CS 178 – Digital Photography
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Final Exam Review Questions

Part 1: True or False. Write T or F beside each question.

1. If the reflectance spectrum of an object is nonzero for some wavelengths that the illumination spectrum is nonzero, the object will definitely reflect some light.

2. Magenta is on the locus of spectral colors because it is derived from a combination of two pure wavelengths.

3. If you illuminate an object with a monochromatic light source, then regardless of the original color of the object, it will either appear to be the same chromaticity as the light source, or black.

4. There are some pure wavelengths that humans are responsive to but that are not in a rainbow.

5. In Maxwell's color matching experiment, matching a color with a negative value for one of the primaries means the color is outside the gamut defined by those primaries.

6. Chromaticity diagrams factor out saturation and leave only hue and value.

7. It is a clear day. White balance temperature for the midday sun is roughly 5200K. If we want to take a picture in a shady area where there is no direct sunlight, we should set the white balance temperature to something lower than 5200K.

8. Blue light contributes more than green light to luminance because blue light is a shorter wavelength, and thus has more energy.

9. When bouncing a floodlight off a uniform white reflector card to produce a fill light, if you move the card closer to your subject, the subject will become more brightly illuminated.

10. JPEG's compression strategy is to compress the luminance information more than the chrominance because humans are less sensitive to luminance information.

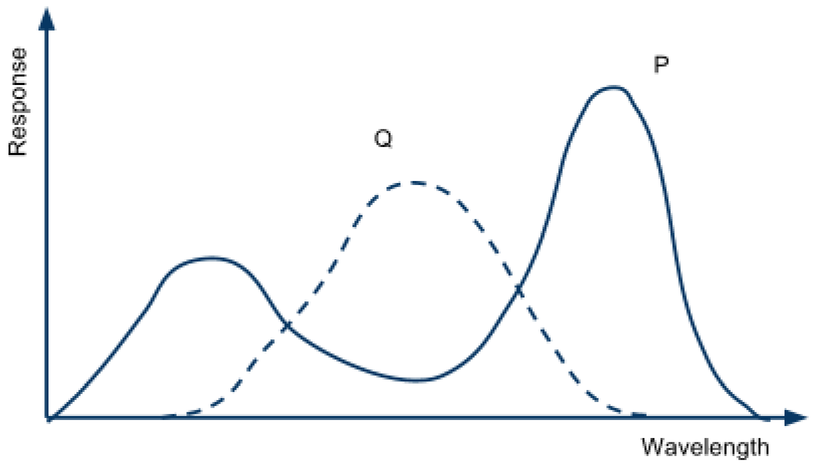
Part 2: Multiple Choice

1. At your favorite band's concert, after settling for a few shots of the whole band, you decide to focus on color as a pictorial element. Differently colored lights are shining on the lead singer and guitar player depending on the mood of the song. If both performers are wearing all blue, what color can the lights be so that they appear to be wearing black, while the red guitar in the scene appears non-black? Assume most of the energy in the materials' reflectance spectrum is focused around the blue and red wavelengths, respectively. Circle the best answer.
(a) Blue lights would work.
(b) Purple lights would work.
(c) White lights would work.
(d) Red lights would work.
(e) No available lighting can possibly work, so you'll do it later in Photoshop.

