of Technology | Education

Answer Key

π IN THE SKY 6

By now, you know a slice of pi can take you far. Check your answers below to see if your pi skills could one day make you a NASA space explorer.

Deadly Dust

What percent of the Mars surface was covered in dust during the height of the storm?

1. Find the area of Olympus Mons' caldera.

$A = \pi r^2$

$\pi \cdot (35 \text{ km})^2 \approx 3{,}800 \text{ km}^2$

2. Find the surface area of Mars.

$A = 4\pi r^2$

$4 \cdot \pi \cdot (3{,}389.5 \text{ km})^2 \approx 144{,}370{,}000 \text{ km}^2$

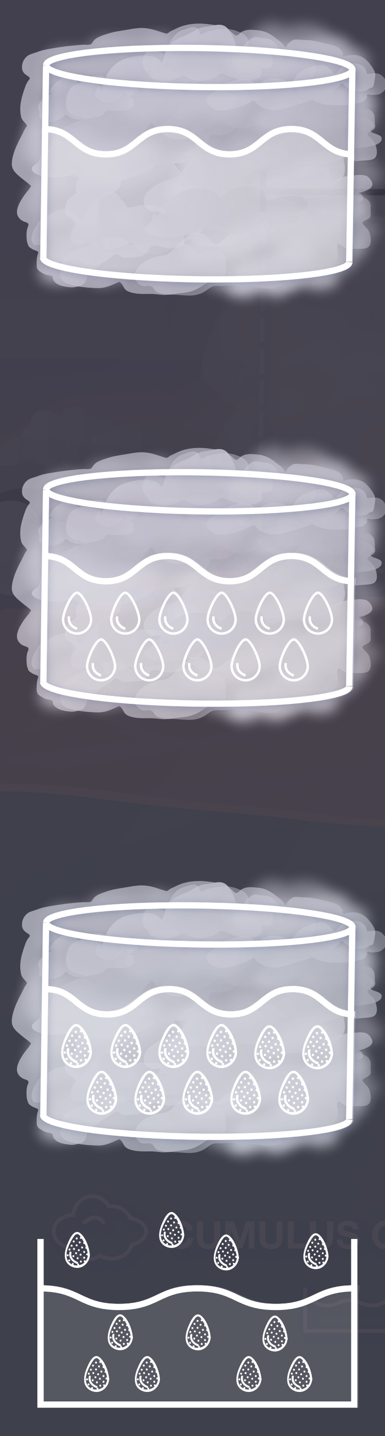
3. Subtract the area of Olympus Mons' caldera from the total surface area of Mars to find the area covered by the dust storm.

$144{,}370{,}000 \text{ km}^2 - 3{,}800 \text{ km}^2 = 144{,}366{,}200 \text{ km}^2$

4. Divide the area covered by the dust storm by the total surface area of Mars to find the percent covered by the dust storm.

$144{,}366{,}200 \text{ km}^2 / 144{,}370{,}000 \text{ km}^2 \approx$ **99.997%**

Cloud Computing



Calculate the approximate volume of the cloud in cubic kilometers.

1. Find the volume of the cylinder-shaped cloud.

$V = \pi r^2 h$

$\pi \cdot (5 \text{ km})^2 \cdot 6 \text{ km} \approx$ **471 km³**

Calculate the total amount of water in the cloud.

1. Multiply the typical liquid water content density of a cumulus cloud by the volume of the cloud to find the total mass of water in the cloud.

$500{,}000 \text{ kg/km}^3 \cdot 471 \text{ km}^3 \approx$ **235,500,000 kg**

How many Olympic size swimming pools could be filled with rain from the cloud?

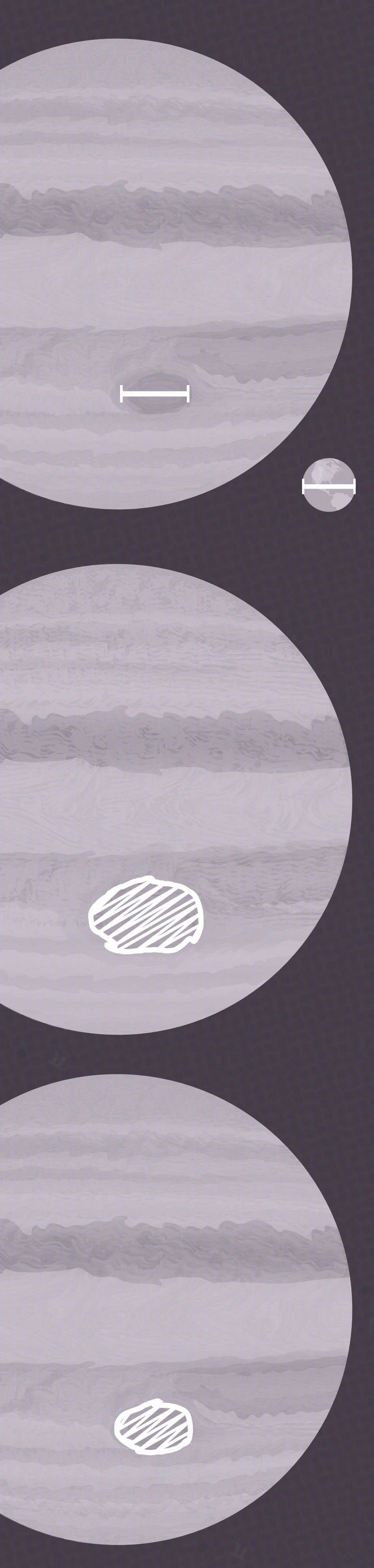
1. Divide the mass of water in the cloud by the density of water to find the volume of water in the cloud.

