Names: _____ _____

_____ _____

| Teamwork (5) | Discussion (5) | Completeness (5) | Correctness (5) | Total (20) |
|---|---|---|---|---|
| | | | | |

# Image Analysis 1

*With pointed fangs it sits in wait,*

*With piercing force it doles out fate,*

*O'er bloodless victims proclaiming its might,*

*Eternally joining in a single bite.*

What is it?

_____

# Pre-Lab Quiz

Record you team's answers as well as your reasoning and explanations.

| |
|---|
| 1. |
| 2. |
| 3. |
| 4. |

# Part 1: The Height of the Danforth Chapel

*labimage → Terrestrial (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. 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". **Be specific.**

3. What is the angular size of the chapel in pixels, $\theta_{\text{pixel}}$, measuring from the base to the top? Use the information window `(ctrl-i)` and set the mode to `Area`.

4. Working with another group, on a white board

- Using **unit conversions**, convert the angular size of the chapel to radians given that the pixel scale is $4'$ / pixel. Note that $1^\circ = 60'$ (arcminutes) and that there are $360^\circ$ in $2\pi$ radians. You should be doing something like: $100 \text{ px} \left(\frac{4'}{1 \text{ px}}\right)$
- Determine the height of the Danforth chapel in meters if the photographer was 46 meters away. Draw a diagram showing the geometry of the problem and indicate the variables of interest. Use the small angle formula, $\theta_{\text{rad}} = h/d$, and solve for the height **before** inserting your numbers.

You may find it helpful to record your work on the back page for future reference. Have your TA mark below when done.

| TA | |
|---|---|

# Part 2: The Ring Nebula (M57)

*labimage → Nebula → Ring Nebula M57 (R, V, B filters)*

1. Make a tricolor image of the Ring Nebula. In the **Combine Color** window,

- For the green color, select the `V` (visual) filter image
- Click the `Align` option and set the align mode to `Auto - star matching`

The last part will align the stars, which are slightly offset from one image to the next. The stars should be mostly white, and you can use the image on pg. 48 of *The Stargazer's Handbook* as a rough guide.

| Filter | R | V | B |
|---|---|---|---|
| Value | | | |

2. The gas in the nebula is illuminated by the star at the center, which radiates at a temperature of 125,000 ± 5,000 K and is in the process of becoming a compact white dwarf. Why are the inner and outer regions different colors?

3. Given the distance to the Ring Nebula on pg. 48, calculate the radius of the nebula in light years. Work with the same group as before, but assign someone else the role of writing on the white board. You may find it helpful to record your work on the last page for future reference. Note that the pixel scale of the image is 0.73″ / pixel and that $1\,\text{rad}\left(\frac{360^\circ}{2\pi\,\text{rad}}\right)\left(\frac{3600''}{1^\circ}\right) = 206265''$ (arcseconds).

| TA | |
|---|---|

# Part 3: The Orion Nebula (M42)

In this problem we're going to first combine several filter images together to improve the signal-to-noise before producing a color image.

- Under the **Process** tab click **Stack**
  - Click `Add Files` and open all the files in the indicated directory below
    - ✔ `scratch → current → ResearchProjects → Nebula → M42`
    - ✔ You can use `ctrl-a` to select all the files.
  - In the left panel, right-click `M42` and under `set group` select `Individual Planes`
  - Under the `Align` tab, set the mode to `Auto - star matching`
  - Under the `Combine` tab, set the combine method to `Median` and click `Go`
- Create a color image of the nebula using some of the following emission line filters for the green and red colors (and optionally the blue)
  - ✔ `OIII` – a pair of oxygen emission lines around 500 nm (green). Often used to find the temperature of the gas.
  - ✔ `Hα` – hydrogen emission line at 656 nm (red). Often used to find the star formation rate.
  - ✔ `SII` – a pair of sulfur emission lines around 670 nm (red). Often used to find the density of the gas.
  - Click `OK` when done
- Under the **Process** tab click **Histogram Specification**
  - ✔ Try out the various transformations and select one that brings out the fainter emission

1. De Mairan's Nebula (M43) is part of the larger Orion Nebula (pg. 124). It is located towards the northeast (north is up, east is left) and is separated from the main part of the nebula by a dust lane. Working just within your group this time, find the radius of M43 as measured from its central star that is responsible for ionizing the gas. Note that the pixel scale is 0.82″ / pixel. Show you work on a white board.

| TA | |
|---|---|