CSCIE 236 – Homework 3, Written portion
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1. We mix blue and yellow paint. Blue reflects only blue, and yellow absorbs all blue. What should the color be of the mixed paint? Typically, however, the mixed paint is green. Explain this.

In adding blue and yellow paint, blue absorbs everything but blue and yellow absorbs everything but yellow, so this should result in black as everything is absorbed. But, in practice the mixed paint will consist of small but finite sized particles of both blue and yellow material. There will be some white light scattered off blue particles reflecting just blue light. There will also be white light reflected off yellow particles giving just yellow light. Then the blue light and the yellow light mix, yielding the average light of the two colors from the color spectrum, so the resultant color seen is Green.

2. Three colors are each matched by three color equations using C.I.E. Tristimulus primaries:

C1 = 0.45X + 1.05Y + 0.5Z
C2 = 1.35X + 3.15Y + 1.5Z
C3 = 3.2X + 1.85Y + 0.95Z

• Compute the chromaticity of each color (small x, y, and z).
• Construct a chromaticity graph by plotting x-chromaticity against y-chromaticity with axis scales from 0.0 to 1.0.
• Compare the chromaticity of the three colors. Will these colors exactly match in appearance? If not how will they differ?
• What C.I.E. primaries X, Y, and Z, will match the color [C4] produced when C2 is added to C3 and plot?

Using formula 4.1 in Ware's book on page 100 and formula 4.5 on page 105.
For C1:

$$x = X/(X + Y + Z) = 0.45/(0.45 + 1.05 + 0.5) = 0.225$$
$$y = Y/(X + Y + Z) = 1.05/(0.45 + 1.05 + 0.5) = 0.525$$
$$z = Z/(X + Y + Z) = 0.5/(0.45 + 1.05 + 0.5) = 0.25$$

For C2:

$$x = X/(X + Y + Z) = 1.35/(1.35 + 3.15 + 1.5) = 0.225$$
$$y = Y/(X + Y + Z) = 3.15/(1.35 + 3.15 + 1.5) = 0.525$$
$$z = Z/(X + Y + Z) = 1.5/(1.35 + 3.15 + 1.5) = 0.25$$

For C3:

x = X/(X + Y + Z)
= 3.20/(3.20 + 1.85 +0.95)
= 0.5333

y = Y/(X + Y + Z)
= 1.85/(3.20 + 1.85 +0.95)
= 0.308333

z = Z/(X + Y + Z)
= 0.95/(3.20 + 1.85 +0.95)
= 0.158333

Note: The chromiticity coordinates of C1 and C2 are the same.

For points C1 and C2 the chromaticity coordinates are exactly the same, so the colors will be exactly the same for C1 and C2. C2 will be brighter.

For C3, x is 2.37 times larger than x for C1 & C2, so it will be redder.

When C2 is added to C3 the new C4 X, Y, Z values will be

X = 1.35+3.2 = 4.55
Y = 3.15+1.85 = 5
Z = 1.50+0.95 = 2.45

C4 = 4.55X + 5Y + 2.45Z

For C4:

