CONSTRUCTING ELLIPSES

BEGIN

In 1609, astronomer Johannes Kepler theorized that planets orbit the Sun along elliptical paths, rather than circular paths.

But what exactly is an ellipse?

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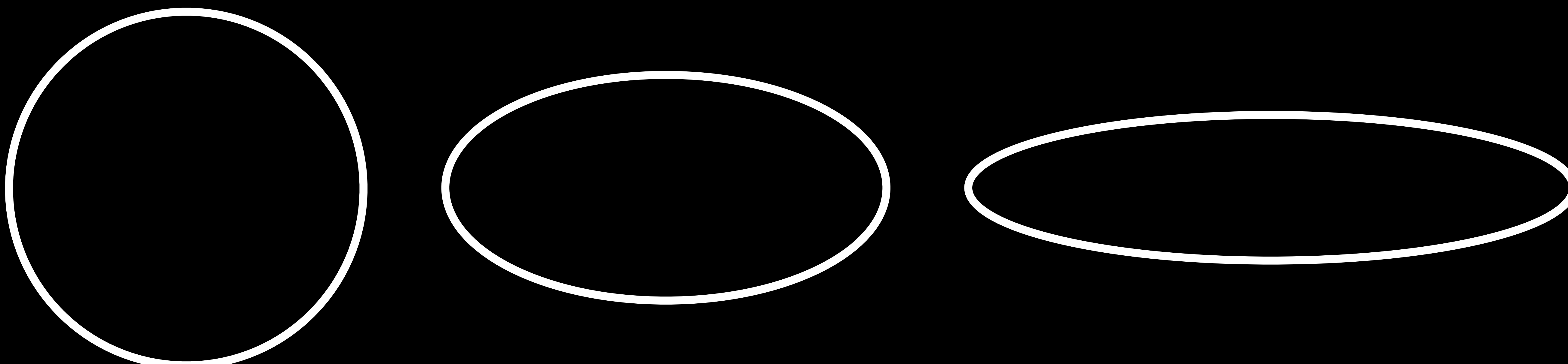
A round shape that can be very circular, very oval, or anywhere in between.

But what exactly is an ellipse?

These are all examples of ellipses.

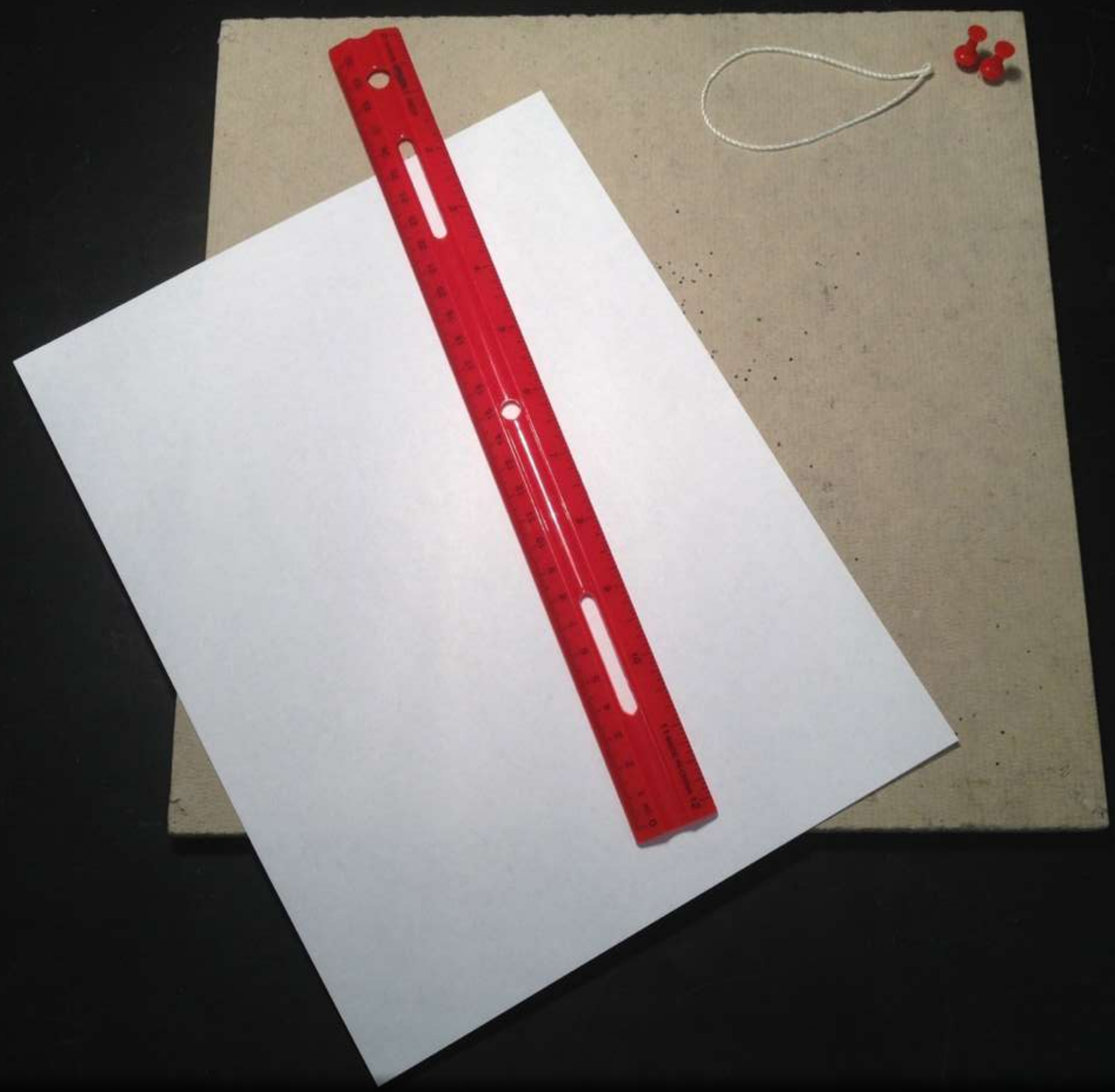


But what exactly is an ellipse?

Let's try drawing an ellipse…

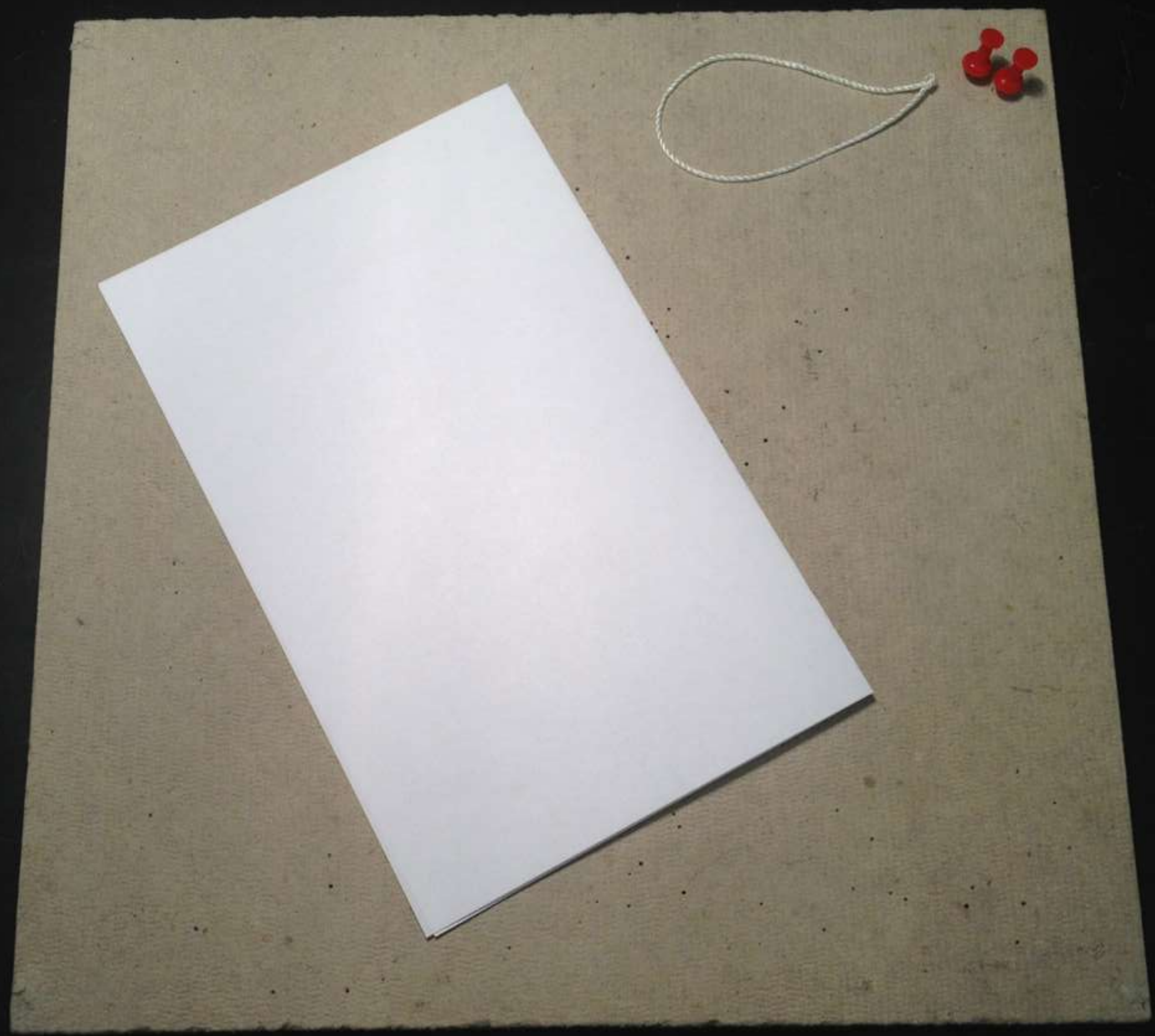
MATERIALS

- ✓ 1 pencil
- ✓ 1 piece of pressboard
- ✓ 2 push pins
- ✓ 1 loop of string
- ✓ 1 orange colored pencil
- ✓ 3 sheets of printer paper
- ✓ 1 calculator



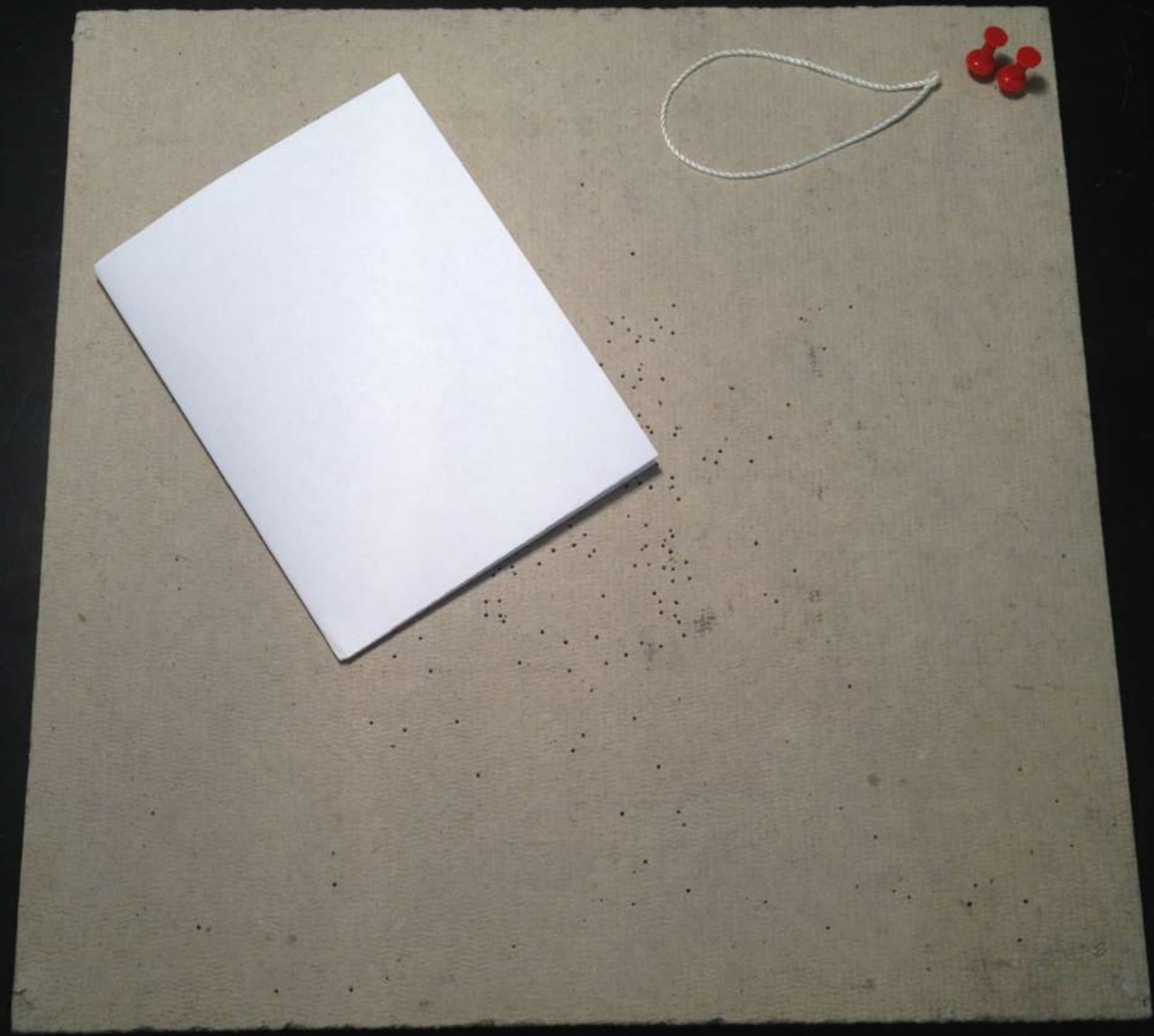
STEP #1

Fold a sheet of printer paper in half.



