1. We know that the color of a light/object we see depends on the selective transmission or reflections of some wavelengths more than others. Based on this fact, explain why the sky on earth looks blue, but the same sky on moon looks black. Why?

2. Your carpet is stained and you are trying to clean it. Often you will find yourself concentrating on the edges of the stain and trying to remove it rather then the whole strain. And it works. A casual viewer finds it difficult to locate the stain when the edge is removed. Why?

3. The preferred color of the runway lights (used usually for nighttime landing and taking off) is usually blue, and not red. Why?

4. Cataracts are tissues that develop clouding the eye's lenses. Cataracts mostly happen in the old age. But there are also juvenile cataracts that occur in babies and often are existent from birth. In 1960s, when the art of cataract removal perfected, they operated on old people and cured them. They also operated on a bunch of young men, who had juvenile cataracts. But this did not cure the cataracts. Why?

5. The response, R, of human eye to intensity of light, I, can be described as $R = I^{1/2}$. The following experiment is used to correct the gamma of any display. Create a image with rows of gratings of the form $Sin^2(x)$ with increasing values of x along the vertical axis. Display this image on your monitor. You will be seeing some interference patterns if your gamma is not correct. These are called Moire patterns. Adjust your gamma until the moiré patterns disappear. This is the correct gamma setting for your display. Explain this phenomenon. (**Hint: Think about linear systems and how they behave).**

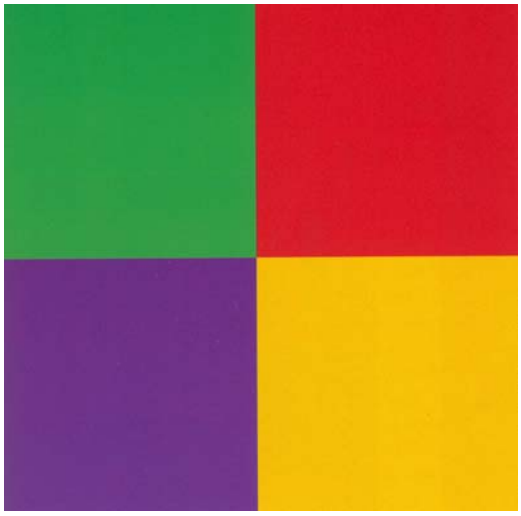
6. The picture on the left appears like ridges in the sand. Now, invert page and look at the same image, it will look like steps. Which perceptual phenomenon can explain it?

7. Let the (x,y,Y) representation of color C_1 be $C_1 = (x_1,y_1,Y_1)$. Find the XYZ coordinate of a color C_2 that has chromaticity coordinates as half of the chromaticity coordinates of C_1 and luminance 1.5 times that of C_1.

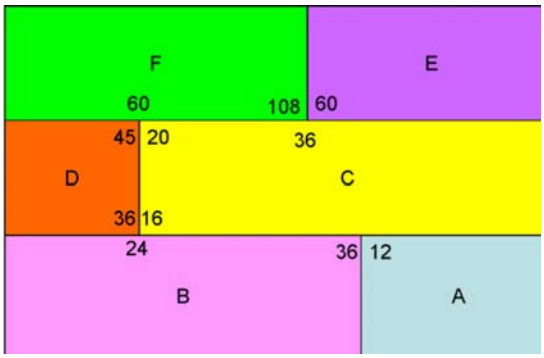
8. C_1 and C_2 are colors with *XYZ* coordinates *(50,75,10)* and *(25,50,100)* respectively. Find the XYZ coordinate of a color C_3 with same luminance as C_1 and chromaticity coordinate half way between C_1 and C_2. How would this color look?

9. What is the dominant wavelength of a color with chromaticity coordinate *(0.4, 0.5)*? What is the chromaticity coordinates of this wavelength? What is the chromaticity coordinates of the complement of this color?