$235{,}500{,}000 \text{ kg} / 1{,}000 \text{ kg/m}^3 \approx 235{,}500 \text{ m}^3$

2. Divide the volume of water in the cloud by the volume of an Olympic size swimming pool to find how many pools the cloud could fill with rain.

$235{,}500 \text{ m}^3 / 2{,}500 \text{ m}^3 \approx$ **94 pools**

Storm Spotter



How does the 2018 width of the Great Red Spot compare with the diameter of Earth?

1. Divide the width of the Great Red Spot in 2018 by the diameter of Earth to determine how the width of the storm compares with the diameter of our planet.

$16{,}500 \text{ km} / 12{,}742 \text{ km} \approx$ **1.29 times the diameter of Earth**

By what percent did the area of the Great Red Spot shrink from 1979 to 2018?

1. Plug the 1979 width and height measurements of the Great Red Spot into the formula for the area of an ellipse to find the area of the storm in 1979.

$\pi \cdot 24{,}700 \text{ km} \cdot 13{,}300 \text{ km} \approx 1{,}032{,}000{,}000 \text{ km}^2$

2. Plug the 2018 width and height of the Great Red Spot into the same formula to find the area of the storm in 2018.

$\pi \cdot 16{,}500 \text{ km} \cdot 11{,}400 \text{ km} \approx 591{,}000{,}000 \text{ km}^2$

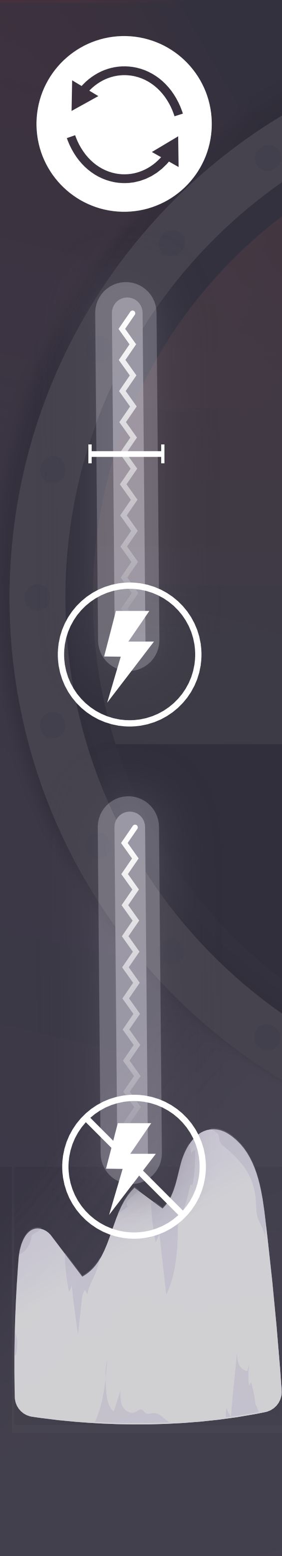
3. Divide the 1979 area of the Great Red Spot by the 2018 area and multiply by 100 to find the size of the 2018 storm relative to the 1979 storm.

$(591{,}000{,}000 \text{ km}^2 / 1{,}032{,}000{,}000 \text{ km}^2) \cdot 100 \approx 57\%$

4. Subtract the relative size percentage from 100% to find the percent by which the storm shrank.

$100\% - 57\% =$ **43%**

Icy Intel



Using a beam that has a radius of 125.0 μm and a total optical pulse energy of 0.30 mJ, what is the laser's peak fluence in J/cm²?

1. Divide the laser's optical pulse energy by 1,000 to convert millijoules (mJ) to joules (J).

$0.30 \text{ mJ} / 1{,}000 = 0.0003 \text{ J}$

2. Divide the laser's radius by 10,000 to convert micrometers (μm) to centimeters (cm).

$125.0 \text{ μm} / 10{,}000 = 0.0125 \text{ cm}$

3. Find the laser's peak fluence by dividing its optical pulse energy by the provided formula with the laser's radius plugged in.

$$\frac{0.0003 \text{ J}}{(\pi \cdot (0.0125 \text{ cm})^2) / 2} \approx 1.2 \text{ J/cm}^2$$

If the optics used to aim and focus the laser reduce its energy by 27% before it hits the sample, will this beam be sufficient to examine a sample that needs a peak fluence of 1.0 J/cm² to explode?

1. Multiply the peak fluence by 0.73 to find the fluence after the 27% reduction in energy.

$1.2 \text{ J/cm}^2 \cdot 0.73 \approx 0.88 \text{ J/cm}^2$

No, the beam is not sufficient to explode the sample.