Names: _____ _____

_____ _____

Grade	

Image Analysis with Solar System Objects

Pre-Lab Quiz

Record your team's answers as well as your reasonings and explanations.

1.
2.
3.
4.

Part 1: Measuring the Height of the Danforth Chapel

This PC → Astronomy_Lab_images → Terrestrial → (Chapel in R, G, B filters)

1. Under "Color", click "Combine Color" and determine the mixing ratio of your red, green, and blue filter images that produces the most realistic image. Note: You can adjust the contrast using the screen stretch tool (ctrl+h).

Filter	R	G	B
Value			

2. Explain how you judged that the image looked "realistic".

3. What is the angular size ("height") of the chapel in pixels? Use the information window (ctrl + i) and set the mode to "area".

4. If the pixel scale of the image is 4' (arcminutes) / pixel, what is the angular size of the chapel in degrees?
Note: $1^{o} = 60' = 3600''$ (arcseconds).

5. Determine the height of the Danforth chapel in meters if the photographer measured their distance from the chapel and it was 46 meters away. You will need to use the Small Angle Formula. Show your work and include units in your answer.

Part 2: Identifying the Moons of Jupiter

This PC → Astronomy_Lab_images →Planet → Jupiter →Moons

These images of the moons were taken over three days, and the images are in different folders.

1. For each of the images of Jupiter and its moons, record when the observations were taken in UTC time from the FITS header window in MaxIm DL (ctrl+f).

Image	Time Taken (UTC)
106	
110	
117	
118	

2. For each image, make a sketch of Jupiter and the moons that you can see. You may need to change the contrast using the stretch tool (ctrl+h). Then, use Stellarium to identify the moons. In Stellarium, you will need to set the location to Arizona and the time to the correct date for the observations. (Remember that you will need to convert from UTC to local time, and that may involve changing the date by 1 day.) These images were taken with the telescope Rigel, which is now retired, but was at the Iowa Robotic Observatory in Arizona. Arizona is -7 hours from UTC time. Label the moons in your sketches.

106	110

117 (Circle one: 000, 001, 002, 003)	118 (Circle one: 000, 001)

3. Examine your sketches of the Jupiter and its moons. What happened to Io on 2015/4/20/02:50:02 UTC?

Part 3: Animating Images of the Asteroid 3 Juno

This PC → Astronomy_Lab_images → Asteroid → 3_Juno

1. Open all the images in one of the 3 Juno folders (105 or 106). Using the fits header (ctrl+f), determine and record the observation dates for both sets of images.

2. Follow the directions below to make an animated image showing the asteroid's movement across the sky. Make sure only the asteroid images are opened.

- ➢ Under the tab **Process** click **Align**
  - ◆In the *Select Images* window that appears, click *Add All* and then *OK*
  - ◆In the *Align Images* window that appears, set the align mode to *Auto – star matching* and click OK
- ➢ Under the tab **View** click **Animate**
  - ◆In the *Select Images* window that appears, add the images
  - ◆In the *Animate* window that appears, click the play button

Have the TA mark below once complete and have identified the asteroid 3 Juno.

TA	

3. The semi-major axis of 3 Juno's orbit is 2.67 AU. How long does it take to complete one orbit around the Sun? **Hint**: Think about Kepler's three laws.

Part 4: Determining the Motion of Comet Garradd

This PC → Astronomy_Lab_images → Comet

Follow the directions below to stack the images.

- ➢ Under the tab "Process" click "Stack"
- ➢ In the "Stack" window that appears, select "Add Images"
- ➢ Select the garradd1.fts and garradd2.fts images using either "Add All" (if they are the only options), or by holding the Ctrl key and clicking. Then click "OK"
- ➢ Click on the "Align" tab in the "Stack" window and set the Mode to "Auto – star matching"
- ➢ In the "Stack" window, click the "Combine" tab and set the "Combine Method" to Sum. Then click "Go"

1. Why is it important to align the images?

2. What is the angular distance (in pixels) that the comet traveled from one image to the next? Record the horizontal (Δx) and vertical (Δy) shifts, as well as the total number of pixels traveled.

Δx	Δy	Total

3. If the comet was $2.7x10^{11}$ meters away when the image was taken, how far did the comet travel in km between the two images?
Note: The pixel scale for this image is 1" / pixel.

4. How much time passed between when the two images were taken? From this, what is the speed of the comet in km / s?
Hint: Review with your TA how to access .fit header information.

5. What assumption(s) did you make when calculating the speed that might cause you to incorrectly estimate the true speed of the comet?