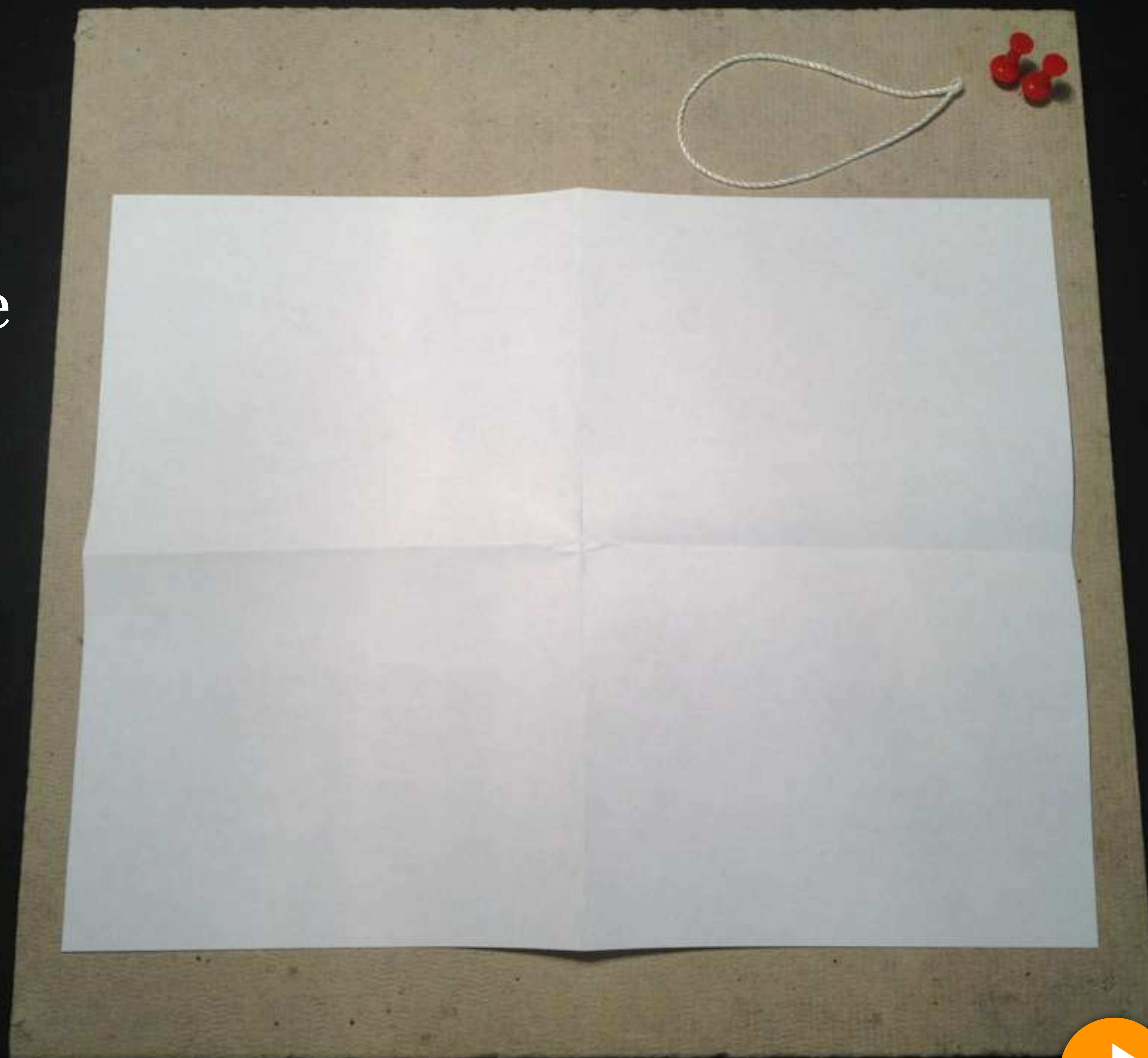
STEP #2

And then fold it in half again (you are trying to create four equal-sized quadrants)



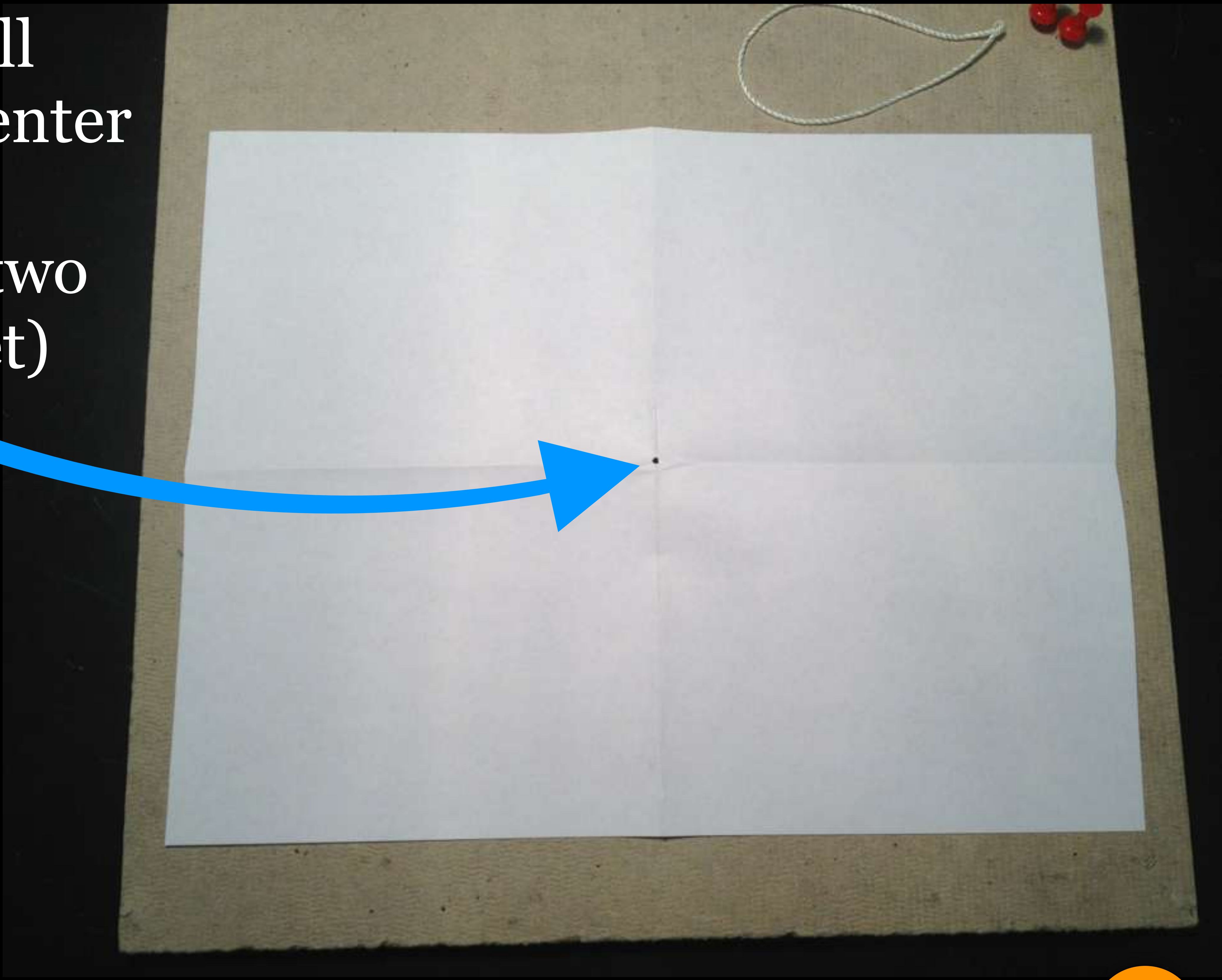
STEP #3

Open up your folded paper and lay it flat in a landscape orientation



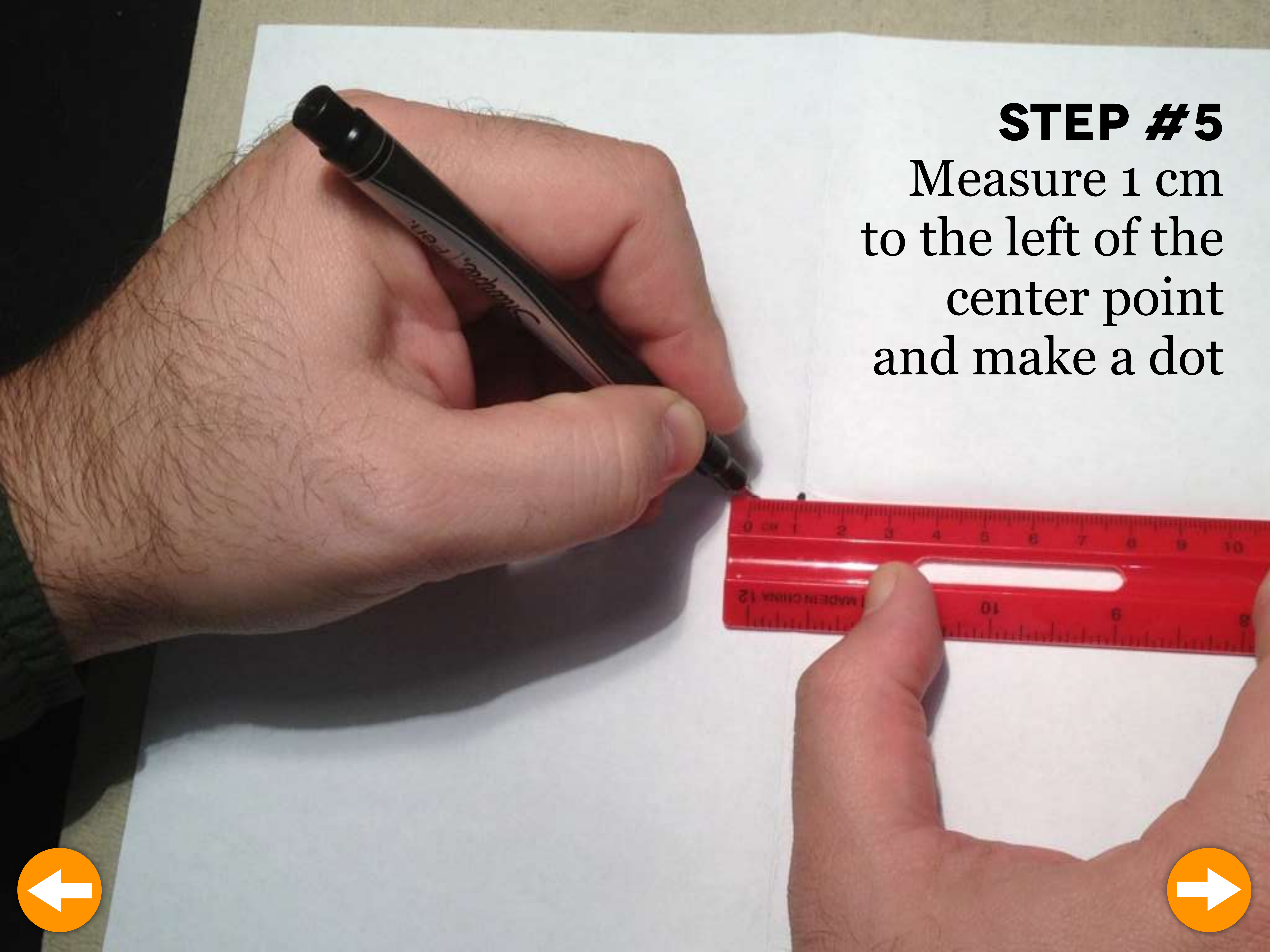
STEP #4

Draw a small dot in the center of the page (where the two creases meet)