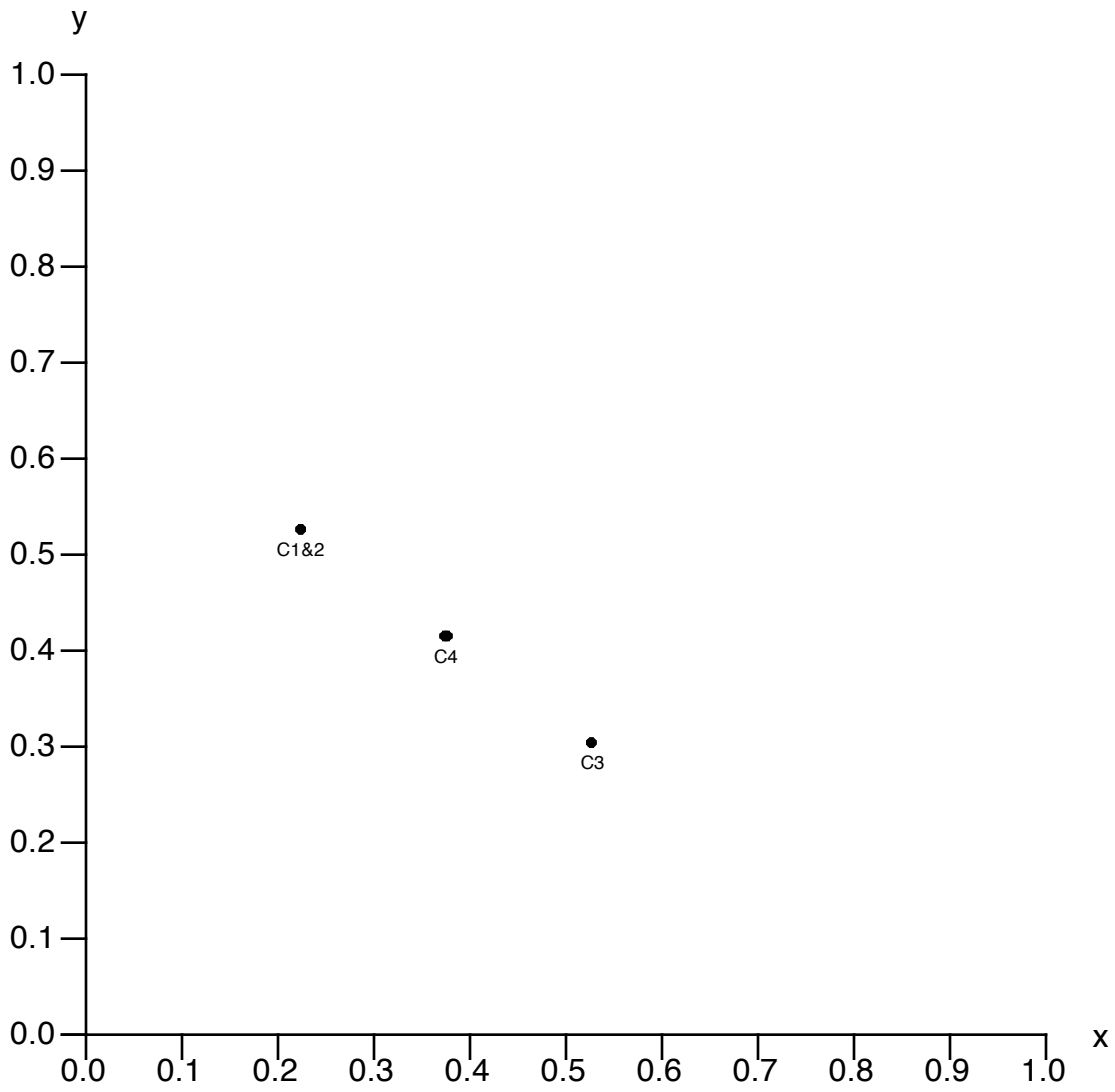
x = X/(X + Y + Z)
= 4.55/(4.55 + 5 + 2.45)
= 0.3791666

y = Y/(X + Y + Z)
= 5/(4.55 + 5 + 2.45)
= 0.41666

z = Z/(X + Y + Z)
= 2.45/(4.55 + 5 + 2.45)
= 0.241666

Not surprisingly C4 is exactly half way between C2 and C3 on the Chromaticity graph.

See next page for plot of C1&2, C3 and C4.



Chromaticity Graph

3. The following are primary colors in the CIE RGB color system.
Convert from Red Green Blue (RGB) to Hue Saturation Value (HSV) color

RGB	Red	Yellow	Green	Cyan	Blue	Magenta
R	1.0	1.0	0	0	0	1.0
G	0	1.0	1.0	1.0	0	0
B	0	0	0	1.0	1.0	1.0

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HSV	Red	Yellow	Green	Cyan	Blue	Magenta
H	0	0.16	0.33	0.5	0.66	0.83
S	1.0	1.0	1.0	1.0	1.0	1.0
V	0.96	0.96	0.96	0.96	0.96	0.96

Converted using applet at http://www.cs.rit.edu/~ncs/color/a_spaces.html