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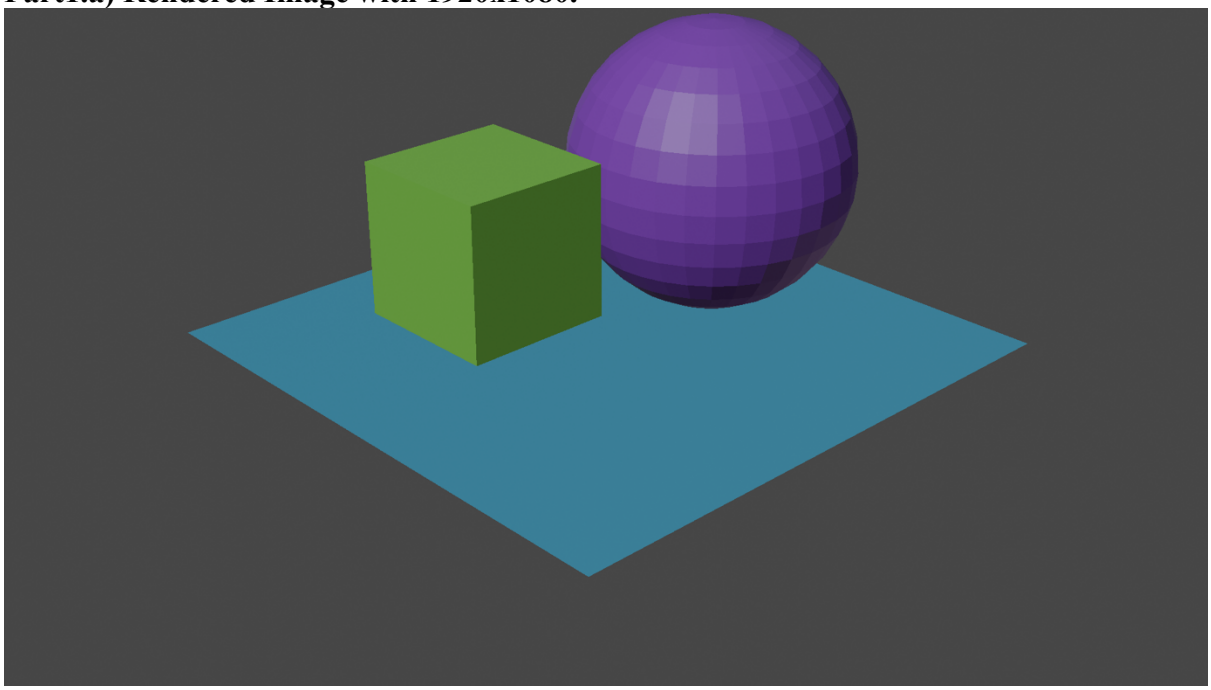
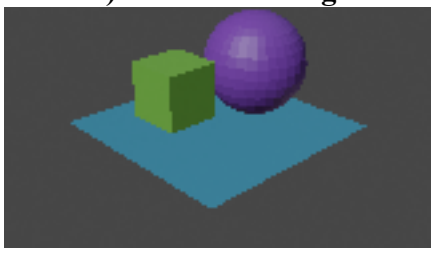
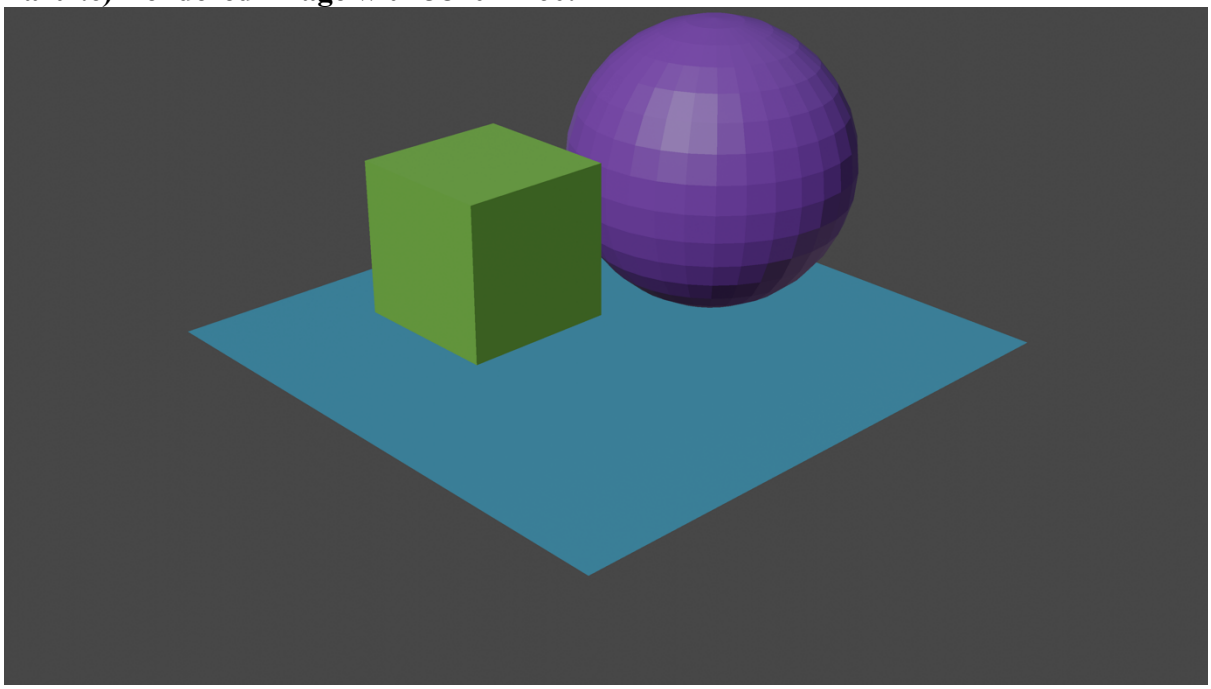
Part1.a) Rendered Image with 1920x1080.