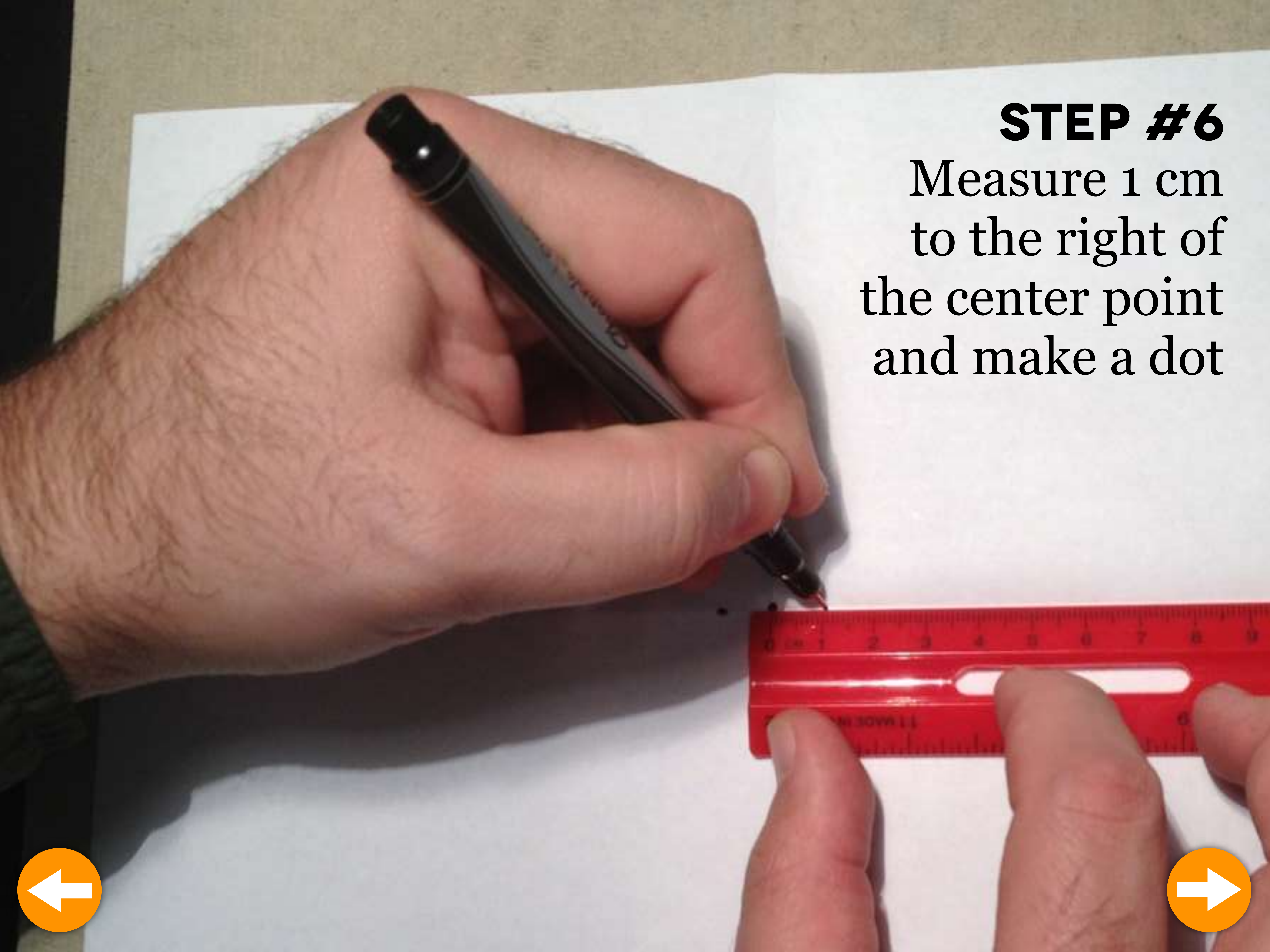
STEP #5

Measure 1 cm to the left of the center point and make a dot



STEP #6

Measure 1 cm to the right of the center point and make a dot

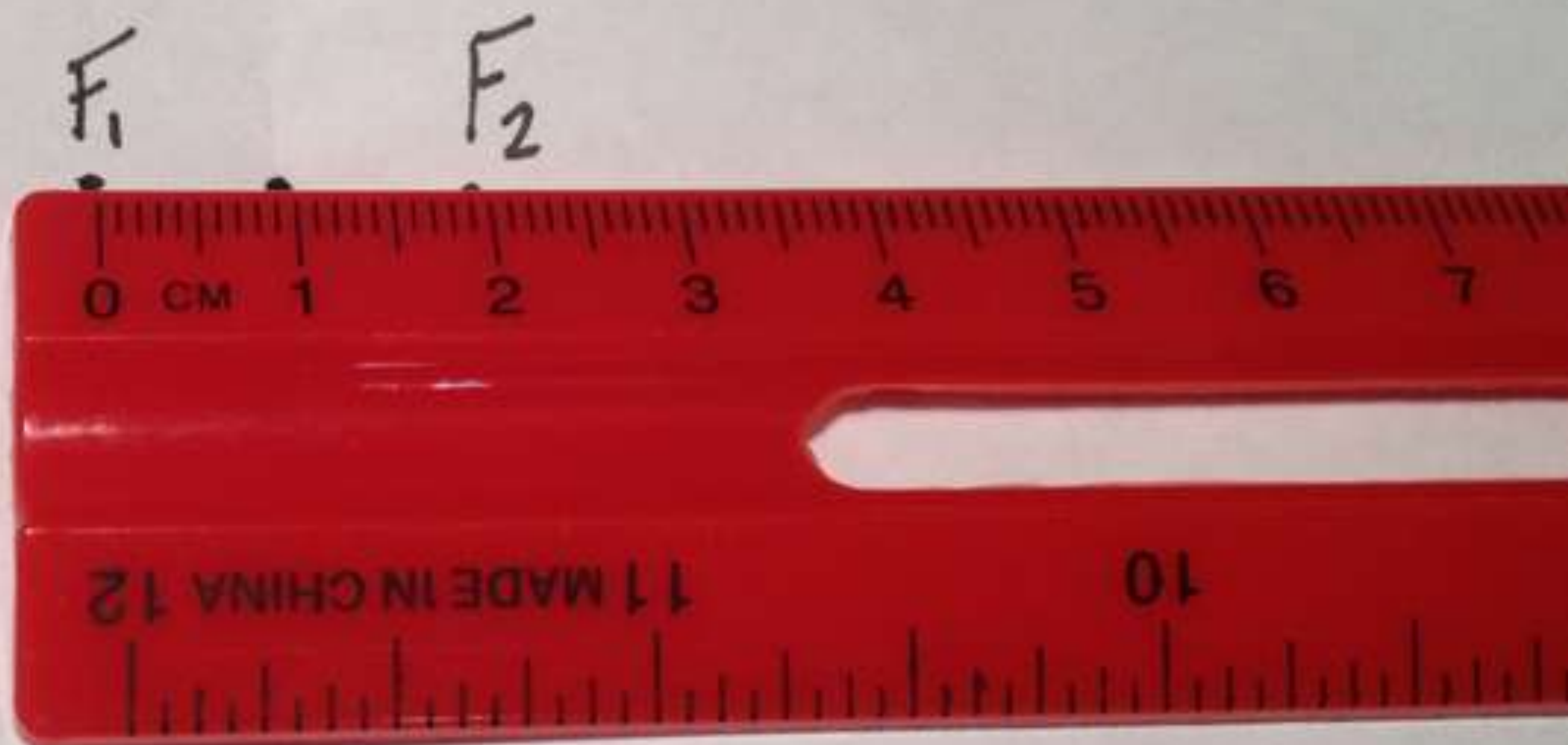


STEP #7

Label the dot on the left "F_1" and the dot on the right "F_2". These are your two foci.

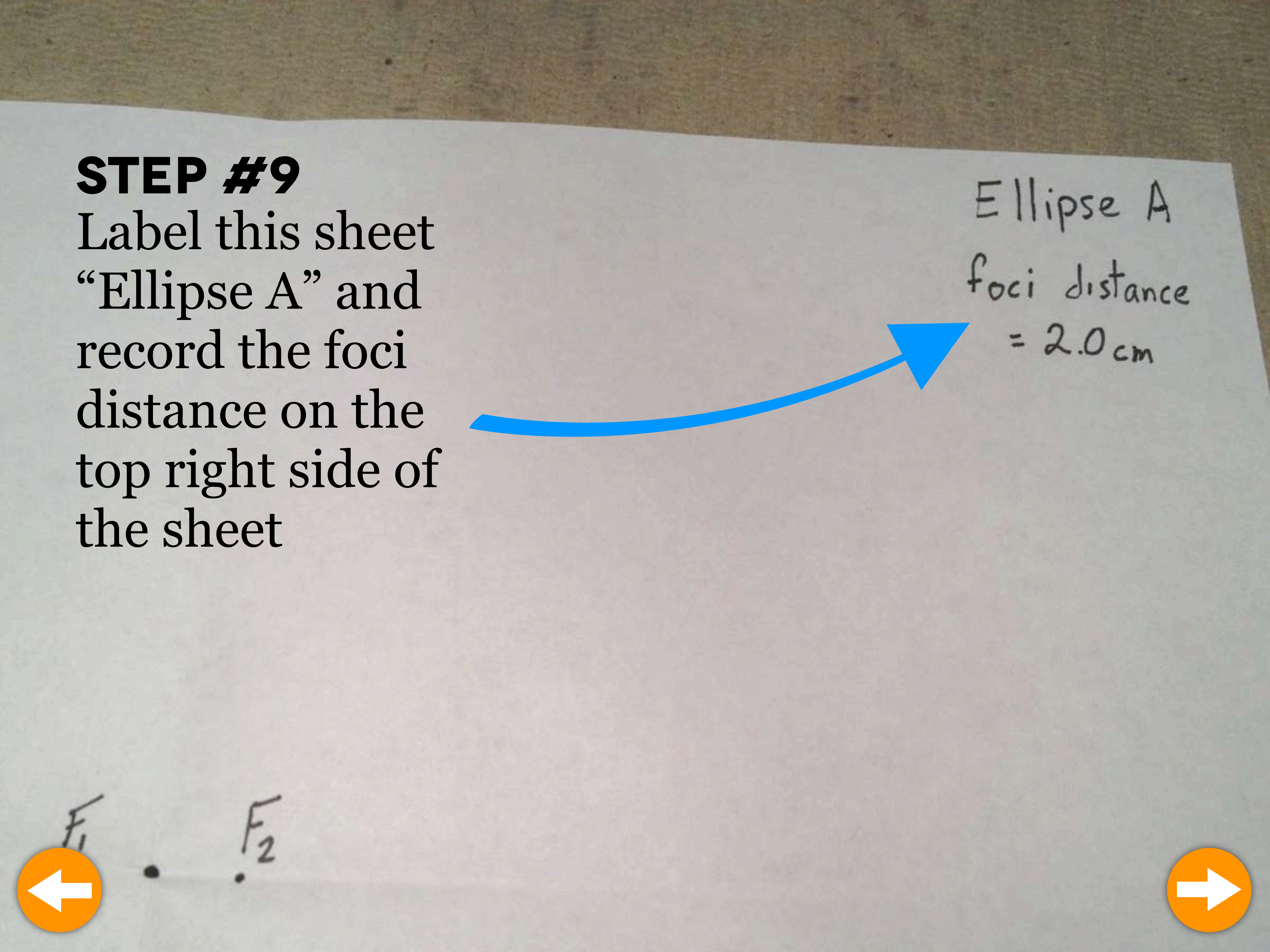
STEP #8

Measure the distance between the two foci (it should be 2.0 cm)



STEP #9

Label this sheet "Ellipse A" and record the foci distance on the top right side of the sheet

