Earth Science Regents Lab
Eratosthenes Method & Earth's Shape

Name: ____________________________

Period: ______________ **Lab #:** _______

Eratosthenes was a Greek astronomer who lived in Alexandria, Egypt about 2,000 years ago. He was interested in figuring out the size of the earth. Specifically, he was concerned about the circumference of the earth – in other words, how big it is around. Eratosthenes heard of a place in southern Egypt (Syene) where the sun shone straight down into the bottom of a vertical well on a very special day of the year - *the summer solstice*. **The *summer solstice* is the day of the year that all observers in the *northern* hemisphere experience the longest duration of insolation (incoming solar radiation).**

By measuring the angular distance of the noon sun at two different locations that were directly North and South of each other (Alexandria and Syene) on the exact same day of the year (the summer solstice), and by knowing that the 2 cities were 5,000 stadia apart, Eratosthenes was able to determine the circumference of our planet to within about 15% error! This was *WAY* before satellites, computers, or even cell phones! ***The diagram below summarizes Eratosthenes' work – use this diagram to help you with the questions below.***

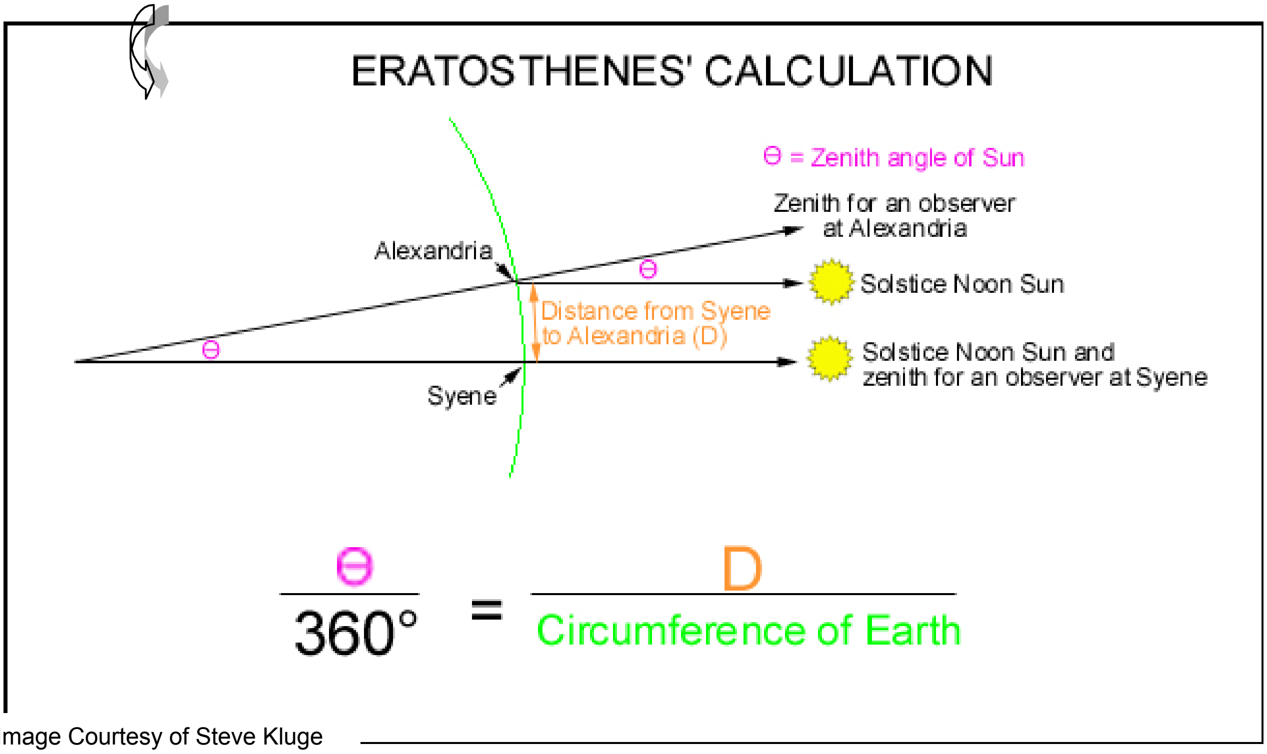
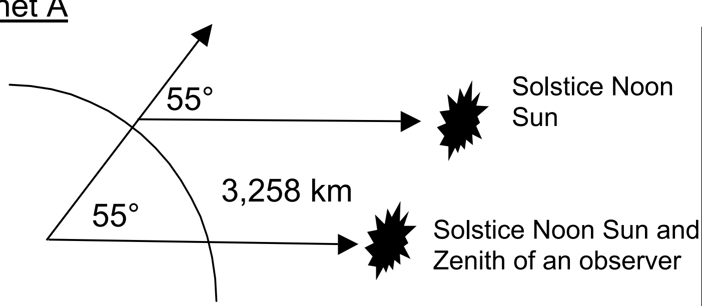


Image Courtesy of Steve Kluge

1. Your job: **Figure out the circumference** of some imaginary planets just like Eratosthenes. Remember that the drawings are ***not*** to scale.