Part1.b) Rendered Image with 160x90.



Part1.c) Rendered Image with 3840x2160.



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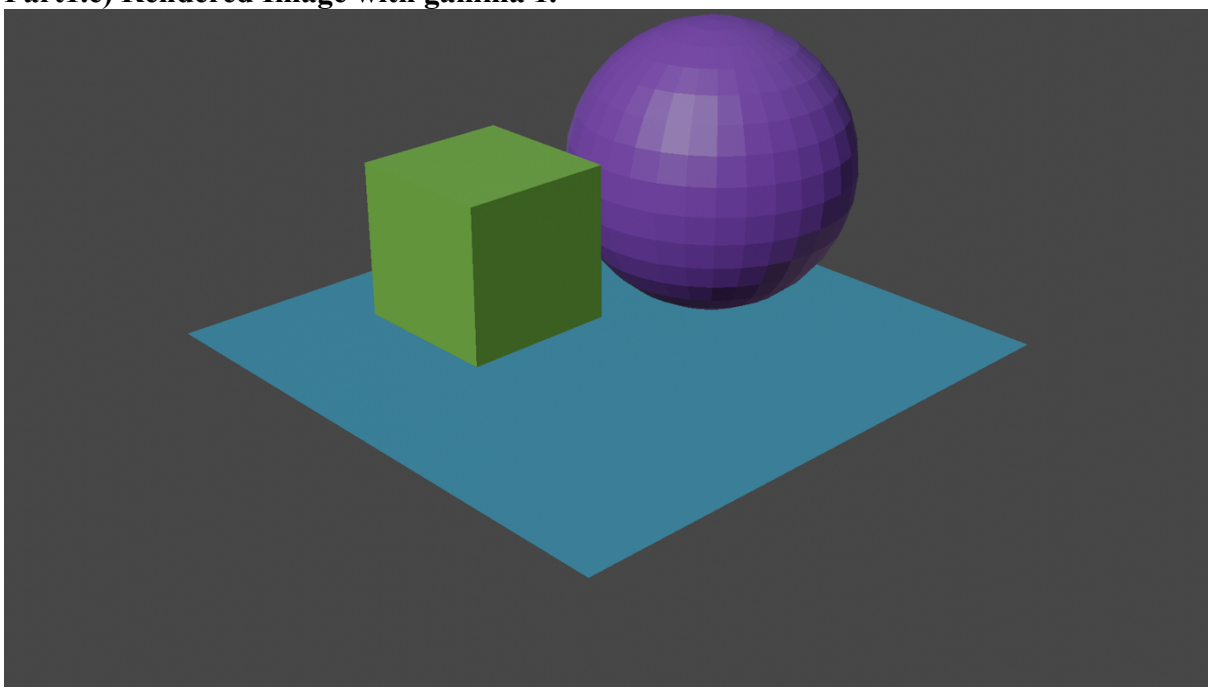
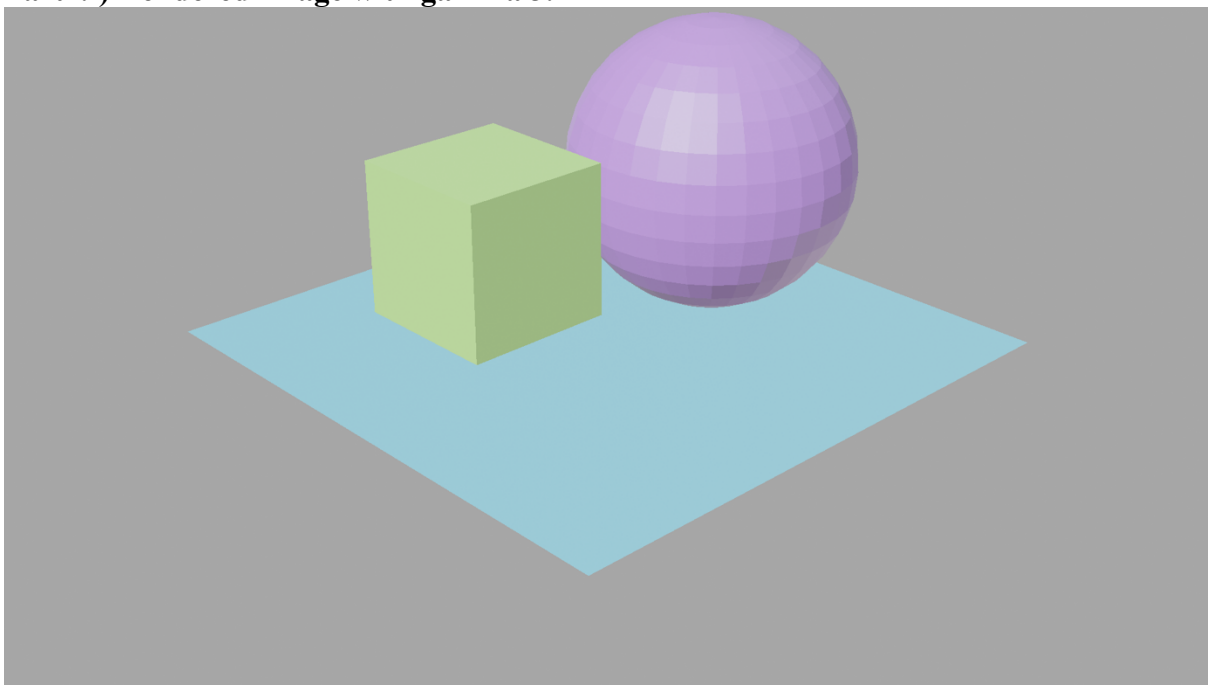
Part1.d) Compare the images that are 1920x1080, 160x90 and 3840x2160. Write the effect of changing the resolution.

