**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_\_\_\_\_**

**Unit 1: Optional Worksheet - Plate Scale of a Smartphone**

1. Use a 30 cm ruler to accurately and precisely measure the diameter of the object you are imaging with the smartphone. Record the value and units below:

**object’s physical (linear) diameter**: **d** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Place object about 1 meter from camera. Measure & record the exact distance with units:

**object’s distance**: **D** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (same units as d)

1. Photograph object and transfer image to computer. Maintain actual size of image in transfer.
2. Open transferred photo in SalsaJ. Zoom until the object’s edges are distinguishable from background; move the object so that it is entirely visible in the image.
3. Use "Straight line selection" and "Plot profile" tools to measure the pixel diameter (**dP**) of the object (diameter in pixels). Record values and units:

**pixel diameter**  **dP** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Use **small angle equation** to calculate the angular size of the object at the 1st distance:

**angular size: θ = (d/D)** = \_\_\_\_\_\_\_\_\_radians OR

**θ = (d/D) x 57.3 °/radian**  = \_\_\_\_\_\_\_\_\_ degrees

1. The **plate scale** of the camera is the angular size (**θ** in degrees) divided by the pixel diameter (**dP**). It has units of °/pixel (can be converted to arcminutes per pixel using 60 arcminutes/°). Record your values in the spaces below (be sure to include units).

**plate scale (P) = θ /** **dP** = \_\_\_\_\_\_\_\_\_\_\_\_ / \_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. This calculated plate scale is valid for any picture using this camera. Test this assertion by taking a second photo of the object from a distance at least twice as far as the first. Mark the distance, but do not measure it, yet. Transfer and process the second image as before to measure pixel diameter (**dP2**). Calculate angular size (**θ2**) of the second image using the camera’s plate scale (P) and the second pixel diameter (**dP2**):

**θ2 = P x dP2**  = \_\_\_\_\_\_\_ x \_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_.

1. Use the small angle equation with units of degrees [**θ2 = (d /** **D2) x 57.3]** to calculate the second distance (**D2**) to the object. Solving for **D2**, the second distance is (include units!):

**D2 = (d / θ2) x 57.3** = (\_\_\_\_\_\_\_\_\_\_\_\_\_ / \_\_\_\_\_\_\_\_\_\_\_\_ ) x **57.3** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. Check your result by measuring the actual distance to the object in the second image.