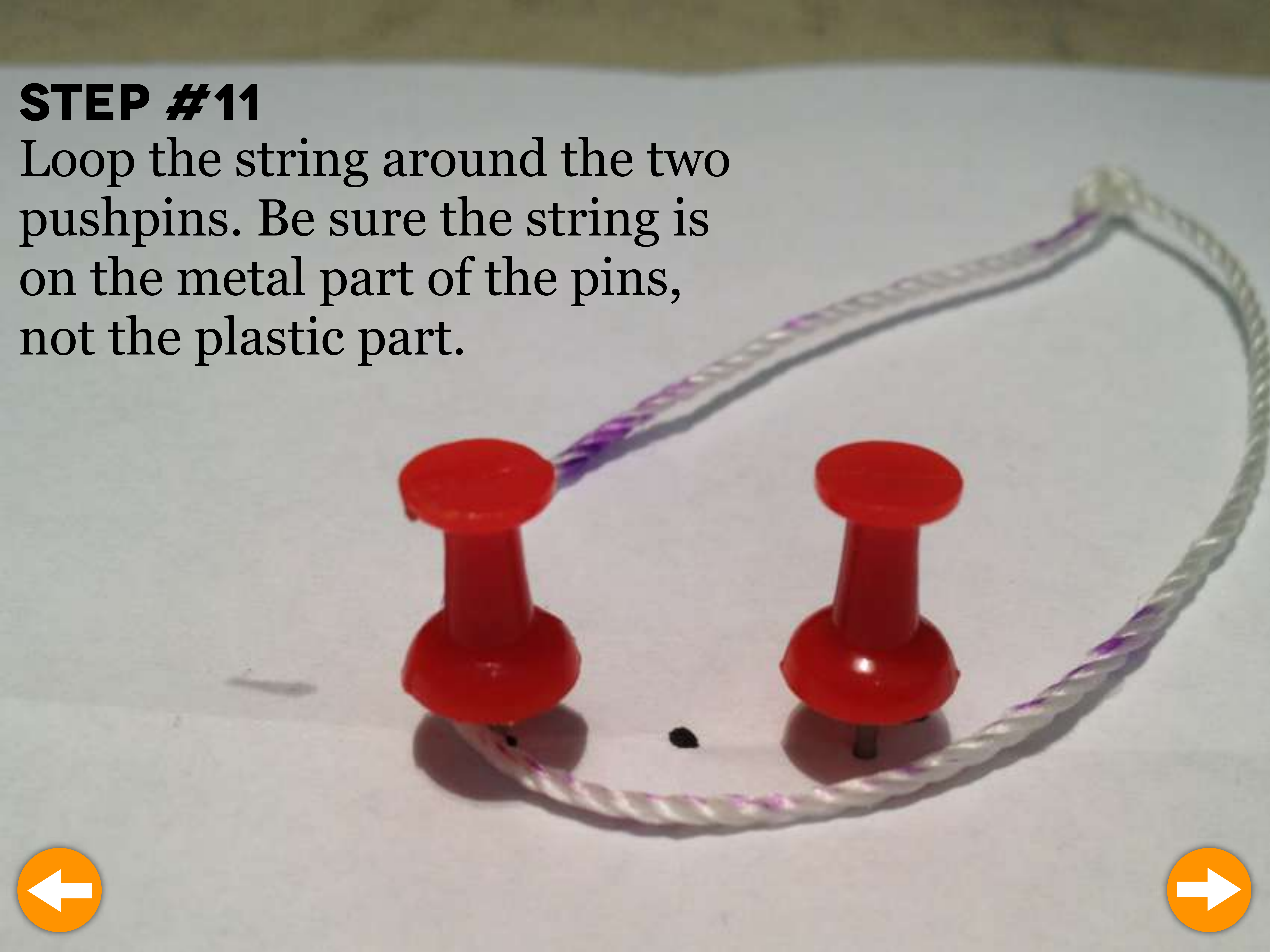


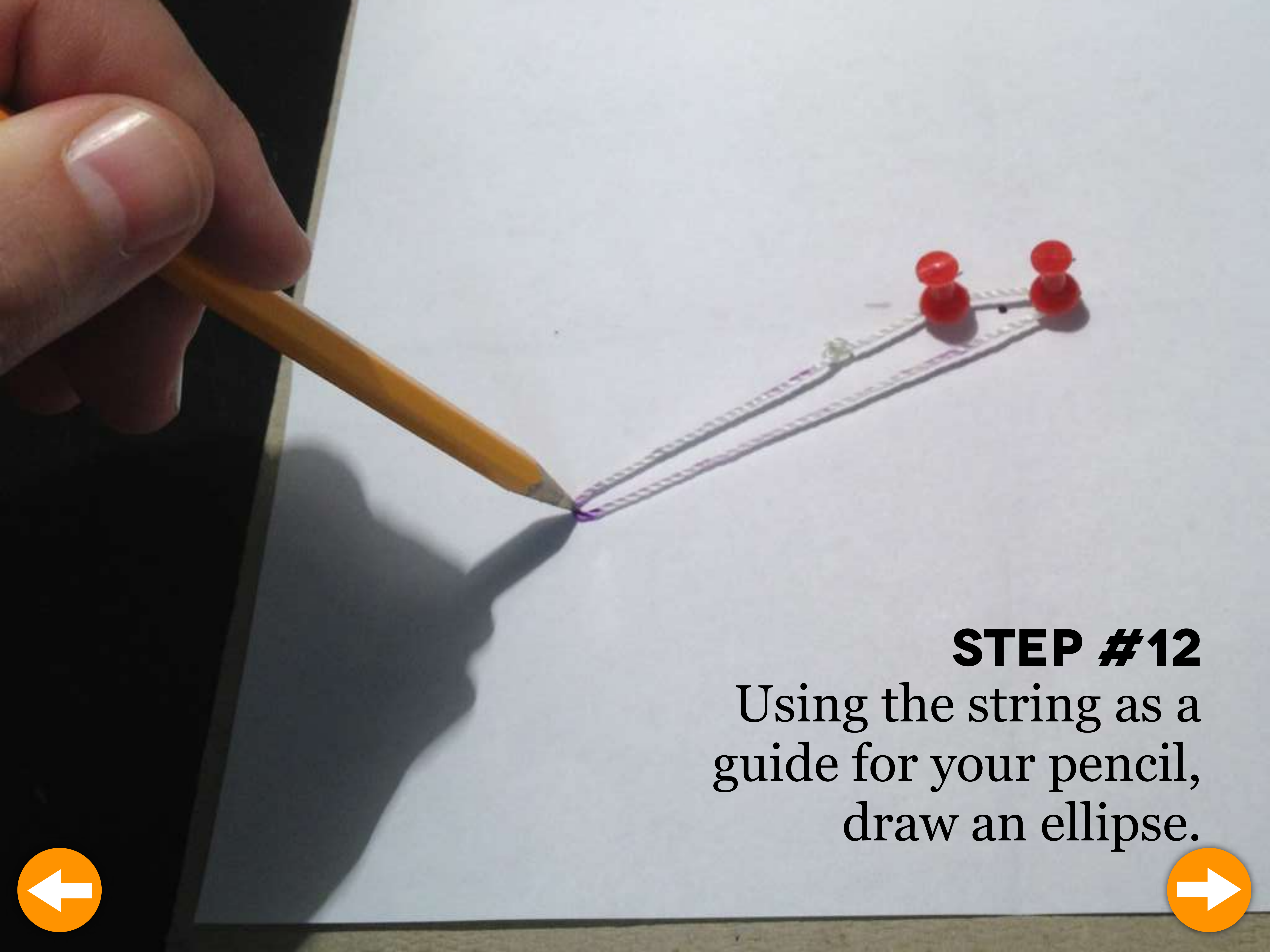
STEP #10

Push a pushpin through each of the foci until they are secure in the pressboard but do not push it all the way in.

STEP #11

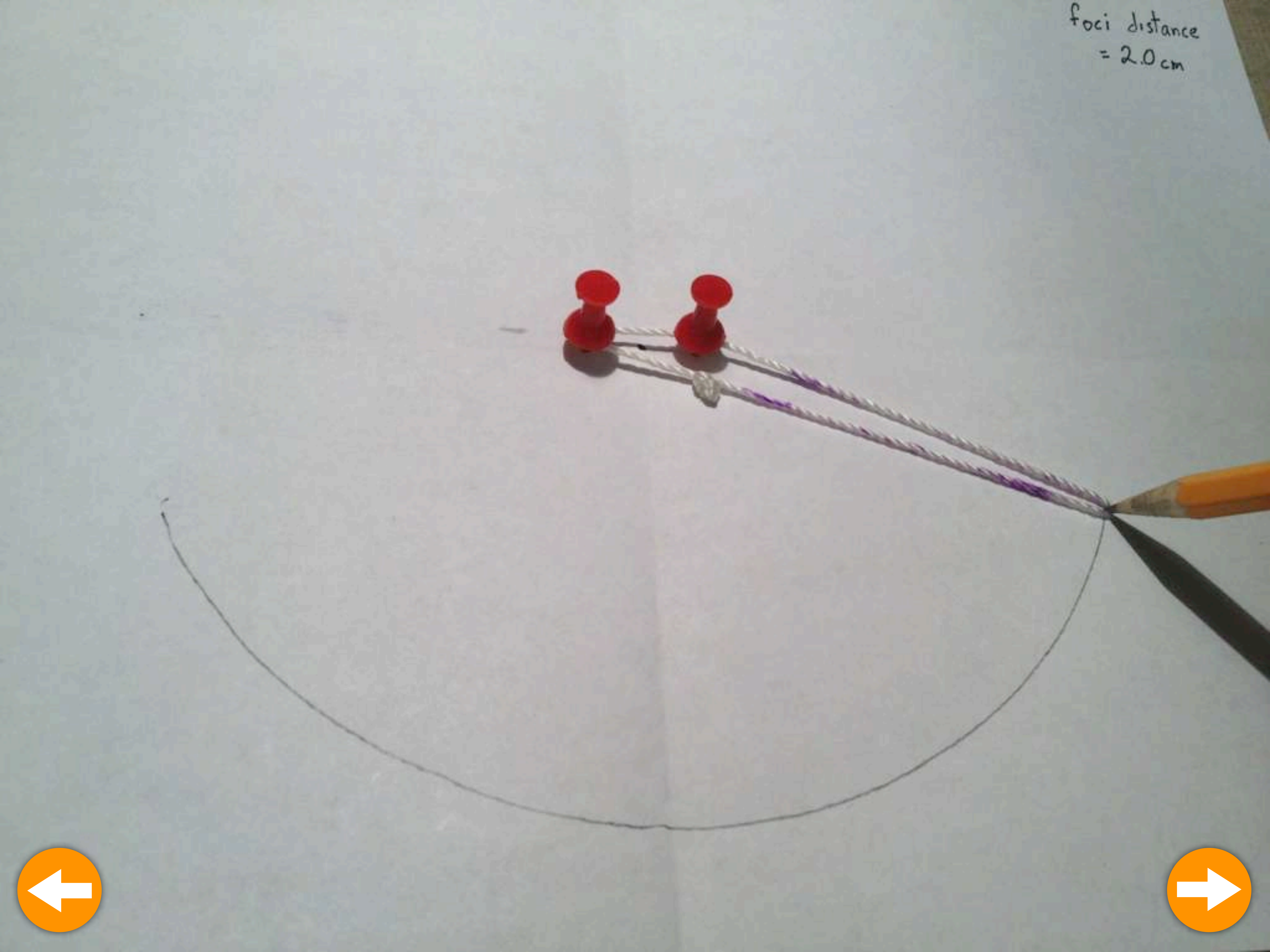
Loop the string around the two pushpins. Be sure the string is on the metal part of the pins, not the plastic part.