As we increase the resolution, we can see the image in a more detailed and clear way. In the same way, the lower the resolution, the lines are less smooth and more pixelated.

Part1.e) Rendered Image with gamma 1.



Part1.f) Rendered Image with gamma 3.



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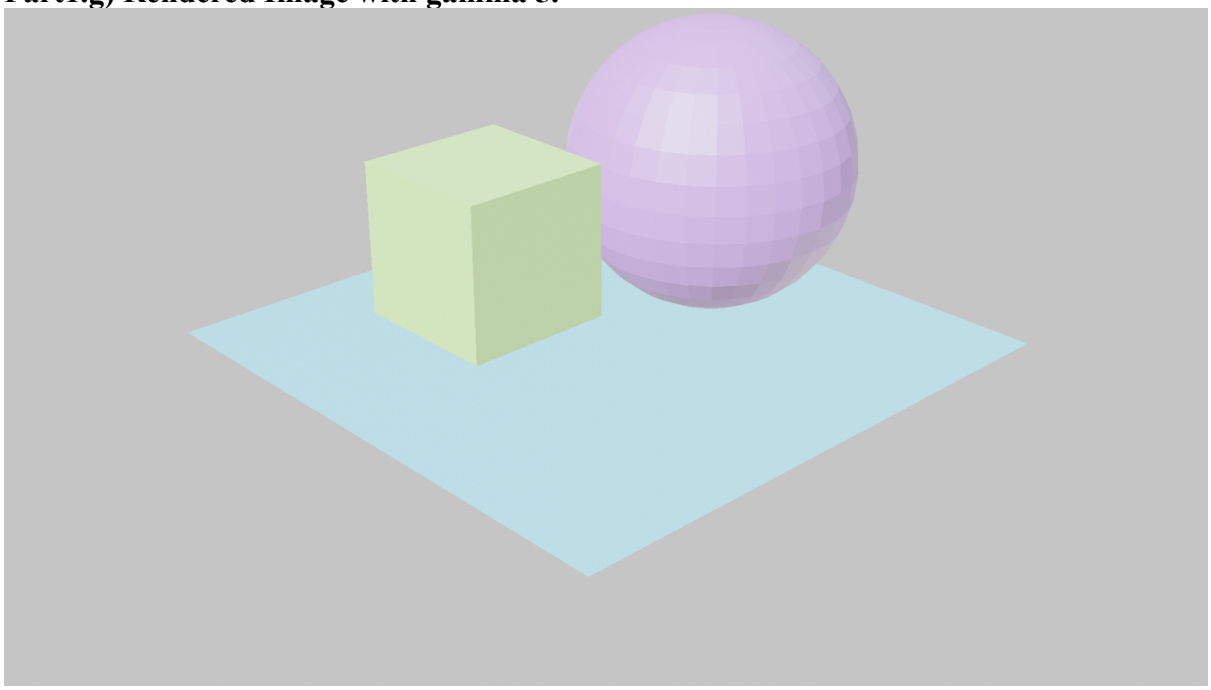
Part1.g) Rendered Image with gamma 5.



Part1.h) Compare the images that have gamma value 1,3 and 5. Write the effect of changing the gamma value.

Gamma value affects the contrast and brightness of the image. When the gamma value is 1, image have both dark and bright areas. However, as the gamma value increases, the color difference between the dark and light areas decreases gradually. Also, we lose the contrast in the image. For this reason, the photo looks brighter when the gamma value is 5.

Part1.i) Answer this question and write your document, What's the advantage of using YUV color space?

YUV color space is useful when preserving brightness information is more critical than color information. Since human perception is more sensitive to changes in brightness than color, using YUV color space makes more sense. Moreover, by compressing chromaticity data with less precision, file sizes can be reduced without significantly reducing image quality.

Part2.a) Write down p_{xy}.

$$P_{xy} = \begin{pmatrix} 1.707 \\ 0 \\ 0.293 \end{pmatrix}$$

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Part2.b) Write down p_{yx}.

$$p_{yx} = \begin{pmatrix} 1.414 \\ 0.707 \\ 0.707 \end{pmatrix}$$

Part2.c) Explain how you get these results.

For p_{xy}:

rotate X-axis by +45°

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos 45 & -\sin 45 \\ 0 & \sin 45 & \cos 45 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ \cos 45 - \sin 45 \\ \cos 45 + \sin 45 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ \sqrt{2} \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 1.414 \end{bmatrix}$$

then rotate Y-axis by +45°

$$\begin{bmatrix} \cos 45 & 0 & \sin 45 \\ 0 & 1 & 0 \\ -\sin 45 & 0 & \cos 45 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ \sqrt{2} \end{bmatrix} = \begin{bmatrix} \cos 45 + \sqrt{2} \cdot \sin 45 \\ 0 \\ -\sin 45 + \sqrt{2} \cos 45 \end{bmatrix} = \begin{bmatrix} 1 + \frac{1}{\sqrt{2}} \\ 0 \\ 1 - \frac{1}{\sqrt{2}} \end{bmatrix} = \begin{bmatrix} 1.707 \\ 0 \\ 0.293 \end{bmatrix}$$

For p_{yx}:

rotate Y-axis by +45°

$$\begin{bmatrix} \cos 45 & 0 & \sin 45 \\ 0 & 1 & 0 \\ -\sin 45 & 0 & \cos 45 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} \cos 45 + \sin 45 \\ 1 \\ -\sin 45 + \cos 45 \end{bmatrix} = \begin{bmatrix} \sqrt{2} \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1.414 \\ 1 \\ 0 \end{bmatrix}$$

then rotate X-axis by +45

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos 45 & -\sin 45 \\ 0 & \sin 45 & \cos 45 \end{bmatrix} \begin{bmatrix} \sqrt{2} \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} \sqrt{2} \\ \cos 45 \\ \sin 45 \end{bmatrix} = \begin{bmatrix} \sqrt{2} \\ 1/\sqrt{2} \\ 1/\sqrt{2} \end{bmatrix} = \begin{bmatrix} 1.414 \\ 0.707 \\ 0.707 \end{bmatrix}$$