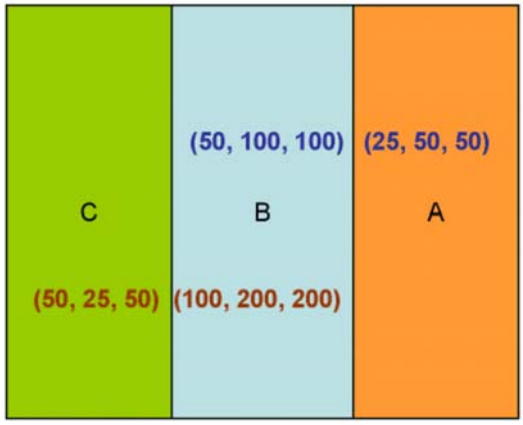
10. Look at the image on the right for 30 seconds or more and then shift your gaze to a white paper. What do you see? What is this phenomenon called and why does it happen?



11. The image on the right shows six different objects A, B, C, D, E and F, which have different reflectance. It also shows the gray scale values at the edges. Assuming that the illumination is continuous throughout the image, find the reflectance of B,C,D,E and F with respect to A. How would you verify that the illumination is indeed continuous?



12. The figure on the right shows an image segmented into three parts, A, B and C based on the detection of edges between them. The XYZ coordinates of the colors on the both sides of the edge between A and B are given in blue. The same for the edge between B and C is given in red. Which of these two edges do you think is due to reflectance and why?



13. A person was presented an annular ring of luminance of 100cd/m^2 with a circular inset of 50cd/m^2. In an adjacent region, he was presented with a circular inset of 150cd/m^2 and asked to adjust the luminance of the annular ring surrounding it so that it creates similar perception as that of the adjacent pair. What luminance do you expect him to adjust to?

14. A two month old was being very jittery and crying in a room lit by a whitish tube light. In order to pacify him, the mother suddenly puts on a very bright yellowish light. The kid suddenly finds renewed interest in everything around him and stops crying. Can you explain this?

15. You are going on a train. The track is lined by electric poles placed regularly along the track so that it is just a few feet away when you look out of the window. When the train just starts you can make out these poles clearly as they keep moving away from you. As the train increases speed, slowly the poles become blurred as they move away from you. Can you explain this phenomenon with CSF?

16. In an movie auditorium, the projection system is used with mean luminance of 12-22 foot Lamberts for refresh rates of 48 Hz. However, it is said that a refresh rate has to be increased to 60 Hz for higher luminance projection system. Can you explain this with CSF?

17. Let the maximum spatial frequency detected by a human at luminance *L* be *30 cycles/degree* of the angle subtended on the human eye. Nyquist sampling condition says that to generate a spatial pattern of a certain frequency *f* on a display, at least *2f* number of pixels are required. From this find out the minimum display resolution needed for a person at a distance *d*, so that he can feel the experience of seeing a natural scene on the display. Plot the *r* with respect to *d*.

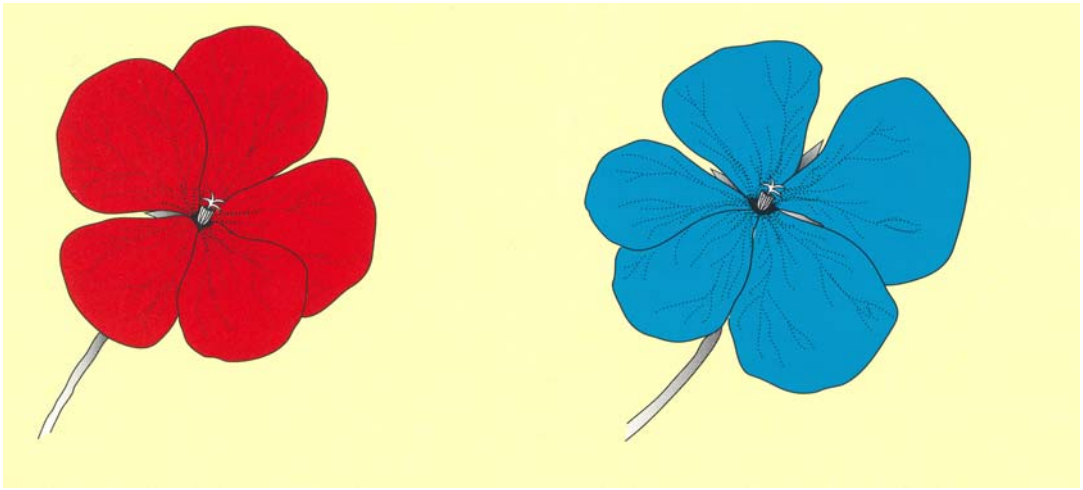
18. A bright lighthouse is not visible in the day, but is easily visible at night even though the power of the light remains unchanged. Why?