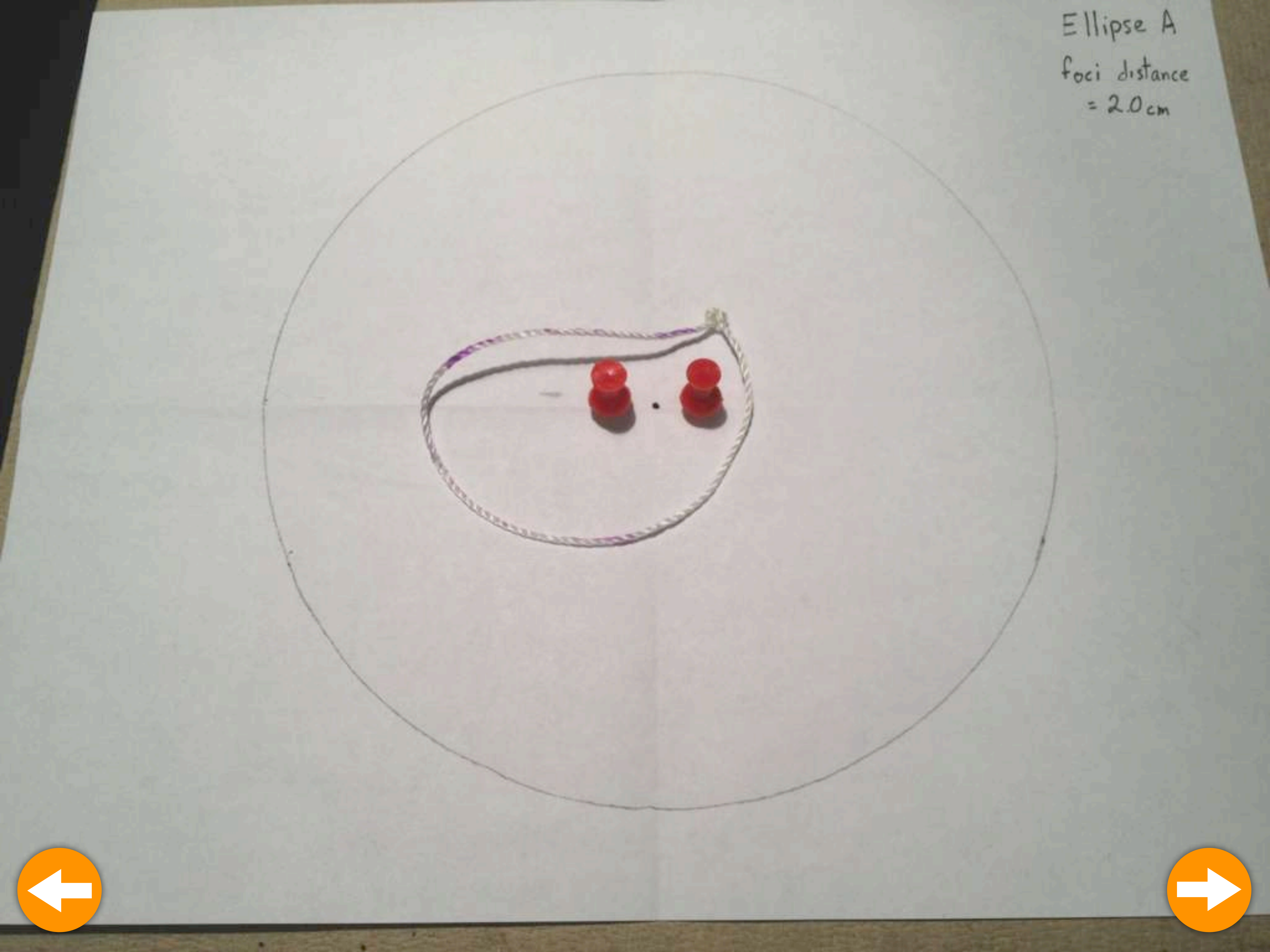




STEP #12

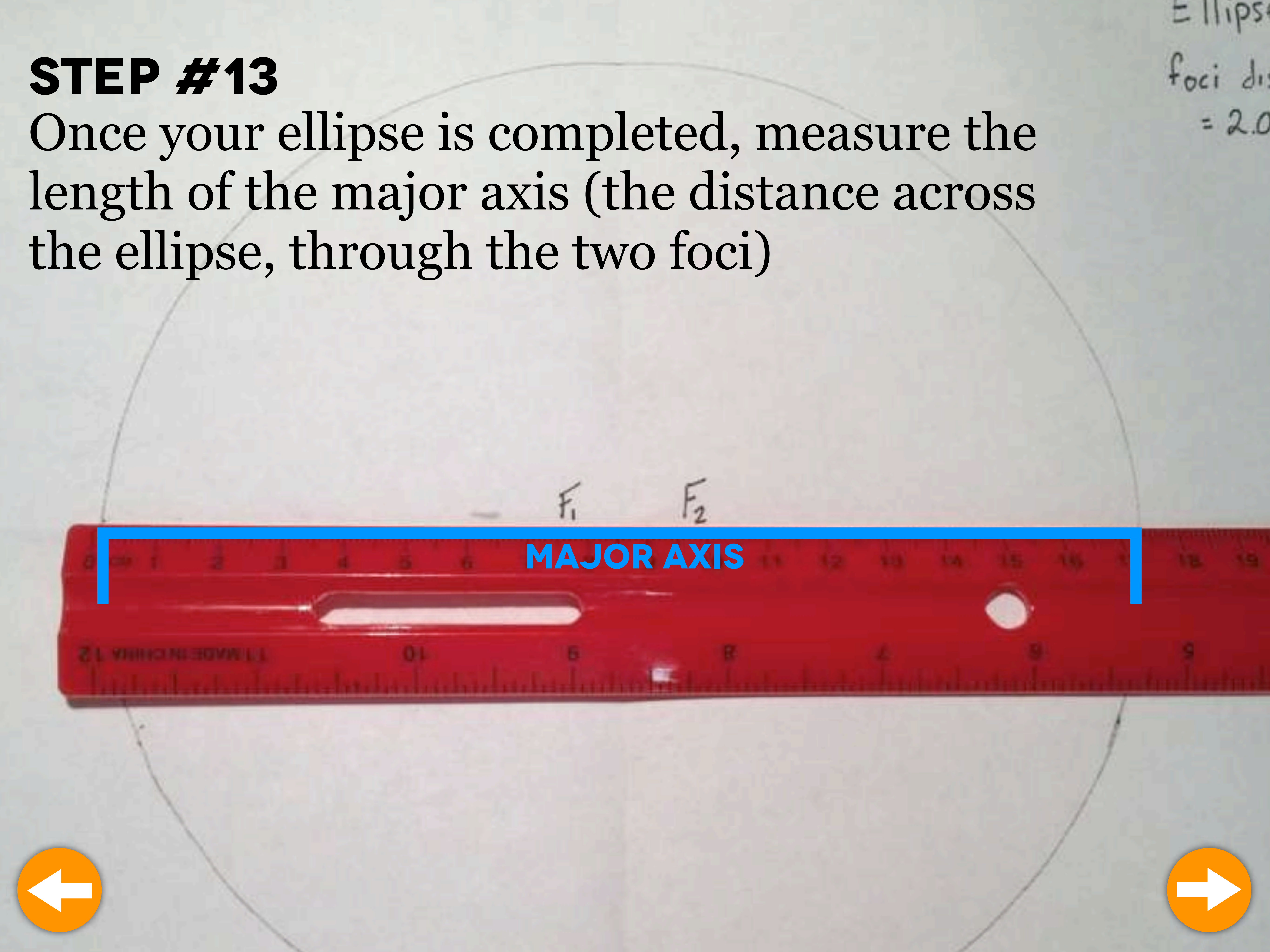
Using the string as a guide for your pencil, draw an ellipse.


foci distance
= 2.0 cm


Ellipse A
foci distance
= 2.0 cm

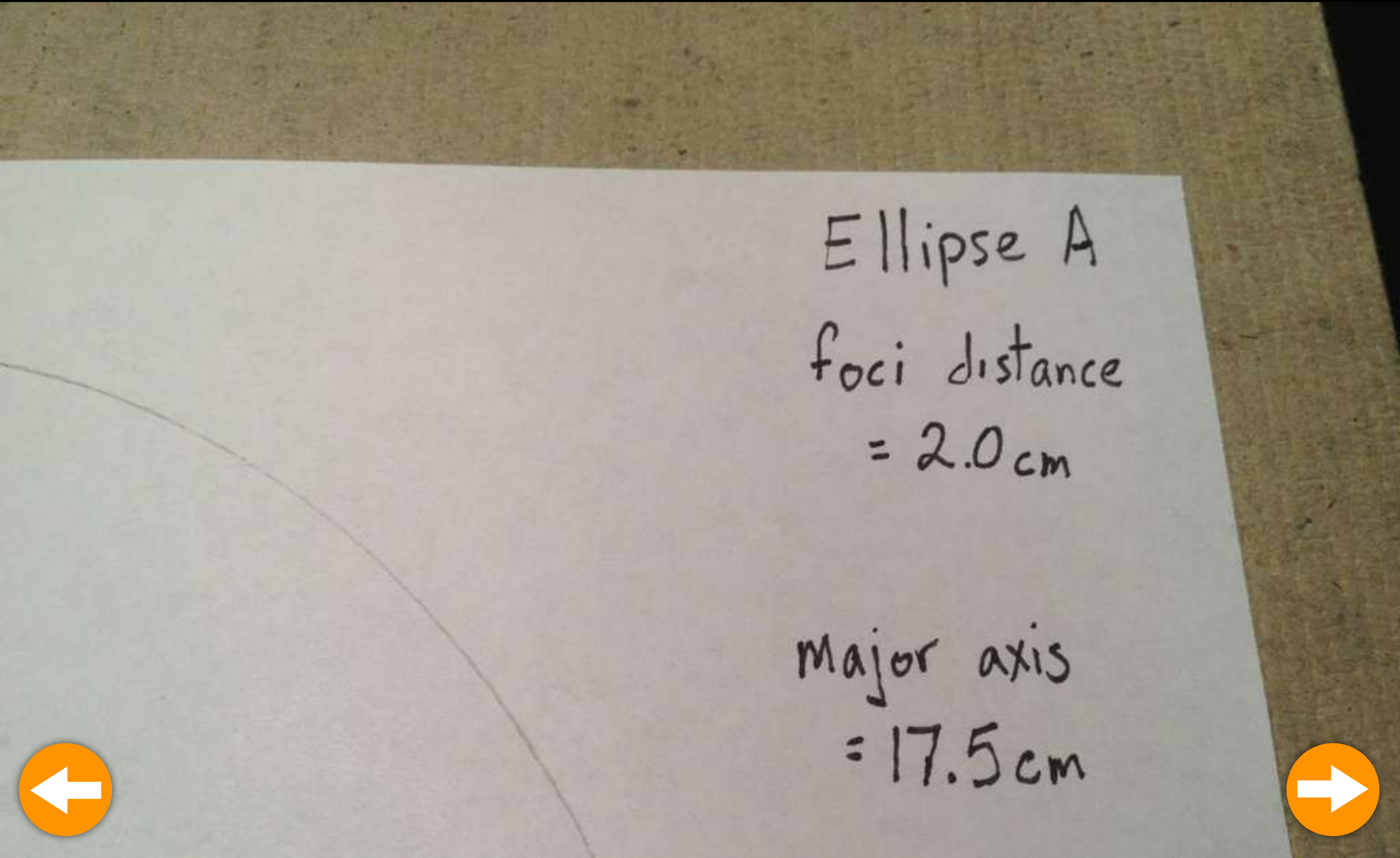
STEP #13

Once your ellipse is completed, measure the length of the major axis (the distance across the ellipse, through the two foci)



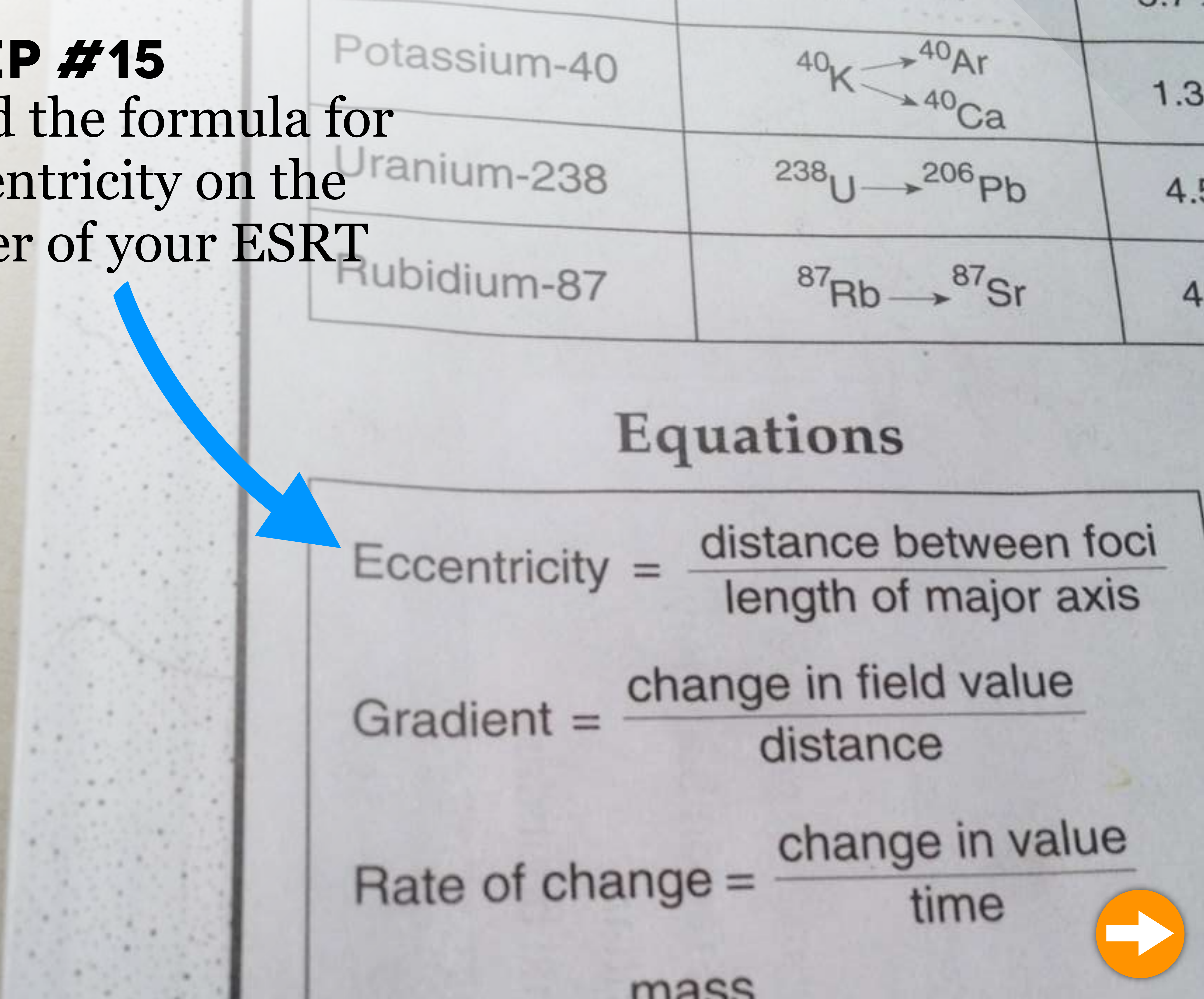
STEP #14

Record your major axis beneath your foci distance



STEP #15

Find the formula for eccentricity on the cover of your ESRT



Potassium-40	$^{40}K \rightarrow {}^{40}Ar$, $^{40}K \rightarrow {}^{40}Ca$	1.3
Uranium-238	$^{238}U \rightarrow {}^{206}Pb$	4.
Rubidium-87	$^{87}Rb \rightarrow {}^{87}Sr$	4

Equations

$$\text{Eccentricity} = \frac{\text{distance between foci}}{\text{length of major axis}}$$

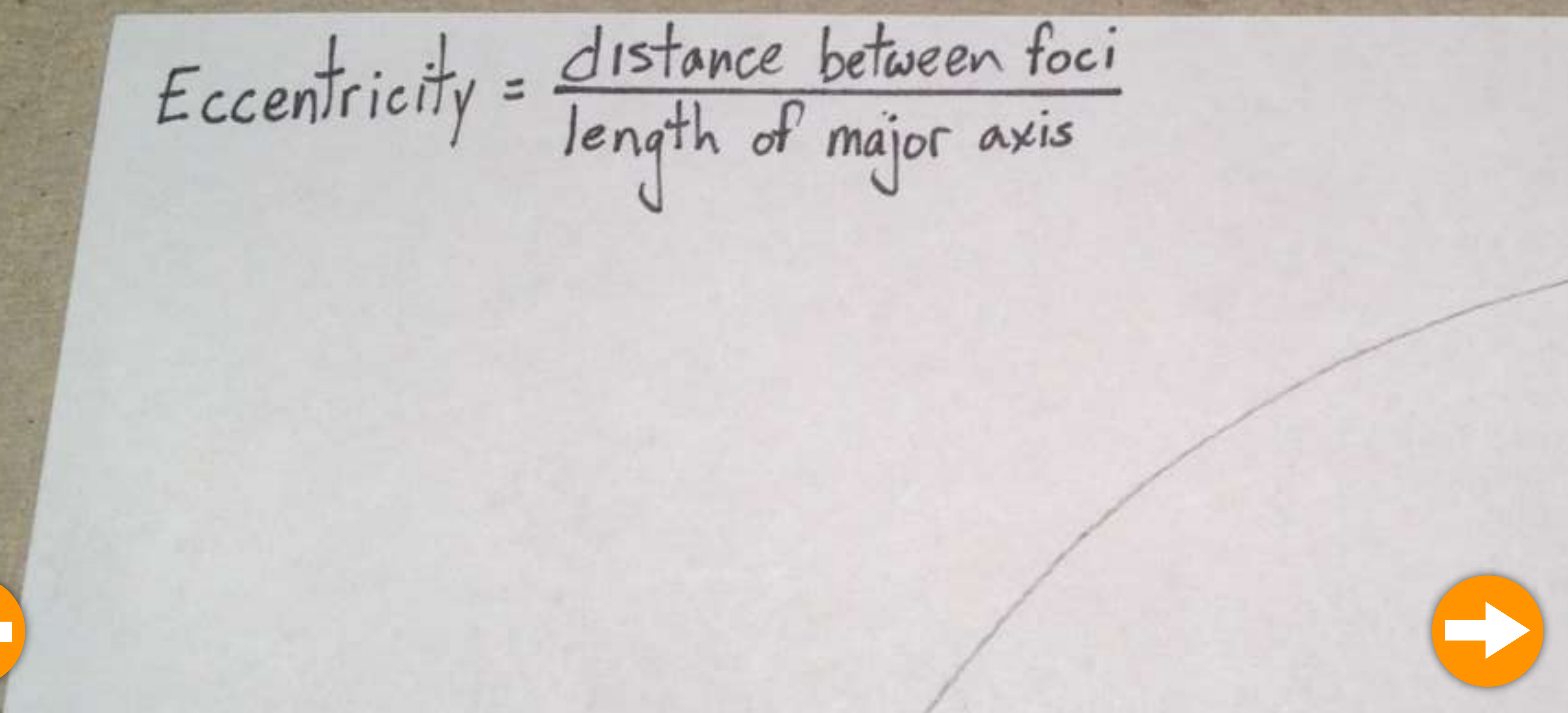
$$\text{Gradient} = \frac{\text{change in field value}}{\text{distance}}$$