Part2.d) Write down t_1 cube ^{World}.

$$\begin{pmatrix} 4 \\ -1 \\ 2 \end{pmatrix}$$

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Part2.e) Write down t_2 cube ^{World}.

$$t_{2cube}^{world} = \begin{pmatrix} 4 \\ 0.58579 \\ 3.8284 \end{pmatrix}$$

Part2.f) Explain how you get these results.

$$t_{1cube}^{world} = t_{cube}^{local} + t_{plane}^{world} = \begin{pmatrix} 1 \\ -3 \\ 1 \end{pmatrix} + \begin{pmatrix} 3 \\ 2 \\ 1 \end{pmatrix} = \begin{pmatrix} 4 \\ -1 \\ 2 \end{pmatrix}$$

rotate X-axis by -45°

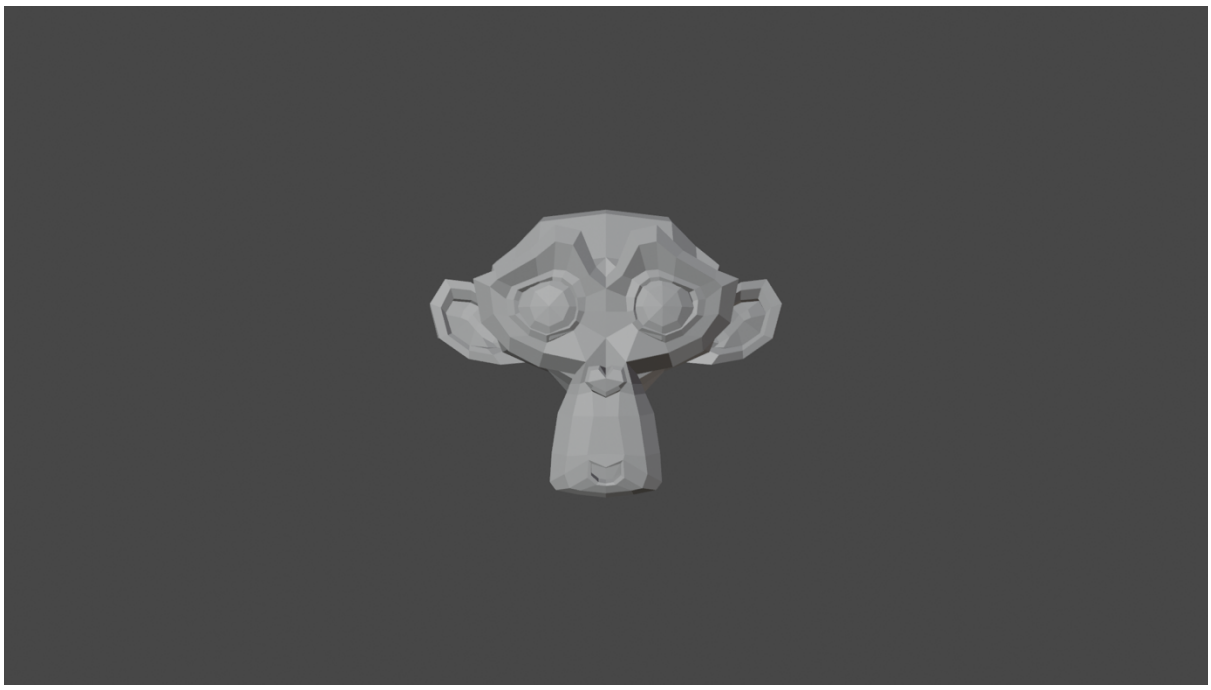
$$\begin{bmatrix} 1 & 0 & 0 & 3 \\ 0 & \cos 45 & \sin 45 & 2 \\ 0 & -\sin 45 & \cos 45 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ -3 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 1+3 \\ -3\cos 45 + \sin 45 + 2 \\ 3\sin 45 + \cos 45 + 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 4 \\ 2 - \sqrt{2} \\ 2\sqrt{2} + 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 4 \\ 0.58579 \\ 3.8284 \\ 1 \end{bmatrix}$$

PS: $\cos(-45) = \cos 45$

$\sin(-45) = -\sin 45$

Part2.g) Save the rendered images under these three camera settings. (Add screenshots of them)

