

# π IN THE SKY<sup>10</sup>

## ANSWER KEY

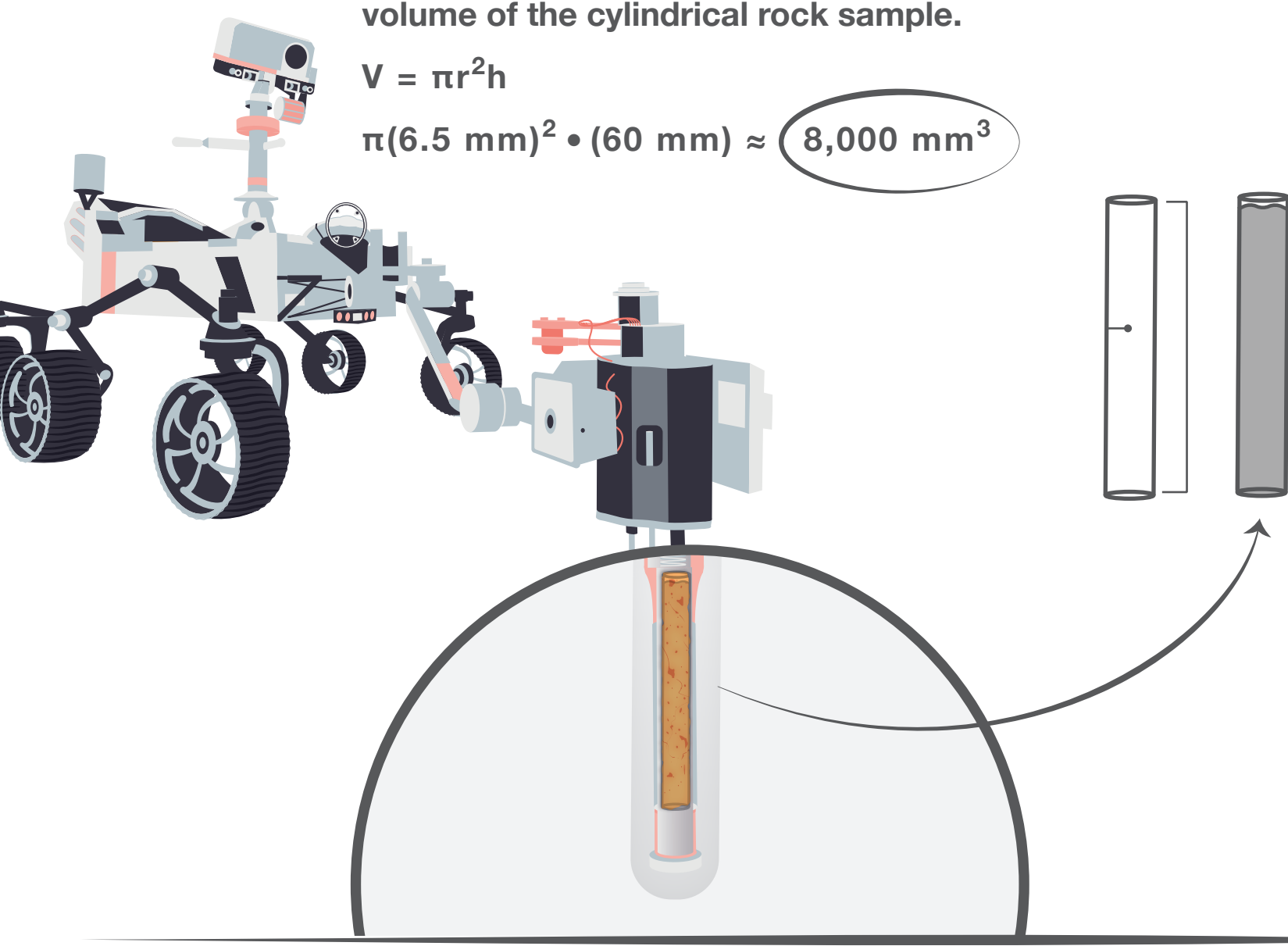
### TUBULAR TALLY

What is the volume of the rock in the sample tube?