$$\text{Rate of change} = \frac{\text{change in value}}{\text{time}}$$

mass

STEP #16

Record the eccentricity formula on the top left side of your sheet



STEP #17

Substitute in your measurements

$$\text{Eccentricity} = \frac{\text{distance between foci}}{\text{length of major axis}}$$

$$\text{Eccentricity} = \frac{2.0\text{ cm}}{17.5\text{ cm}}$$

STEP #18

Use a calculator to solve the equation

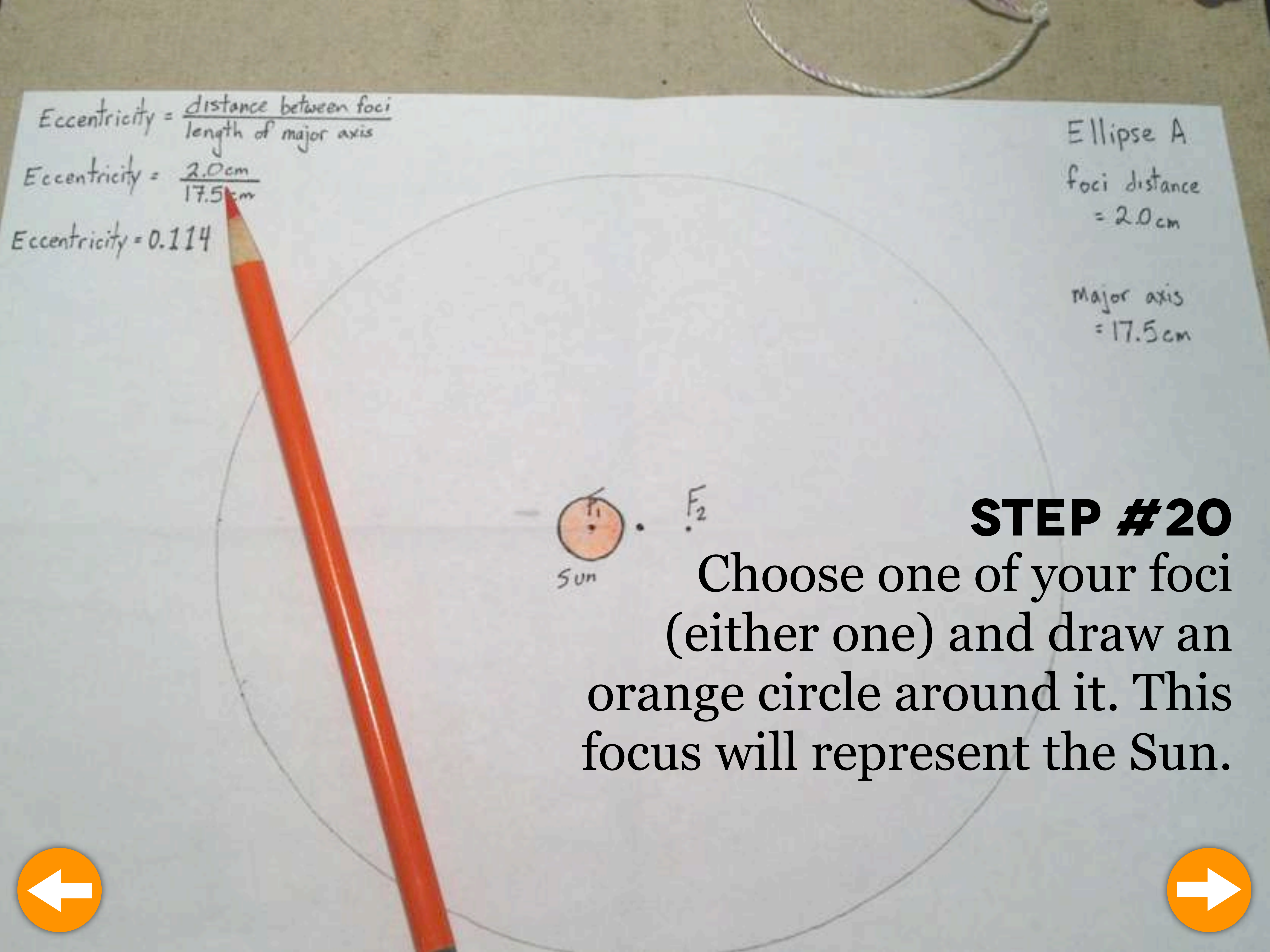
STEP #19

Record your answer to the nearest thousandth (three places). Eccentricity DOES NOT get any units.

$$\text{Eccentricity} = \frac{\text{distance between}}{\text{length of major}}$$

$$\text{Eccentricity} = \frac{2.0\text{ cm}}{17.5\text{ cm}}$$

$$\text{Eccentricity} = 0.114$$

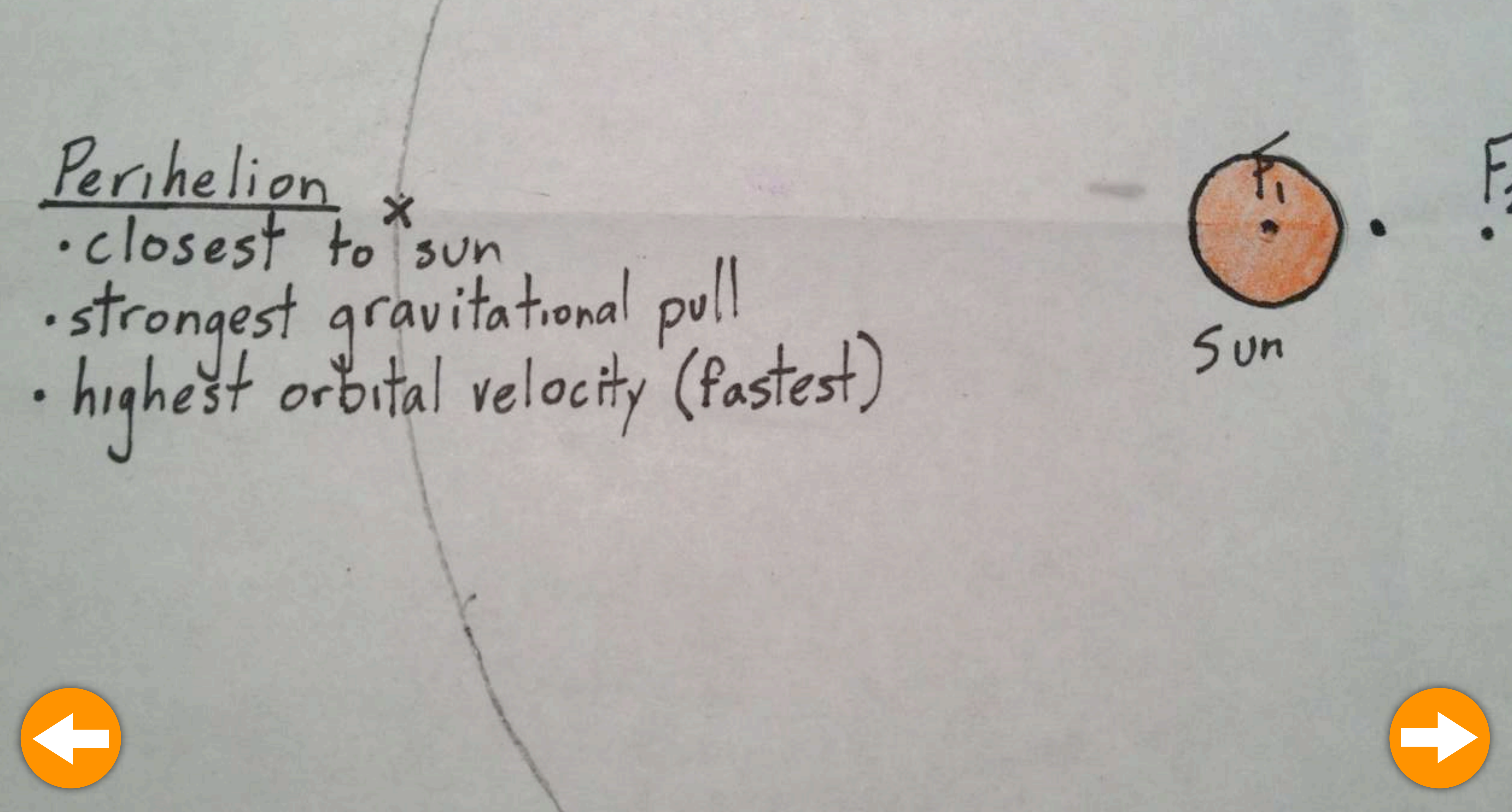


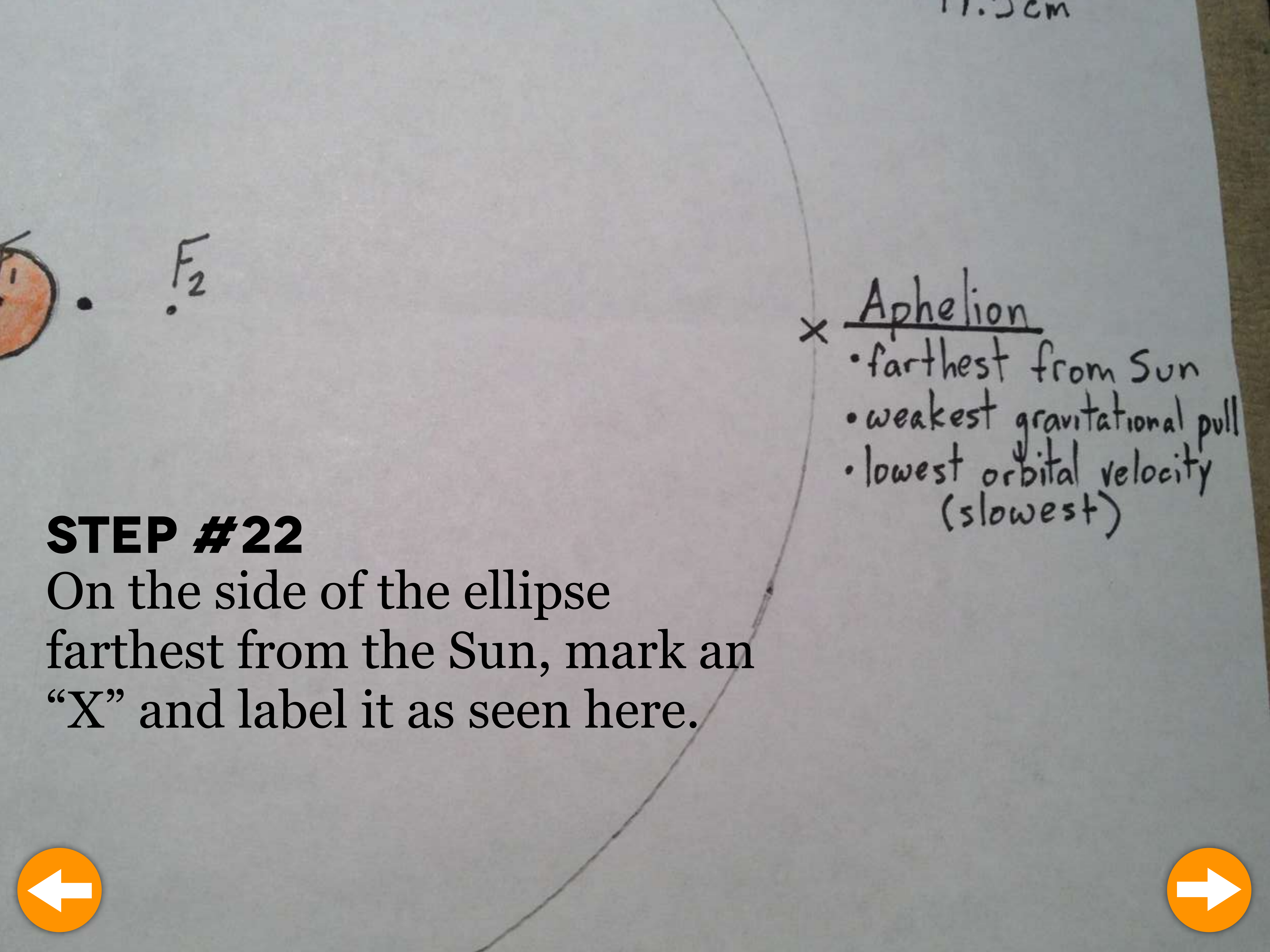
STEP #20

Choose one of your foci (either one) and draw an orange circle around it. This focus will represent the Sun.

STEP #21

On the side of the ellipse closest to the Sun, mark an "X" and label it as seen here.





STEP #22

On the side of the ellipse farthest from the Sun, mark an "X" and label it as seen here.