(0,-6,0) & 25mm



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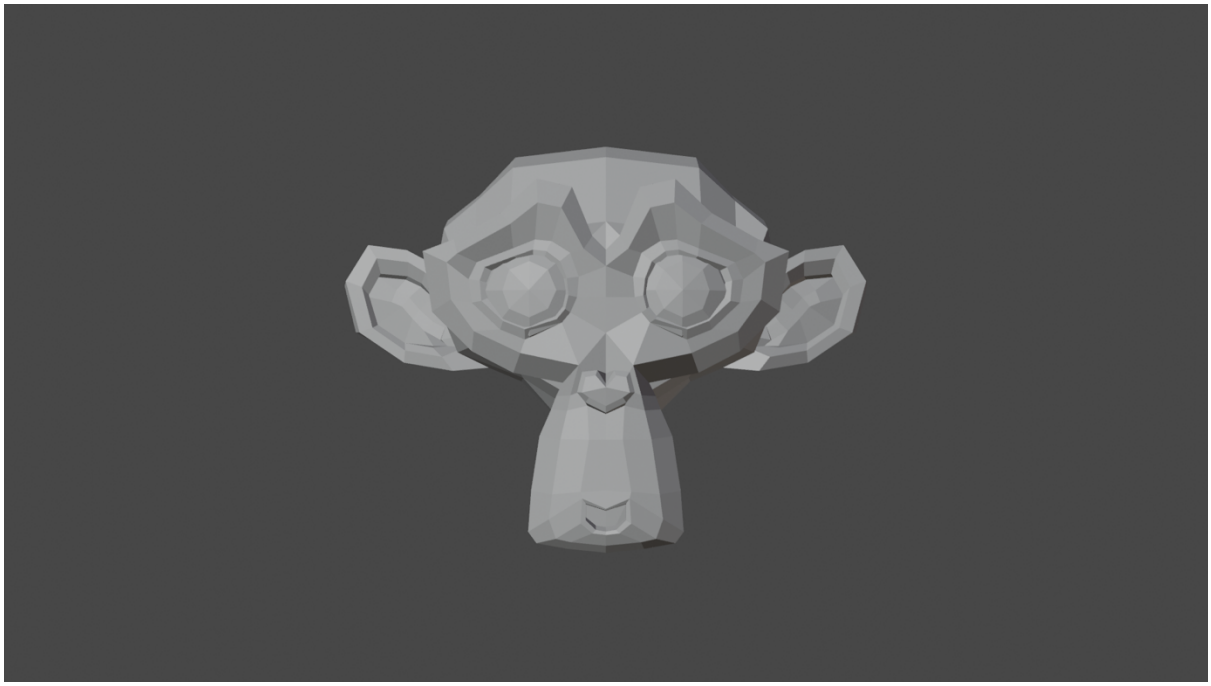
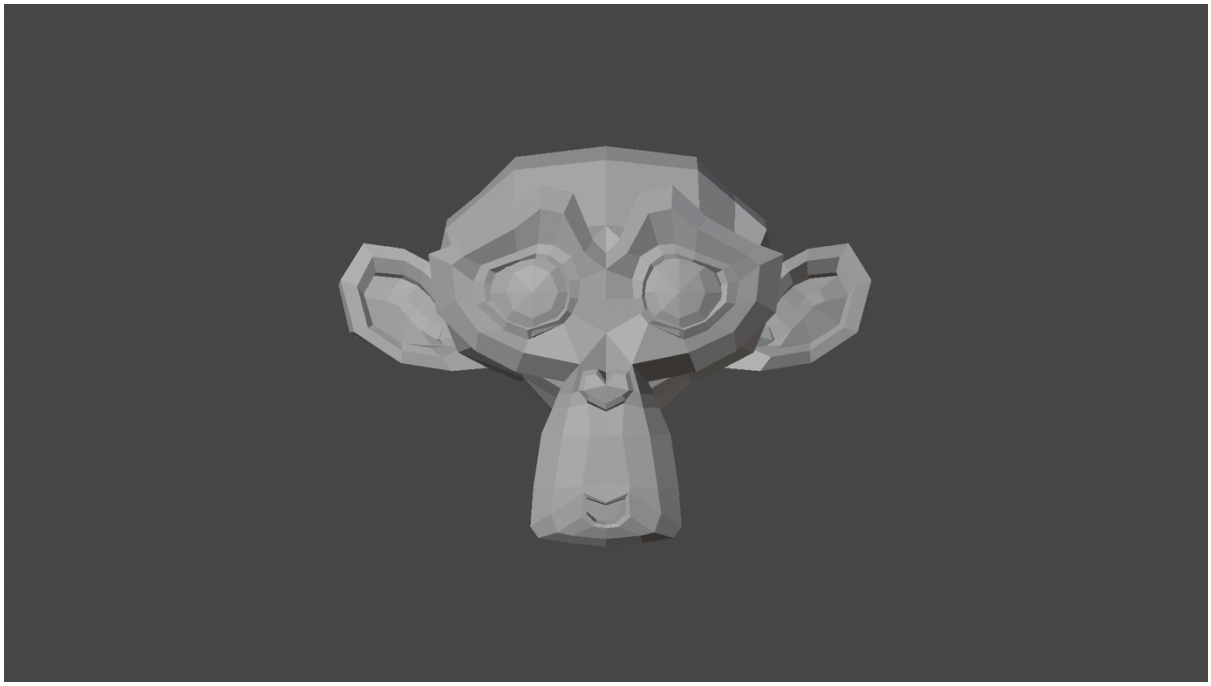
(0,-10,0) & 60mm



(0,-20,0) & 120mm



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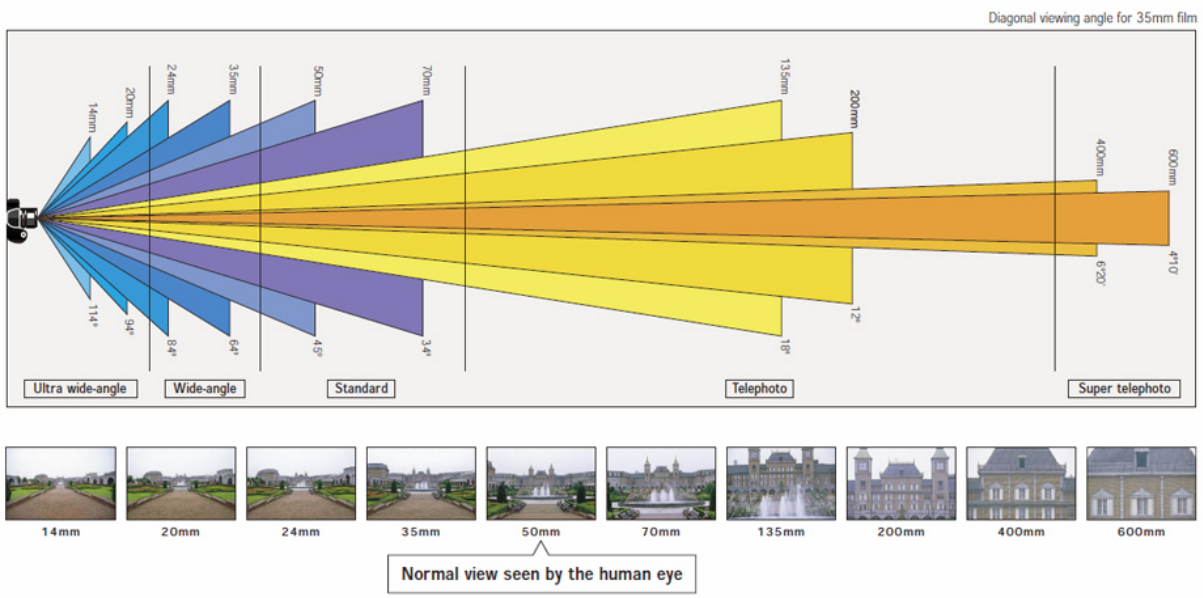
Part2.h) Compare the three images in Checkpoint 3. Discuss the effect of changing the focal length.