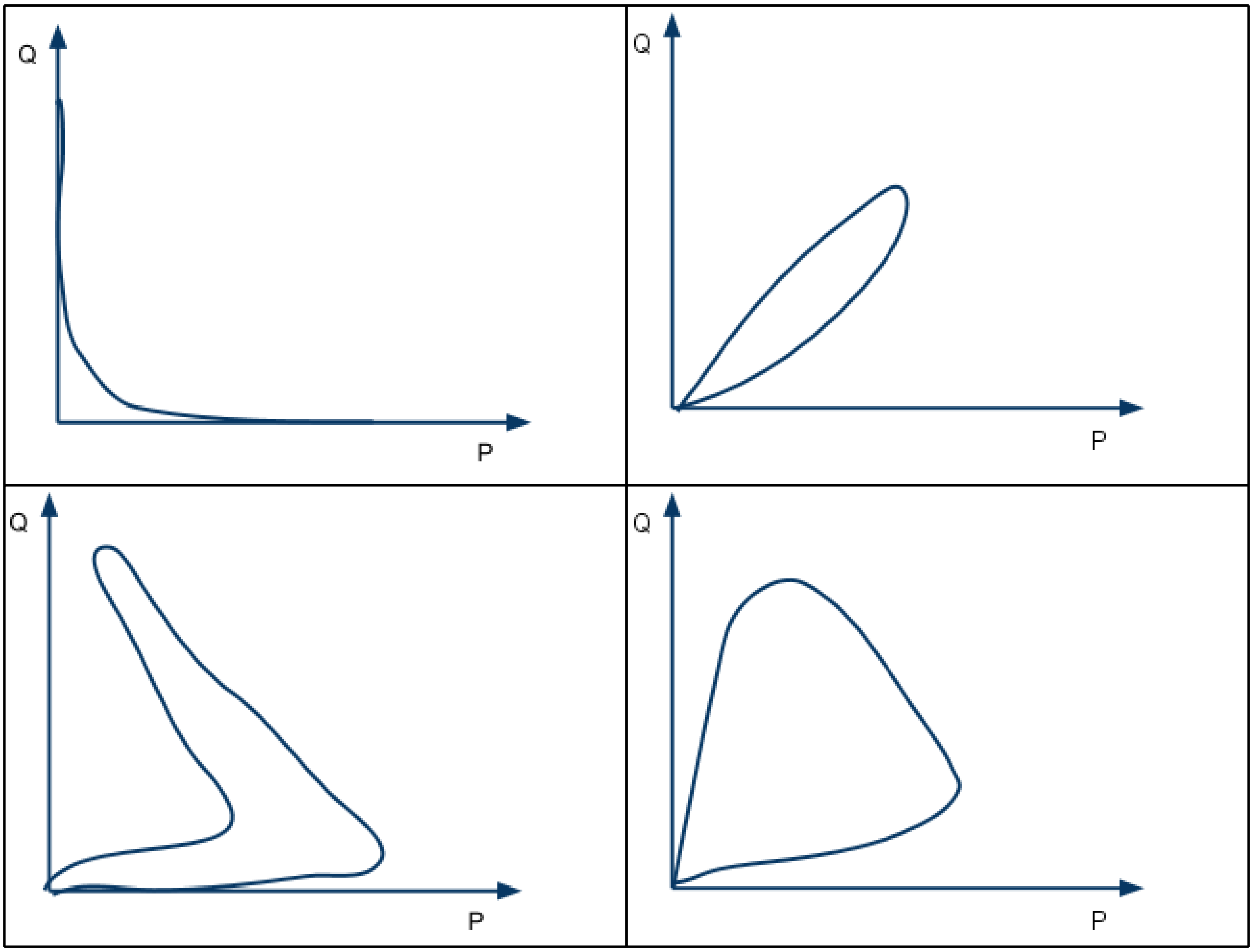
2. A streetlight has a uniform luminous intensity of 8 lumens/sr over its whole cone of light, and the cone is pointed directly downward. If the light subtends 3 steradians, how much total power will fall on the road 5 meters below? Assume the road is larger than the lit area created by the streetlight.
(a) 5 lumens.
(b) 8 lumens.
(c) 24 lumens.
(d) 40 lumens.

3. If you are taking a picture of the sunset where the scene is mostly red but the camera assumes that the average color of the scene is grey, the picture will come out more _______ than what you see. Circle the best answer.
(a) red
(b) yellow
(c) green
(d) cyan
(e) magenta

4. Imagine a (rather strange) dichromat whose spectral response curves look like this:



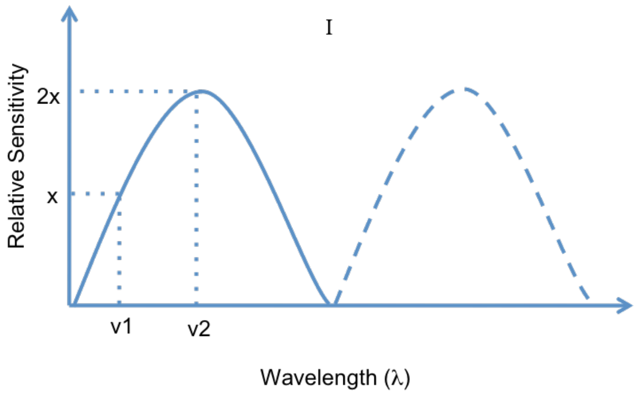
What would the spectral locus of perceivable colors look like? Circle the most plausible graph from among the following:

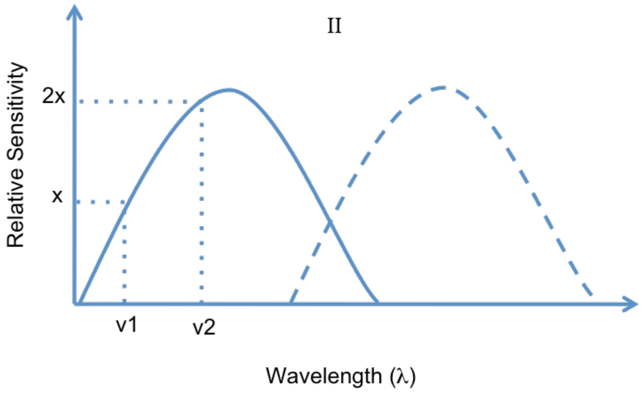


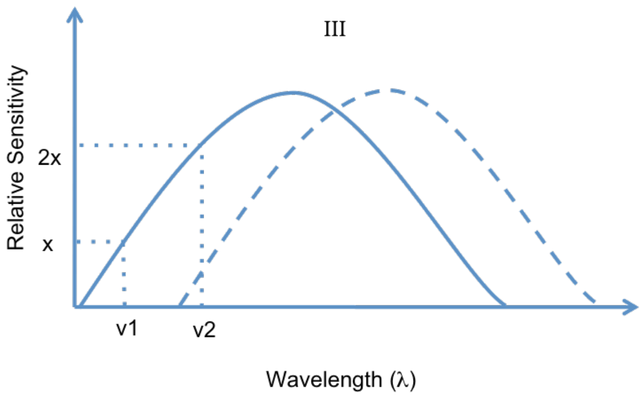
5. It is possible to design a light that appears red and a filter that appears green, such that if you shine the red light through the green filter, the resulting light appears ____. (Circle all that apply.)