PLEASE REPEAT ALL OF THESE STEPS TWO MORE TIMES ACCORDING TO THE FOLLOWING MEASUREMENTS:

Ellipse B

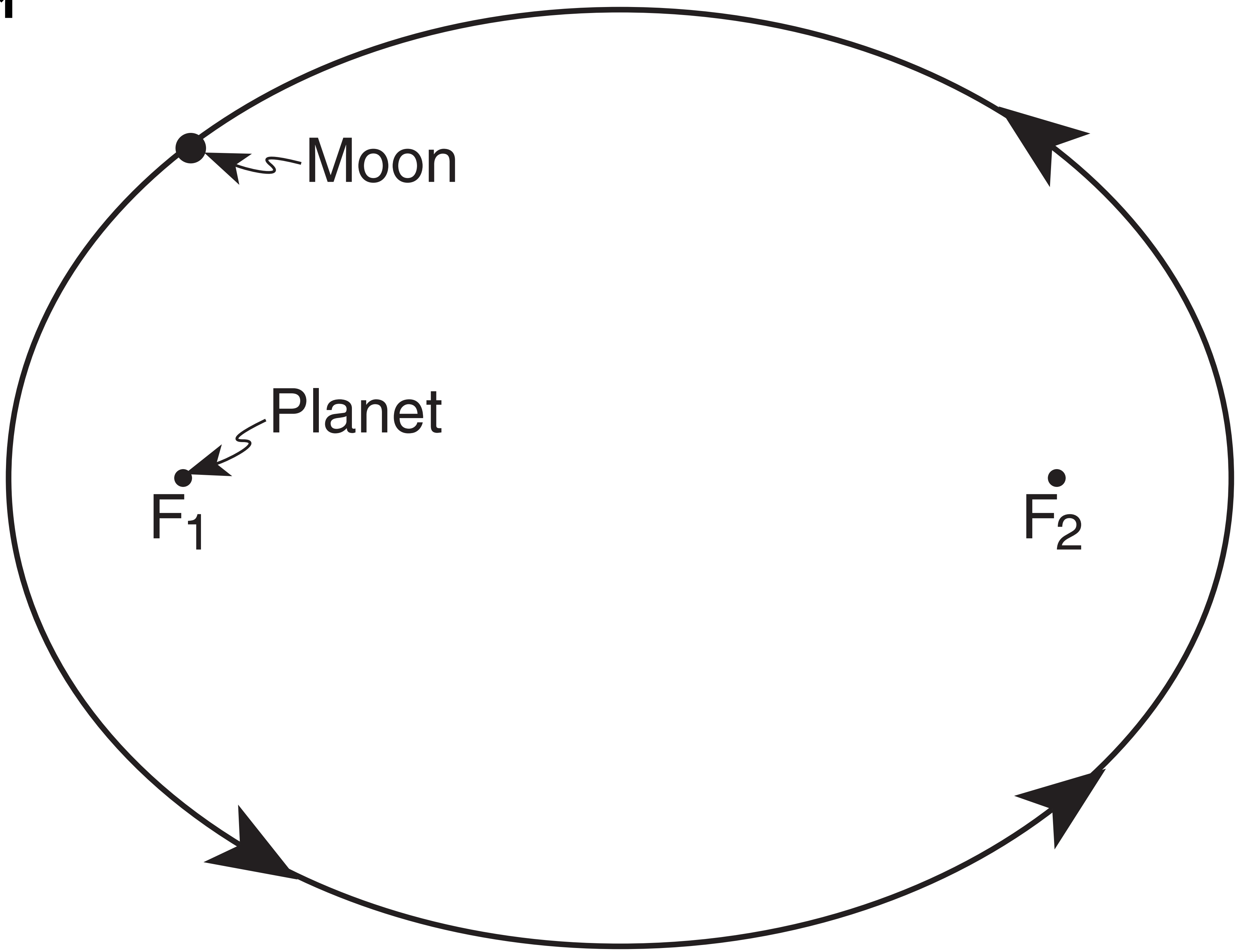
foci distance = 5 cm

Ellipse C

foci distance = 8 cm

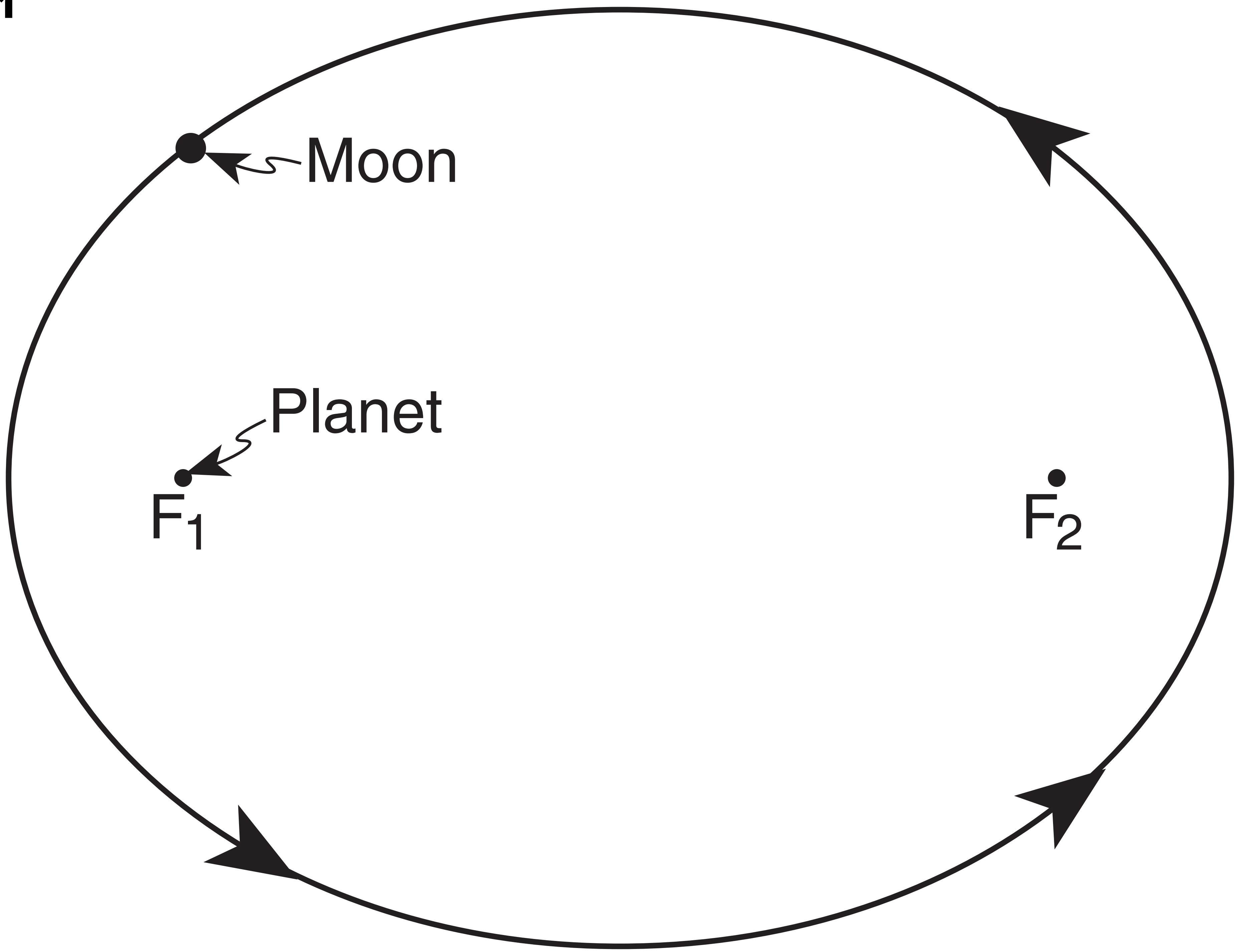
ANSWER ALL OF THE FOLLOWING QUESTIONS ON THE BACK OF YOUR ELLIPSE A SHEET.

DIAGRAM #1



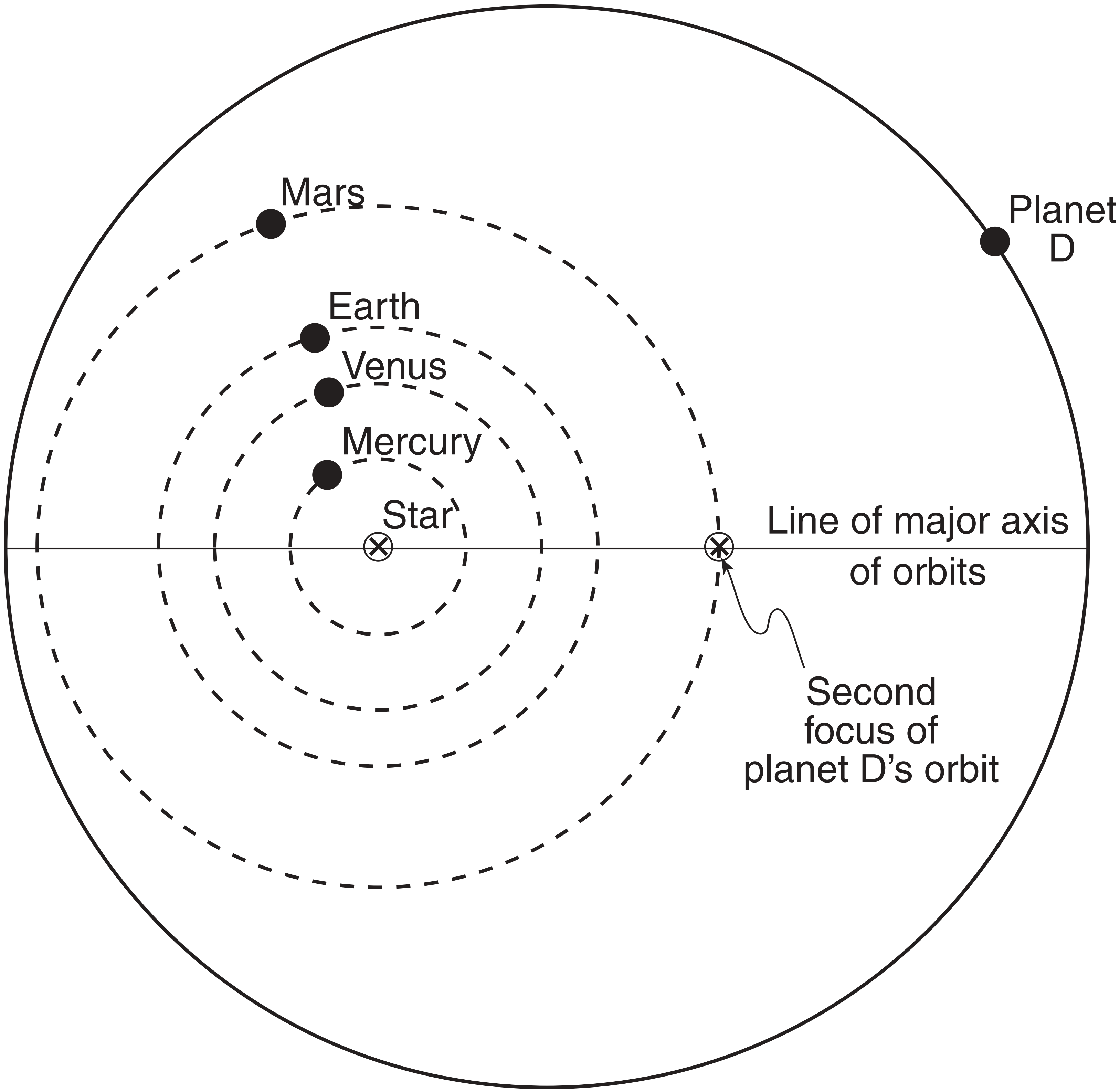
1. What is the eccentricity of this ellipse? (Round to the nearest thousandth)

DIAGRAM #1



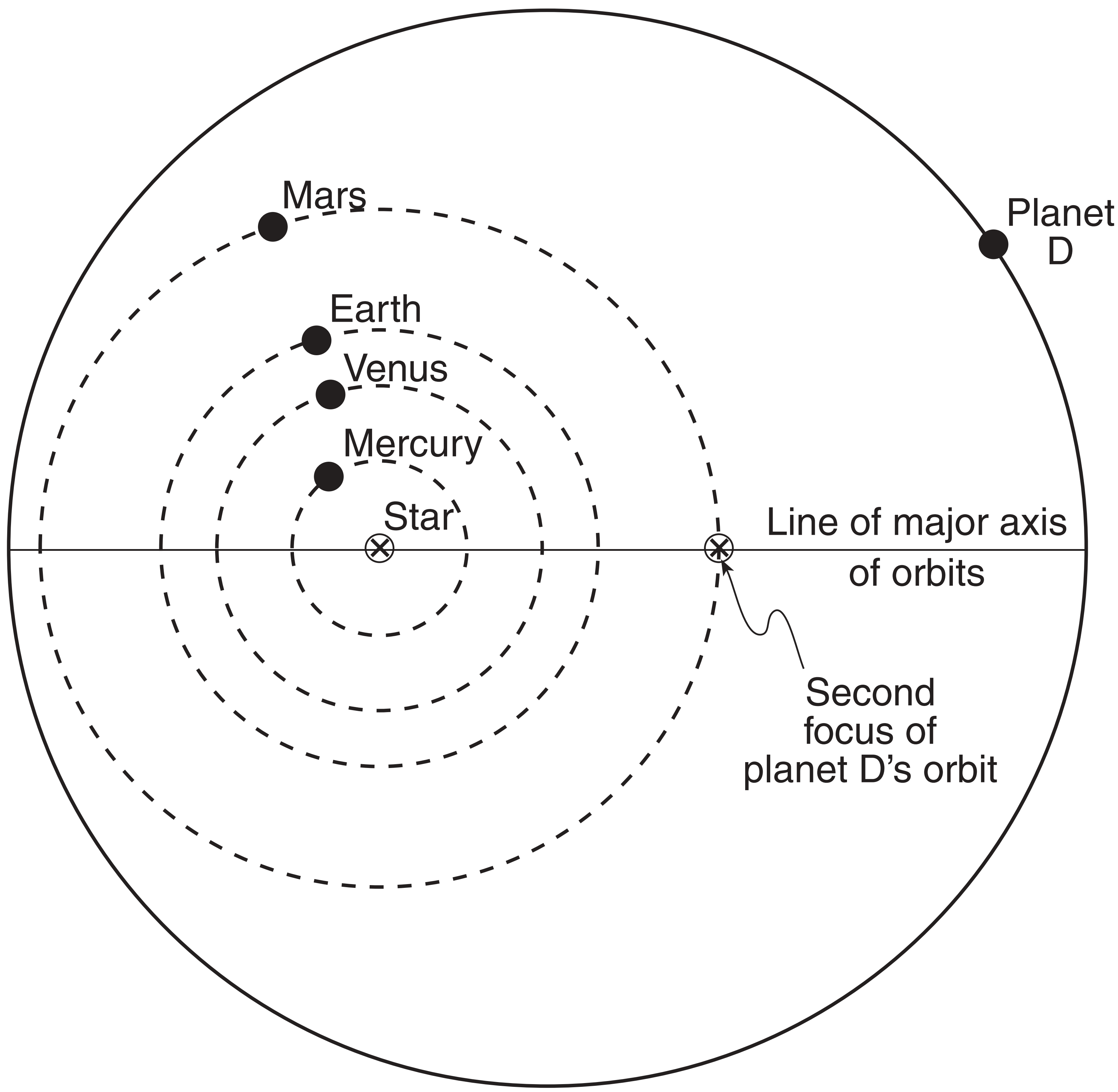
2. On which side of this orbit is the Moon traveling at the highest velocity (top, bottom, left, right)?

