NASA’s new mission to Mars called InSight will be launched in March, 2016. It will land on September 20, 2016 in a region of Mars located near the equator and deploy a seismographic station to study the interior of Mars.

To provide the electricity it needs, the lander will deploy two solar panels, each shaped like a regular, 10-sided polygon called a decagon.

In a regular decagon, the lengths of each of the 10 sides, \(a\), are equal. For the two InSight lander solar panels:

\[
a = 0.62 \text{ meters}, \\
r = 0.95 \text{ meters}, \\
R = 1.0 \text{ meters.}
\]

Problem 1 – What is the measure of the interior angle, \(y\) for a regular decagon?

Problem 2 – An isosceles triangle is formed by the base \(a\) and side length \(R\). What is the length, \(r\), in terms of \(a\) and \(R\)?

Problem 3 – What is the area of the isosceles triangle in Problem 2?

Problem 4 – What is the area of the regular decagon in terms of \(a\) and \(r\)?

Problem 5 - Calculate the area of one InSight solar panel in meter\(^2\).

Problem 6 - What is the estimated area of one solar panel by using the inscribed circle with a radius of \(r\) and the circumscribed circle with a radius \(R\)?

Problem 7 – To two significant figures, if the solar panels produce 75 watts/m\(^2\) of electricity at the distance of Mars from the sun, what is the total power produced by the two solar panels using either area method?

**Problem 1** – What is the measure of the interior angle, \( y \) for a regular decagon?

Answer: \( y = \frac{360}{10} = 36^\circ \).

**Problem 2** – An isosceles triangle is formed by the base \( a \) and side length \( R \). What is the length, \( r \), in terms of \( a \) and \( R \)?

Answer: The segment with the length, \( r \), is called the apothem and is the perpendicular bisector of the side with the length \( a \), so from the Pythagorean Theorem we get \( r = \left( R^2 - \left(\frac{a}{2}\right)^2 \right)^{1/2} \).

Note for the InSight dimensions: \( 0.95 = (1 - 0.096)^{1/2} \)

**Problem 3** – What is the area of the isosceles triangle in Problem 2?

Answer: \( A = 2 \times \frac{1}{2} \left(\frac{a}{2}\right) \times r \quad \text{so} \quad A = \frac{a r}{2} \)

For the InSight solar panel: \( A = 0.62 \times 0.95/2 = 0.29 \text{ m}^2 \).

**Problem 4** – What is the area of the regular decagon in terms of \( a \) and \( r \)?

Answer: \( A = 10 \times \frac{ar}{2} \quad \text{so} \quad A = 5ar \).

**Problem 5** - Calculate the area of one InSight solar panel in \( \text{meter}^2 \).

Answer: For the Insight solar panel, \( A = 5 \times (0.62)(0.95) = 2.95 \text{ m}^2 \).

**Problem 6** - What is the estimated area of one solar panel by using the inscribed circle with a radius of \( r \) and the circumscribed circle with a radius \( R \)?

Answer: Take the average areas of the inscribed and circumscribed circles to get \( A = 0.5 \pi \left( R^2 + r^2 \right) \). For Insight, \( A = 0.5 \times 3.141 \times (1 + 0.90) = 2.98 \text{ m}^2 \).

**Problem 7** – To two significant figures, if the solar panels produce 75 watts/\( \text{m}^2 \) of electricity at Mars, what is the total power produced by the two solar panels using either area method?

Answer: To 2 SF, the areas are both 3.0 \( \text{m}^2 \), so \( P = 2 \text{ panels} \times 75 \text{ w/}\text{m}^2 \times 3.0 \text{ m}^2 = 450 \text{ watts} \).

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