- Use the formula for the volume of a cylinder to compute the volume of the cylindrical rock sample.

$$V = \pi r^2 h$$

$$\pi(6.5 \text{ mm})^2 \cdot (60 \text{ mm}) \approx 8,000 \text{ mm}^3$$



### RAD REFLECTION

How much bigger is the surface of Webb's primary mirror than Hubble's?

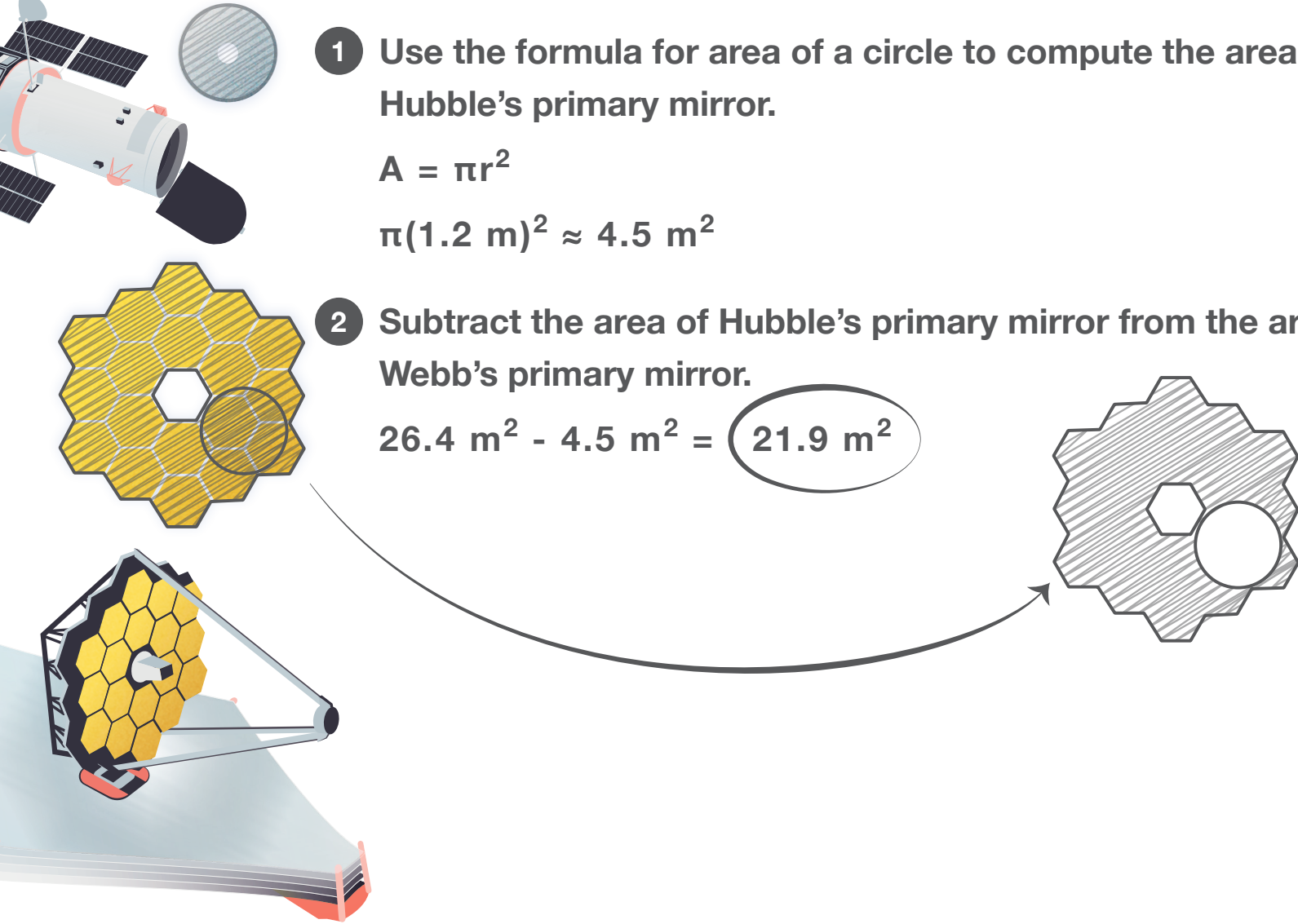
- Use the formula for area of a circle to compute the area of Hubble's primary mirror.

$$A = \pi r^2$$

$$\pi(1.2 \text{ m})^2 \approx 4.5 \text{ m}^2$$

- Subtract the area of Hubble's primary mirror from the area of Webb's primary mirror.

$$26.4 \text{ m}^2 - 4.5 \text{ m}^2 = 21.9 \text{ m}^2$$



### METAL MATH

Compute the approximate density of asteroid (16) Psyche.