A shorter focal length provides a broader field of view, while a longer focal length narrows the field of view. As in the first ((0,-6,0) & 25mm) and second ((0,-10,0) & 60mm) examples, we approach the monkey as the focal length increases. However, in our case we are moving the monkey away from the camera. For this reason, we expect a closer image to the monkey to be formed in the third example, but at the same time, because we moved the monkey away, it looks as if the second and third examples are the same.



Part2.i) Save the image with flat lighting. (Add screenshots). Write the effect of flat lighting.

There is lack of shadows, highlights, and contrast. They are in flat appearance like in 2D.

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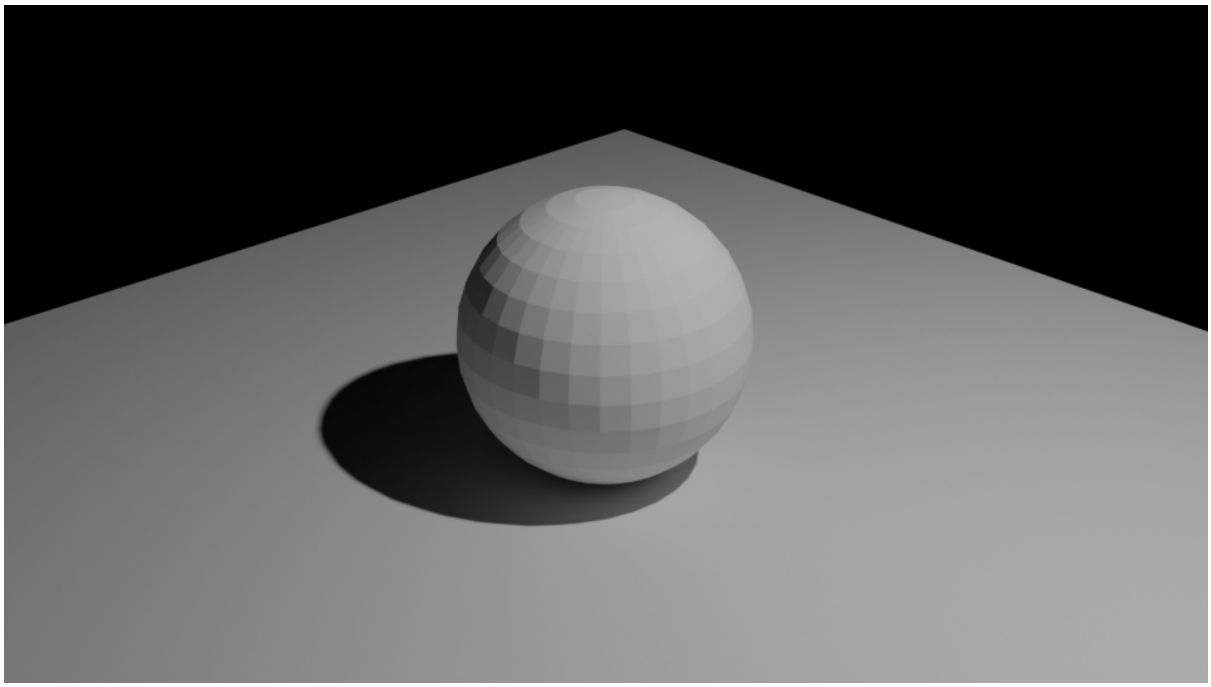
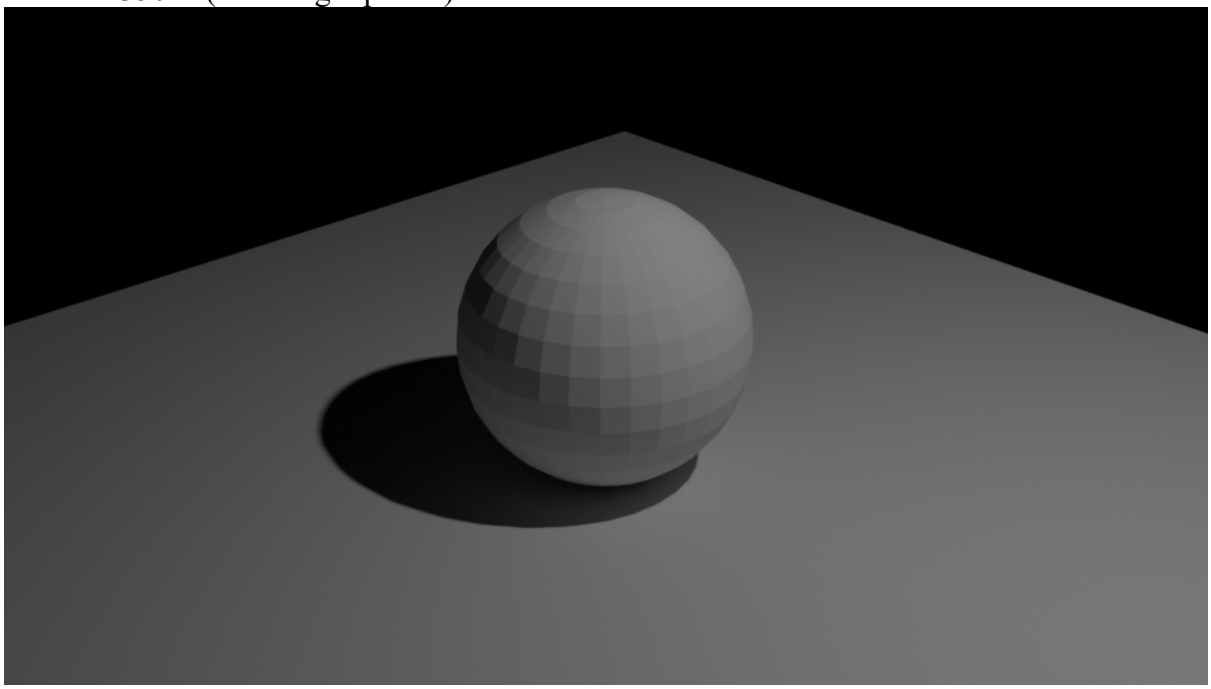
Part2.j) Save the rendered the image with lower light power (Add screenshots)

