**Year 10 Science – Astronomy investigation**

**The distance to the Sun**



**Aim:** To determine a value for the distance from the Earth to the Sun using a pinhole camera and compare it to the known value.

|  |  |  |
| --- | --- | --- |
| **Apparatus:** | * 1 m length of metal rod (unscrew a retort stand and use the metal rod) * 2 paper screens * sharp point to make a pinhole * 2 circular frames (ring with boss head) or similar * calculator * Sun visible in the sky |  |

**Theory:** This experiment uses ratio to determine the distance from the Earth to the Sun.

If we know the distance from the pinhole to the image of the sum, the diameter of the sun’s image, and the diameter of the Sun we can calculate the unknown (the distance to the Sun).

In the space below, write a ratio equation using the following symbols:

length from pinhole to sun’s image = Li

distance to the Sun = LS

diameter of Sun’s image = di

diameter of the Sun = dS

**Method:**

* Build your apparatus by attaching the two frames to the metal rod with boss heads.
* Punch a small pinhole in one of the screens.
* On the other screen rule two lines 7 mm apart (if they are not exactly 7 mm apart, measure them and record this value, but it should be close to 7 mm)
* Attach paper screens over the frames with sticky or masking tape.
* Point the screen with the pinhole in it at the sun.
* Adjust the position of one of the screen’s until the image of the sun falls exactly between the two lines you drew.

7 mm

Measure the length between the two screens in mm. This is Li in the equation above.

Li = \_\_\_\_\_\_\_\_\_ mm

The 7 mm = di

**Results:**

di = 7 mm Li = \_\_\_\_\_\_\_\_\_ mm

dS = 1,392,000 km (this is the accepted value for the diameter of the Sun)

Make LS  the subject of your formula from before and write it below.

Perform a calculation below, based on your measurements to determine a value for LS.

The correct value for the distance to the Sun is 149 500 000 km (i.e. 1.495 × 108 km).

**Error Calculation (optional)**

Work out the difference between your value and this value. Call this value the difference.

Difference = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ km

Divide the difference by the correct value and multiply by 100. This converts it to a percentage and is called the **percentage error**. Round it off to the nearest whole number.

My percentage error is: \_\_\_\_\_\_\_\_\_\_ %

What factors contributed to this error? (Hint: which measurements were not exact?)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In Scientific experiments, scientists try to design experiments that reduce the error values to as low as possible. This makes their results more reliable.

**Conclusion:** Write a good conclusion to this experiment that relates your findings to the aim. Mention the size of your percentage error and comment about how the experiment could have been modified in order to reduce the errors.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_