19. The image of your TV looks washed out. The technician says that the intensity response curve of the TV is linear and hence the problem. To correct the problem, he has to make it non-linear. Why? What kind of non-linear response do you think he will put in?

20. We know that the color of a light/object we see depends on the selective transmission or reflections of some wavelengths more than others. Based on this fact, explain why sunsets and sunrises in polluted areas are found to be much more spectacular than other area. **Hint**: Sunlight passes through the environment before reaching the eye.

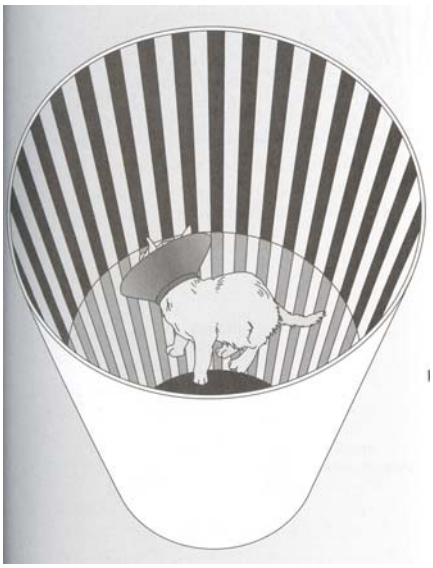
21. What will be the difference of our perception of Hermann's grid if we had lateral excitation instead of lateral inhibition (i.e a center surround receptive field that has inhibition in the center and excitation in the surround)?

22. Why do we see better in the dark if we avert/skew our gaze a little?



23. Do the following experiment. Look at the above picture. Then cover your left eye with hand for 10 minutes. So, now you are looking at the image with **just** your right eye. After 10 minutes, uncover your left eye and cover your right eye. Compare what you see with what you were seeing with your right eye before. You will see that the blue flower looks brighter from your left eye than from your right eye. Why does this happen?

24. A bunch of kittens were reared from birth by seeing only vertical stripes. They were in an enclosed area with just stripes all around them. They wore neck ruffs so that they cannot turn their heads to see the vertical stripes in a different orientation. After this, they were compared with normal kittens. What difference would you expect in the sensitivity of these kittens from the normal kittens? Why? Which area of the brain is responsible for this difference and how?



25. The left picture is a simple line drawing of a face while the right image is a low resolution picture. The right hand side image has a lot more information, yet we perceive the face of the man with the line drawing much better. What does it say about our visual system? What are the different areas and cells in the visual system that the left image would stimulate?

26. The color gamut of a printer is given by triangle ABC on the chromaticity chart where *A = (0.15, 0.65), B = (0.6, 0.3)* and *C = (0.15, 0.125).* The color gamut of a monitor is given by triangle DEF on the chromaticity chart where *D = (0.2, 0.05), E = (0.55, 0.4)* and *F = (0.05, 0.55).* How many sides does the polygon that represents all the colors that can be produced *both* by the printer and the monitor have? Find the coordinates of all the vertices of this polygon.

27. You have difficulty in reading very small text on the screen. However, this difficulty reduces as you increase the size of the fonts. Explain this using CSF.

28. You are working in your office which receives good sunlight in the day time. Around dusk when it is getting dark, you find that it is difficult to read the text on the book. You light your table lamp and the text is again legible again. Explain this phenomenon with CSF.

29. In the image on the right, one X looks yellow and the other looks gray though they are the same color as you can see from the place where they are connected. What is this phenomenon and why does this happen?