- Use the formula for volume of a triaxial ellipsoid to compute the volume of Psyche.

$$V = 4/3 \pi abc$$

$$V = 4/3 \pi(145 \text{ km}) \cdot (122.5 \text{ km}) \cdot (85 \text{ km}) \approx 6,300,000 \text{ km}^3$$

- Use the formula for density to compute the approximate density of Psyche.

$$D = m/V$$

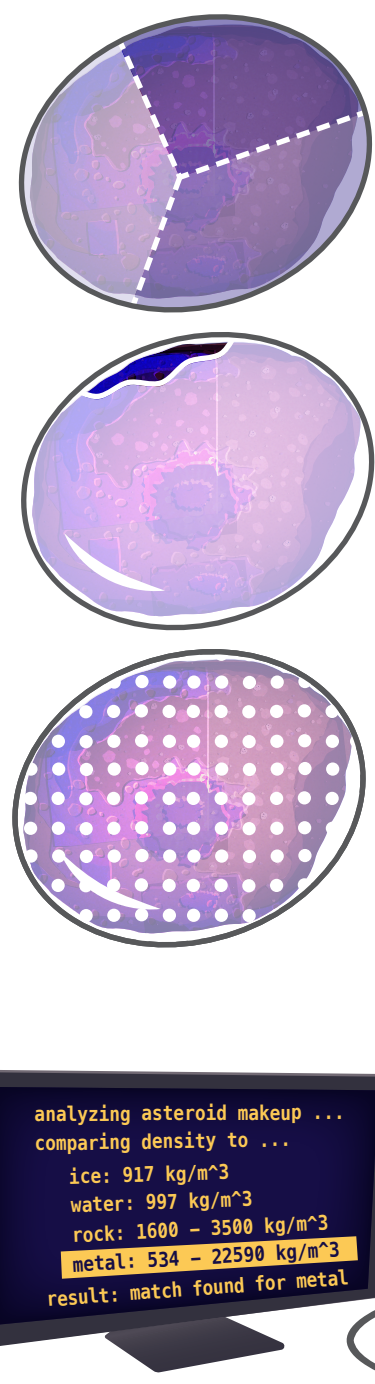
$$D = (2.7 \cdot 10^{19} \text{ kg}) / (6.3 \cdot 10^6 \text{ km}^3) \approx 4.3 \cdot 10^{12} \text{ kg/km}^3$$

Does the density of Psyche support the observations indicating the presence of metal?

- Convert the units to match the density units given.

$$4.3 \cdot 10^{12} \text{ kg/km}^3 \cdot (1 \text{ km}^3 / 10^9 \text{ m}^3) = 4.3 \cdot 10^3 \text{ kg/m}^3 = 4,300 \text{ kg/m}^3$$

This is higher density than rock, so Psyche must contain some metal.



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analyzing asteroid makeup ...
comparing density to ...
ice: 917 kg/m^3
water: 997 kg/m^3
rock: 1600 - 3500 kg/m^3
metal: 534 - 22590 kg/m^3
result: match found for metal.
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### ECLIPSING ENIGMA

What percentage of the Sun's disk area will be obscured by the Moon?

- Use similar triangles to find the radius of the Sun's disk area that is obscured by the Moon.

$$\frac{1,737 \text{ km}}{388,901 \text{ km}} = \frac{x}{148,523,036 \text{ km}} \Rightarrow x \approx 663,400 \text{ km}$$

- Calculate the ratio of the obscured area to the Sun's total disk area using the formula for area of a circle.

$$\frac{A_{\text{Moon}}}{A_{\text{Sun}}} = \frac{\pi r^2}{\pi R^2} \approx \frac{\pi(663,400 \text{ km})^2}{\pi(695,700 \text{ km})^2} \approx 0.91 = 91\%$$

Will the eclipse be an annular eclipse or total eclipse?

It will be an annular eclipse.