Power = 1000W



Power = 350W (lower light power)



Part2.k) Compare the rendered checkpoint 8 with 8.1 State the relationship between light power and irradiance. Write your answer.

Power = 1000W

Power = 350W

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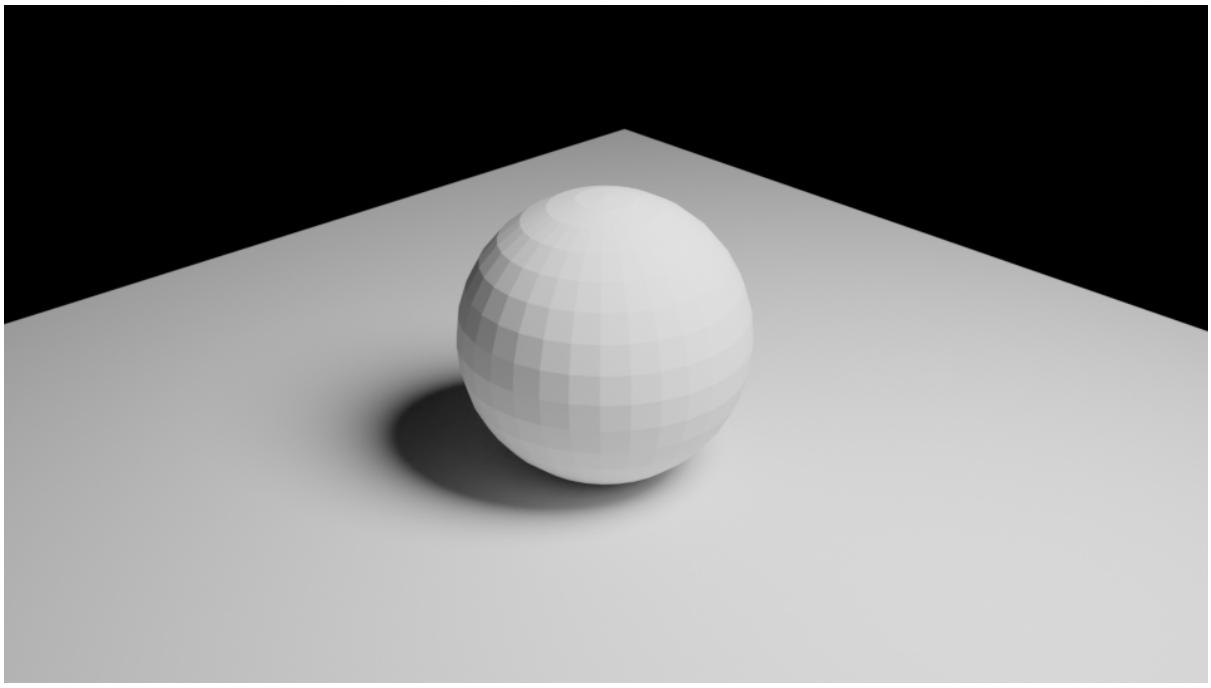
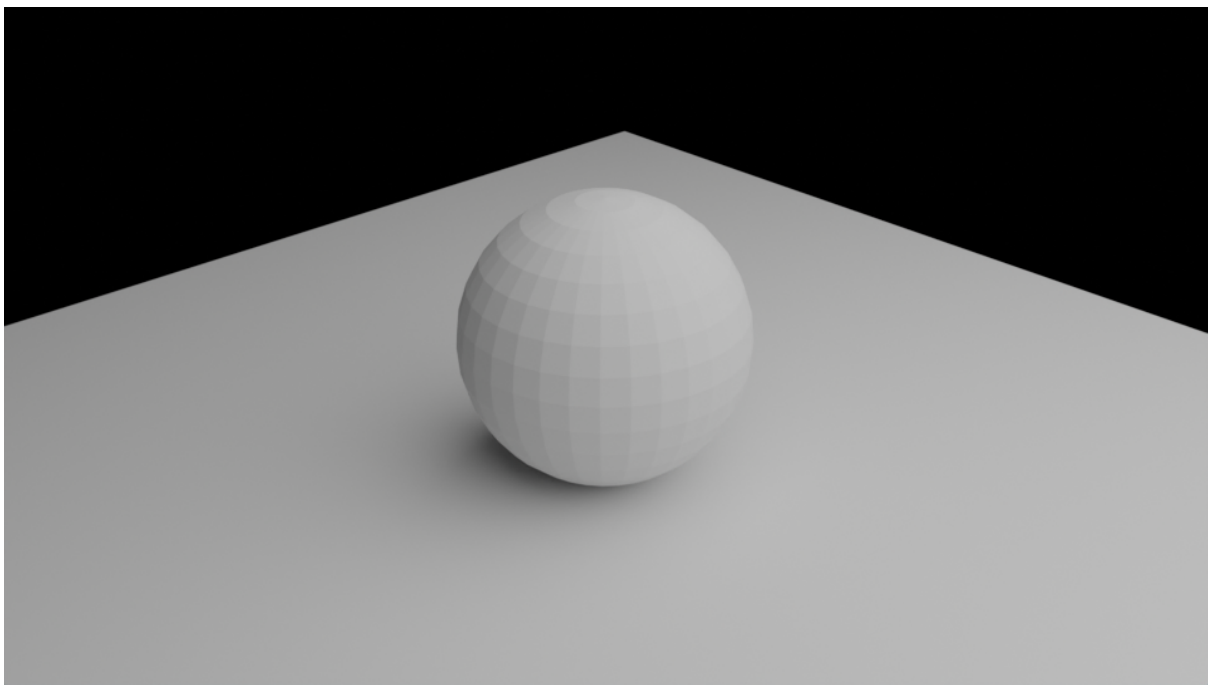
The stronger the light power, the greater the brightness. The object in light with a power of 1000 watts appears lighter in color compared to the object in light with a power of 350 watts.