(a) Red
(b) Yellow
(c) Green
(d) Brown
(e) Cyan
(f) Black (nothing gets through)

6. The figure shows the spectral response curves of three different organisms. These organisms first look at a source that emits light of wavelength v1 and then at a source that emits light of wavelength v2 but at half the intensity of the first source. Which of the organisms can distinguish between the two sources of light? Circle the best answer (a-f).







(a) I only
(b) I & II
(c) II only
(d) III only
(e) All three
(f) None of the above

7. You're taking a photo of a friend who is 10 feet away, lit only by your on-camera flash. If she walks to 40 feet away, what could you do so that your friend appears the same brightness as before, assuming you keep the rest of your settings constant? Assume all settings are available, and circle all that apply.

(a) Increase flash power by 2x
(b) Increase flash power by 4x
(c) Increase flash power by 16x
(d) Decrease your f-number by 2x
(e) Decrease your f-number by 4x
(f) Decrease your f-number by 16x
(g) Increase your ISO by 2x
(h) Increase your ISO by 4x
(i) Increase your ISO by 16x
(j) You don't need to change anything -- she will already appear the same brightness

8. Fresnel lenses are useful because (circle all that apply)

(a) They are good for focusing light.
(b) They are good for capturing images because of their focusing ability.
(c) They have the same refractive power as thicker lenses.
(d) They allow you to make lenses that are smaller in diameter.

9. What assumption underlies panoramic mosaicing?

(a) rotation about the center of the camera body
(b) rotation about the center of projection
(c) translation in the xy plane, assuming the z axis points in the direction of the lens
(d) translation in the xz plane, assuming the z axis points in the direction of the lens

CS178 Final Exam Formulas

As previously explained, you are responsible for knowing how to use these equations. Please do not ask the TAs what these equations mean during the exam. You may not refer to any other notes during the exam.

$$(\rho,\gamma,\beta) = \left(\int_{400nm}^{700nm} L_e(\lambda)\,\rho(\lambda)\,d\lambda,\ \int_{400nm}^{700nm} L_e(\lambda)\,\gamma(\lambda)\,d\lambda,\ \int_{400nm}^{700nm} L_e(\lambda)\,\beta(\lambda)\,d\lambda \right)$$

$$(R,G,B) = \left(\int_{400nm}^{700nm} L_e(\lambda)\,\bar{r}(\lambda)\,d\lambda,\ \int_{400nm}^{700nm} L_e(\lambda)\,\bar{g}(\lambda)\,d\lambda,\ \int_{400nm}^{700nm} L_e(\lambda)\,\bar{b}(\lambda)\,d\lambda \right)$$

$$r = \frac{R}{R+G+B} \qquad g = \frac{G}{R+G+B}$$

$$(X,Y,Z) = \left(\int_{400nm}^{700nm} L_e(\lambda)\,\bar{x}(\lambda)\,d\lambda,\ \int_{400nm}^{700nm} L_e(\lambda)\,\bar{y}(\lambda)\,d\lambda,\ \int_{400nm}^{700nm} L_e(\lambda)\,\bar{z}(\lambda)\,d\lambda \right)$$

$$x = \frac{X}{X+Y+Z} \qquad y = \frac{Y}{X+Y+Z}$$

$$L = \rho+\gamma+\beta = \int_{400nm}^{700nm} L_e(\lambda)\,V(\lambda)\,d\lambda \qquad V(\lambda) = \rho(\lambda)+\gamma(\lambda)+\beta(\lambda)$$

$$I = \frac{P}{\Omega} \quad \left(\frac{\text{lumens}}{\text{steradian}}\right) \qquad L = \frac{P}{\Omega A\cos\theta} \quad \left(\frac{\text{lumens}}{\text{steradian m}^2}\right)$$

$$E = \frac{P}{A} \quad \left(\frac{\text{lumens}}{\text{m}^2}\right) \qquad \text{BRDF:}\ \ f_r(\theta_i,\phi_i,\theta_r,\phi_r) \quad \left(\frac{1}{sr}\right)$$

$$\text{BSSRDF:}\ \ \rho(x_i,y_i,\theta_i,\phi_i,x_r,y_r,\theta_r,\phi_r) \quad \left(\frac{1}{sr}\right)$$

1 steradian of solid angle (sr) = $r^2 / 4\pi r^2$

aperture size = flash guide number / distance to subject

luminance of a CRT = voltage$^{\gamma}$ where $\gamma \approx 2.5$