Planet A

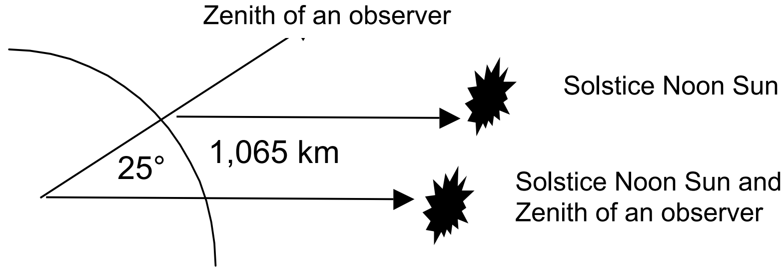


SHOW YOUR WORK AND YOUR UNITS!
(I set up this up one for you)

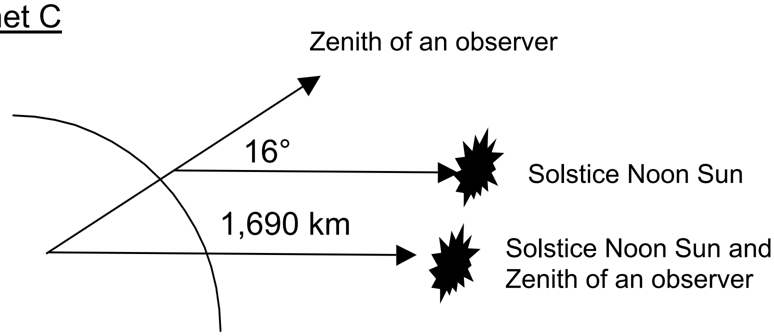
$$\frac{55^\circ}{360^\circ} = \frac{3{,}258\text{ km}}{\text{Circumference of Planet A}}$$

SHOW YOUR WORK & YOUR UNITS FOR ALL PROBLEMS!!!!!

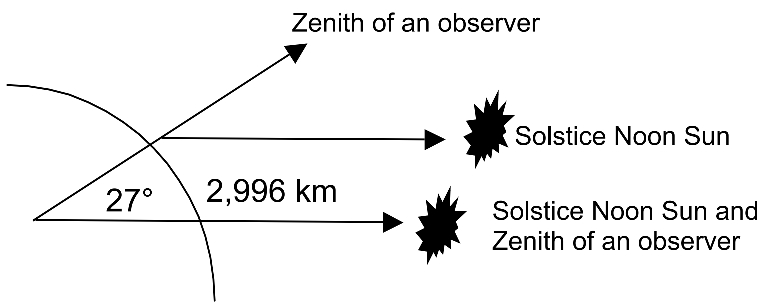
Planet B



Planet C



Planet D



2a. BRAIN BUSTER – Part 1: Now that you have determined the circumference of imaginary "Planet D", you can now use basic algebra to figure out the Diameter of this planet!
NOTE: You should round to the <u>nearest whole number</u> before doing the math for this question! Remember how to correctly round numbers!!!

Formula: Circumference = π (use 3.14 not the button) x Diameter (d)
SHOW YOUR WORK!!!!!!!!

Calculated Diameter of Planet D = ________________

2b. BRAIN BUSTER – Part 2: The dimensions of Planet D match very closely (it's o.k. if they differ *slightly*) to a planet you are familiar with in our solar system. Use your Handy Dandy ESRT's Page 15 to determine which planet "Planet D" really is! NOTE: The ESRT's lists the diameter of the planets in our solar system as "equatorial diameter".

Planet D = _____________

3. You should note that your diameter calculation of "Planet D" on the previous page is approximately **34 kilometers** different when compared to its diameter listed in the ESRTs *(Hint: you may have calculated the polar diameter and not the equatorial diameter)*. Write a 1-2 sentence inference summarizing your thoughts on what you think may be causing this slight discrepancy (this difference)?

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4. Your calculations of Earth's shape on the previous page assume that the earth is a perfect sphere. However, what if the earth is not a perfect shere? Instead, what if the earth is slightly bulged?

Using your ESRTs, and your earth calculations from page 2, is earth's diameter slightly larger at the poles **or** at the equator? Why?
(Hint #1: How do you feel around the holidays after a big meal? Hint #2: you came very close to calculating the polar diameter of earth on page 2.)

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5. You are now ready to calculate the percent deviation for **your** calculated value versus the ESRT value! You are like Eratosthenes – but just 2,000 years later!

(***HINT:*** *You can use the ESRT diameter on pg. 15 of the ESRTs as the* ***accepted*** *value, and your calculated value from Planet D on page 2 as* ***yours*** *to calculate the % deviation.)*

SHOW ALL OF YOUR WORK!!! (formula, plug-ins with units, circle answer with units!!!!!!)

6a. Due to the Earth being *slightly bulged at the equator* - the right answer to question 4, the name we give to Earth's shape is an <u>OBLATE SPHEROID</u>. Draw a picture of the earth with a bulge at the equator. Be sure to label the equator. You can exaggerate – have fun with it.

Your Drawing:

***6b.** However, it is <u>VERY IMPORTANT</u> to remember that the earth's bulge is very slight. How slight a bulge? Well, you calculated that the percent deviation between the polar and equatorial circumferences was only*

_____________ *%*

***6c.** So, at any reasonable scale, a perfect ____________________ is the best representation of the earth's shape.*

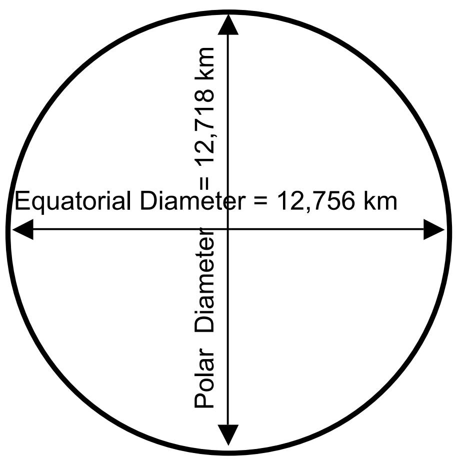

Fig 1: Map of Egypt
FYI - Aswan used to be called Syene.