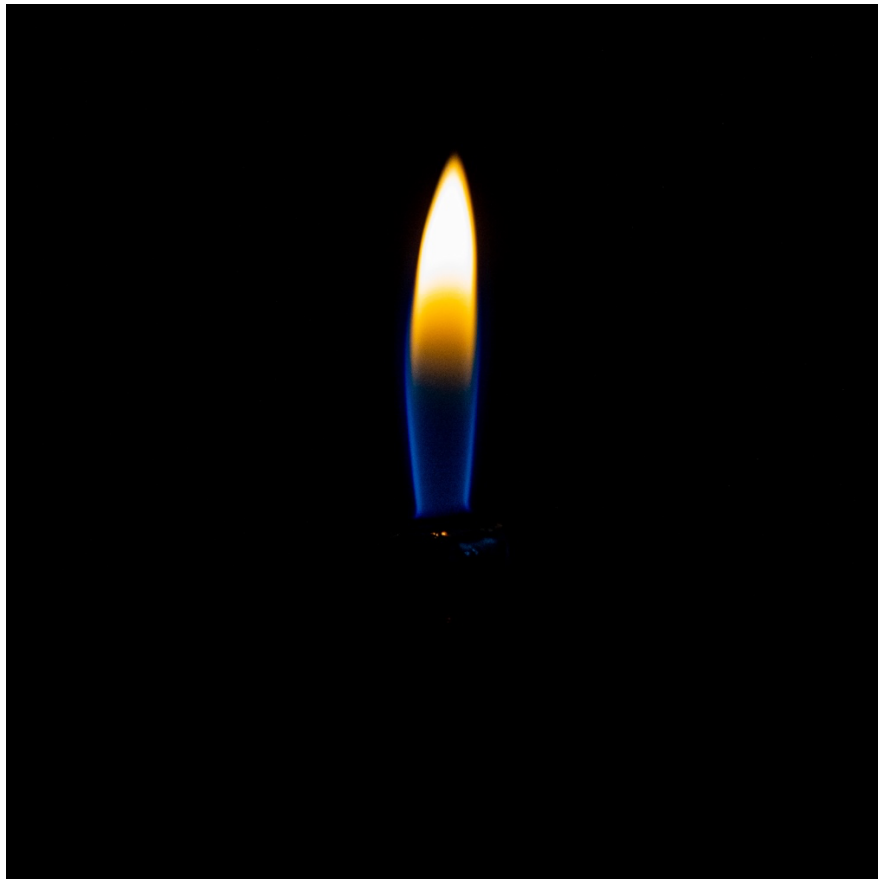# IV 3 Report
Flame by a lighter

MCEN 4151: Flow Visualization
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I.   The purpose of the image

This is the third image assignment in MCEN 4151 (Flow Visualization). The purpose of the image is to capture the flame produced by a lighter. In my experiment, I did use a lighter to produce flame and see how it behaves. The main focus of this experiment is to observe the flow of the flame produced by the lighter. The flow should behave as a laminar flow since the velocity of the air is not high in the surroundings.

II.   Fluid Mechanics

Flames can be either turbulent or laminar, in my experiment the flames produced by the lighter turned out to be laminar. The velocity of the air in the surrounding was pretty low which helped to keep the flame stable throughout the shooting process. Reynolds equation is used to prove that the behavior of the fluid is laminar. Depending on Reynolds number, if it is higher lower than 2000, then this mean that the fluid is laminar.

$$Re = \frac{\rho_{flame} * u_{flame} * L_{lighter}}{\mu_{flame}} = \frac{\left(0.3 \; \frac{kg}{m^3}\right)^{[2]} * \left(0.1 \; \frac{m}{s}\right) * (0.2m)}{\left(0.0002 \; \frac{Ns}{m^2}\right)} = \; 30 \quad [1]$$

Where:
Rho: Flame density, u: Flame flow speed (Assumed), L: characteristic length of the lighter and mu: absolute viscosity of the flame (Assumed).

Reynolds number is 30 which is less than 2000, this proves that the flow is laminar.

III.   Flow Visualization Technique

The experiment was conducted indoors in my apartment living room. The surrounding light was low, and the coach was used as a background. The camera was setting on a tissue box that sits on the table. The lighter was handheld by me, in front of the camera. The "timer" feature was used to capture the photo since I was taking the picture alone.

IV.   Photographic Technique

 A Nikon D7100 DSLR camera with lens of 18-105 mm was used to capture this phenomenon. The camera was laying on a tissue box on the table 20 cm away from the object. The image was captured with a zoom of 105 mm, 1000 ISO, f/5.6 aperture 1/160 shutter speed. Adobe Lightroom software was used to do post-processing to the image. The blacks were decreased to make the background blacker. The saturation was increased to make the blue and yellow colors pop up. Moreover, the clarity was increased to make the colors pop up more.
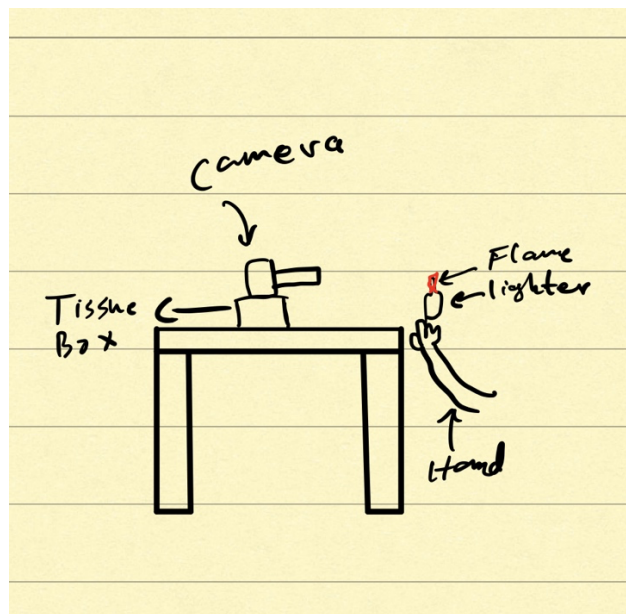
Sketch of the set up

Initial Image

Final Image

V.   Image Reveals

The image shows a flame produced by a lighter. I like the colors (red and yellow) of the flame in the image. Besides, I like how the flame behaved and the colors of it. What I would do different if I were to repeat the experiment is to improve the focus point on the flame to be more pleasant to the eye looking at it. Overall, I am pretty happy with the result of this experiment and I believe that I fulfilled my intent of this project.

VI.   References

[1] *Reynolds number*. Engineering ToolBox. (n.d.). Retrieved October 12, 2021, from https://www.engineeringtoolbox.com/reynolds-number-d_237.html.

[2] https://www.askamathematician.com/2012/04/q-how-much-does-fire-weigh/