Part2.l) Save the rendered the images with the area light. (Add screenshots)

Disk – 4m – 1200W



Square – 15m – 1200 W



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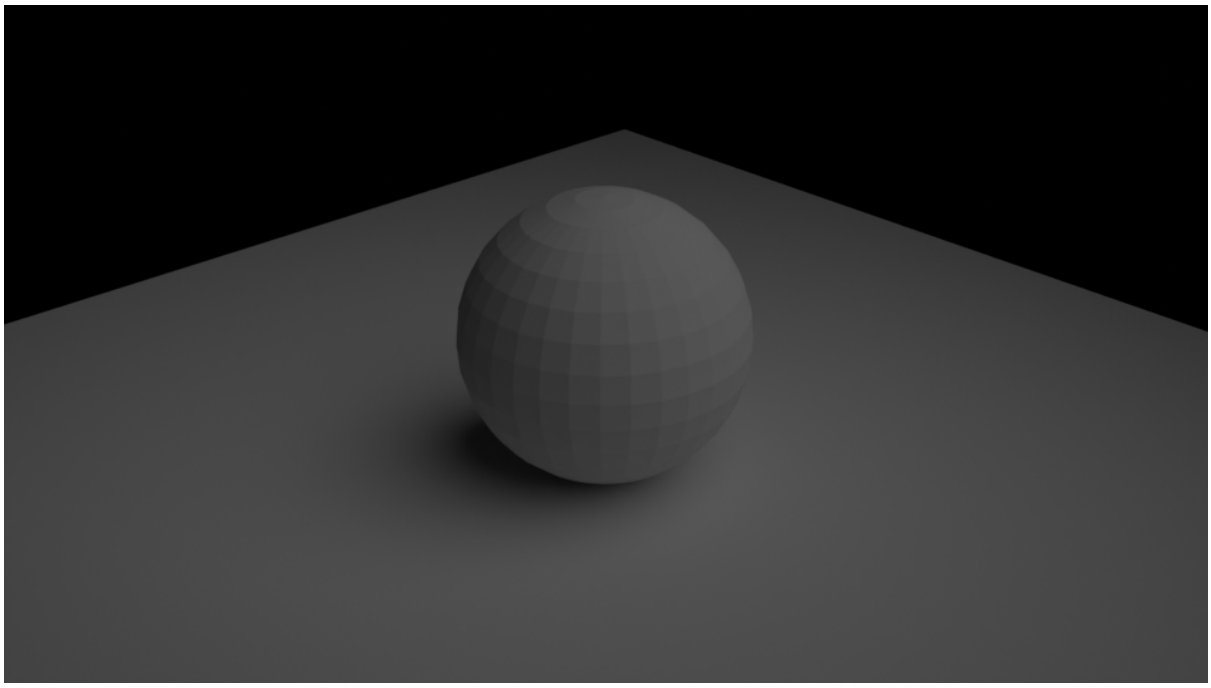
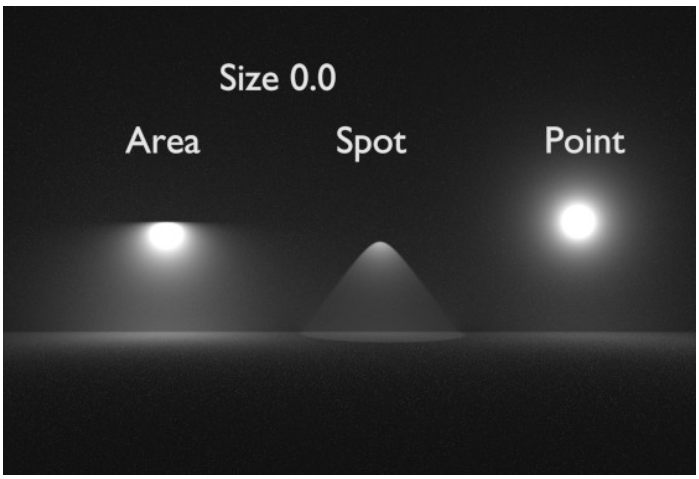
Part2.m) Save the rendered the image with the spot light. (Add screenshots)

Spot – 8m – 700W



Part2.n) Compare Checkpoint 8, Checkpoint 8.3, Checkpoint 8.4 and Checkpoint 8.5. Discuss how the shadow looks different between the point light, spot light and area light. Write your answer.



As we can see in the figure, point lights emit light like the sun. They create focused and defined shadows. Whereas spotlights emit light within a cone, which allows for a focused light. They provide a balance between focused and soft shadows. However, area lights are large, extended light sources, such as rectangular panels providing a natural and gentle light distribution with soft shadows.