DIAGRAM #2



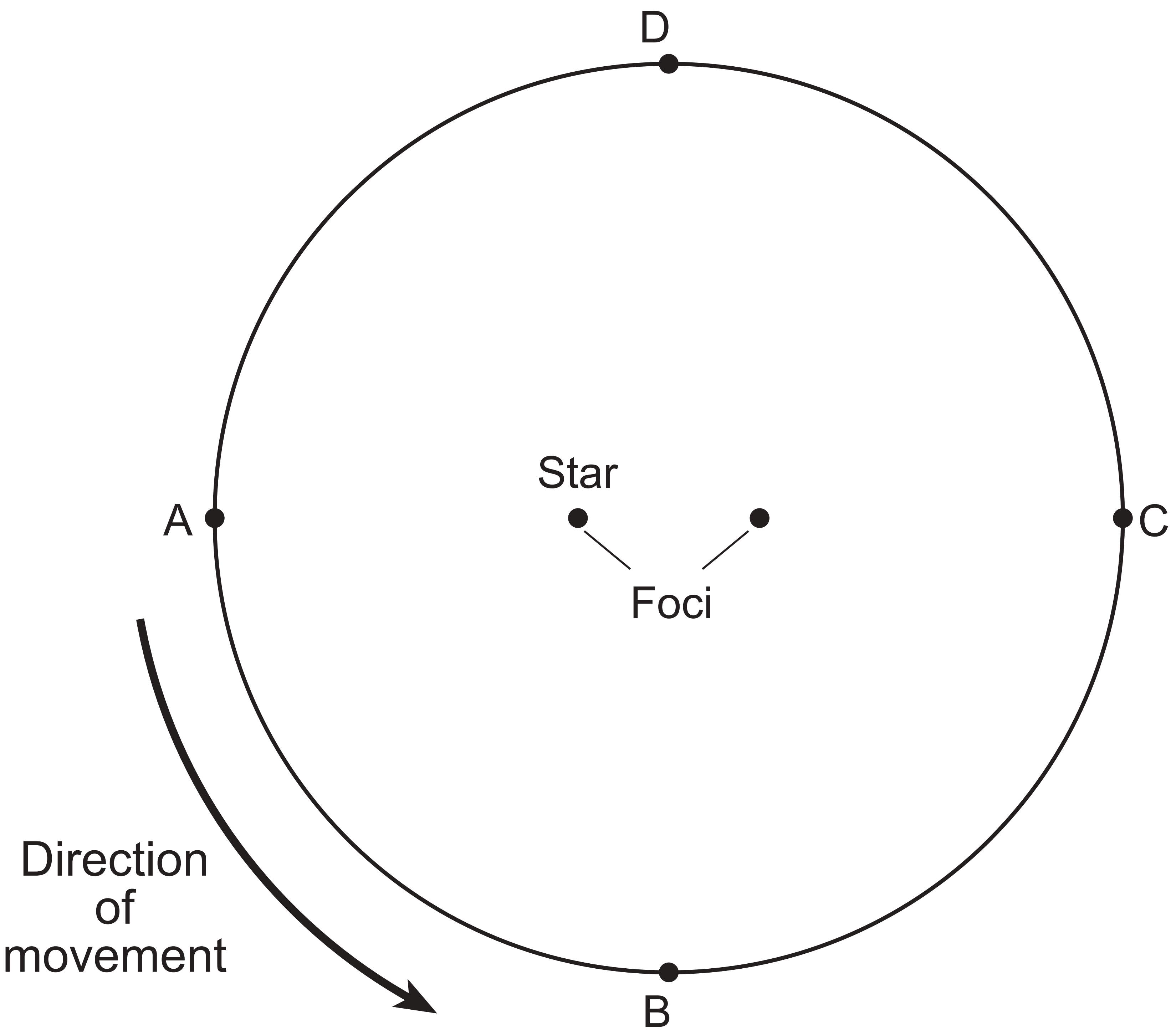
3. What is the eccentricity of the orbit of Planet D? (Round to the nearest thousandth)

DIAGRAM #2



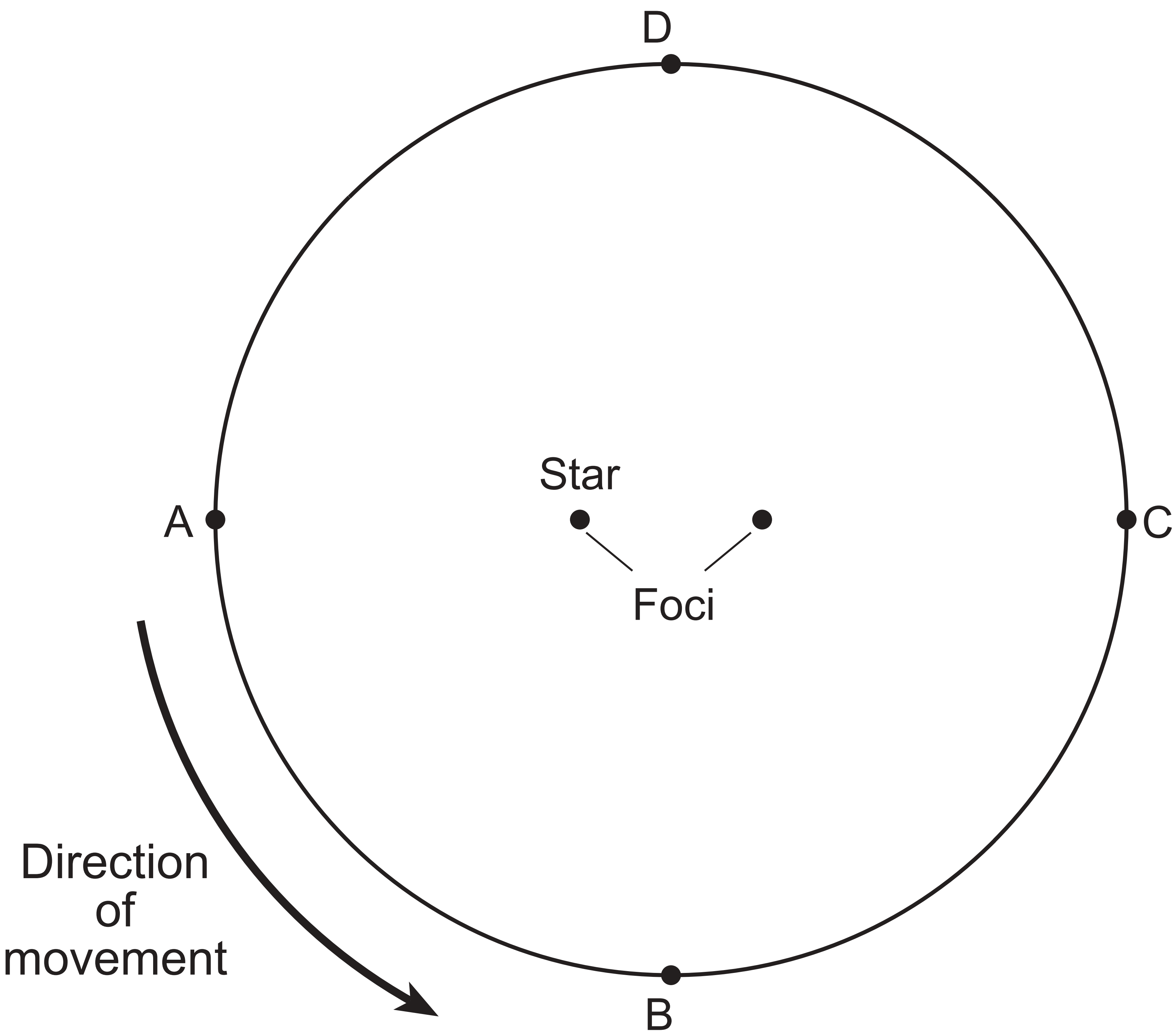
4. Describe how the shape of Planet D's orbit differs from the shape of Earth's orbit?

DIAGRAM #3



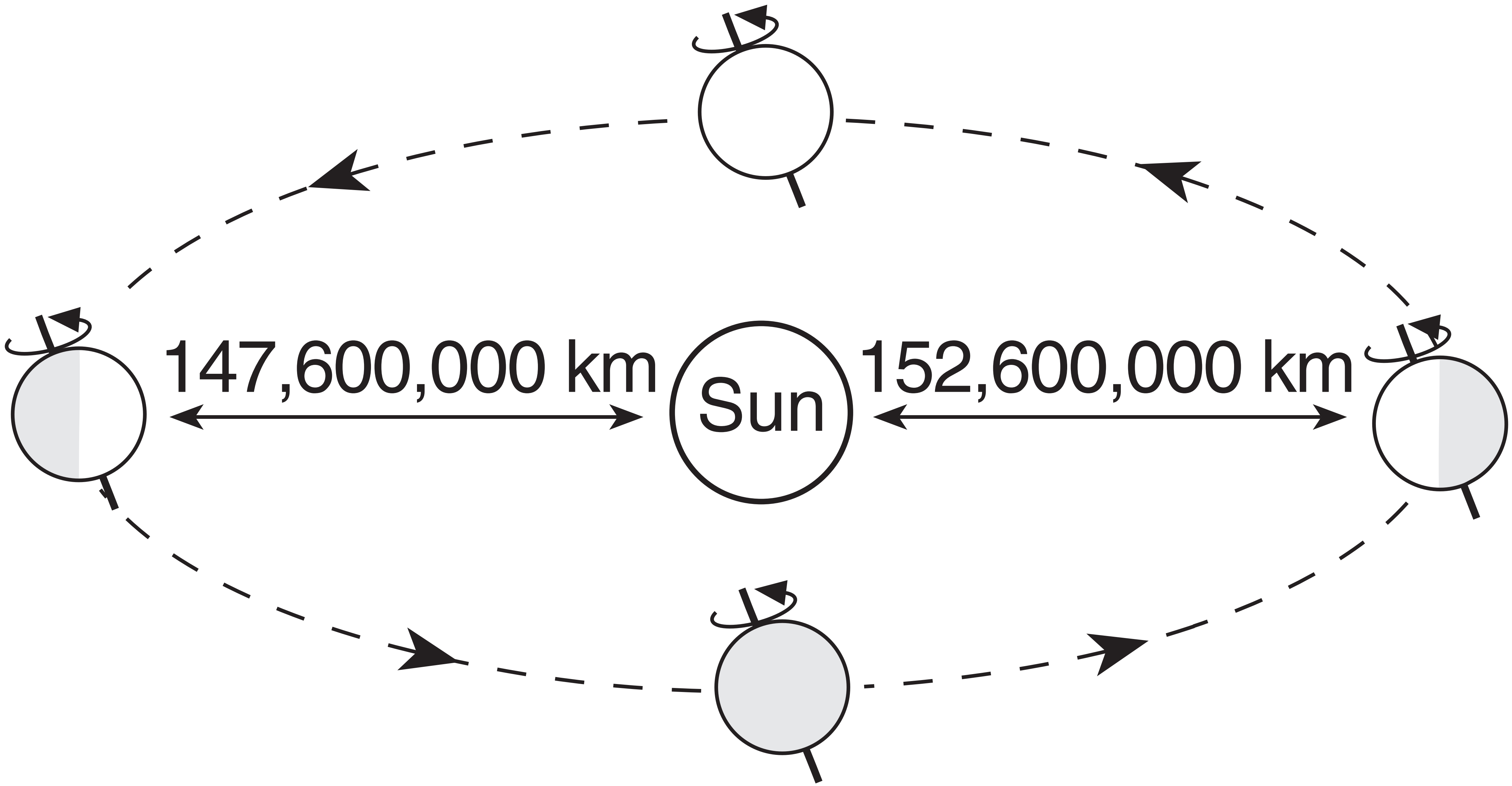
5. What is the eccentricity of this orbit? (Round to the nearest thousandth)

DIAGRAM #3



6. At which point will the object be traveling at the lowest velocity?

DIAGRAM #4



7. What is the eccentricity of this ellipse? (Round to the nearest thousandth)

YOU'RE DONE! GO BACK HOME