Homework 2

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Name

As with all homework in this class, work on this alone.

1. Consider a scene containing an infinitely small white light source that radiates equally in all directions and a 1m^2 card in the shape of a planar disk. The card is at distance $r > 0$ from the light and oriented so that its normal always points directly towards the light from the center of the card. The total rate of energy emission by the light (i.e., power of the light) is 10 W. What is the total power directly incident on the card due to the light as a function of r? *Hints: this problem is set up so that you do not have to consider the angle of incidence inside the integral. Try solving the 2D version of this problem first if you have trouble, and then generalize to 3D.*

2. a) Ten simulation photons, each representing 100 real photons at 450 nm hit a surface that has a 50% probability of reflecting photons at 450 nm. Under Russian Roulette sampling, how many <u>simulation</u> photons reflect? How many <u>real</u> photons do each of those reflected simulation photons represent?

b) Let the representation of a simulation photon contain a *power* field that has type Color3, with *r, g,* and *b* floating point values that are *proportional* to the number of real photons at 650nm, 550 nm, and 450 nm. Let the representation of a surface BSDF contain the probability *p_diff* of a diffuse bounce and *p_abs* of absorption at each of those three wavelengths, so that *p_diff* and *p_abs* both have type Color3 as well and *p_abs* + *p_diff* = (1, 1, 1). Write pseudo-code for computing whether a photon bounces or is absorbed at a surface, and what the *power* of the bounced photon is, using Russian Roulette sampling.
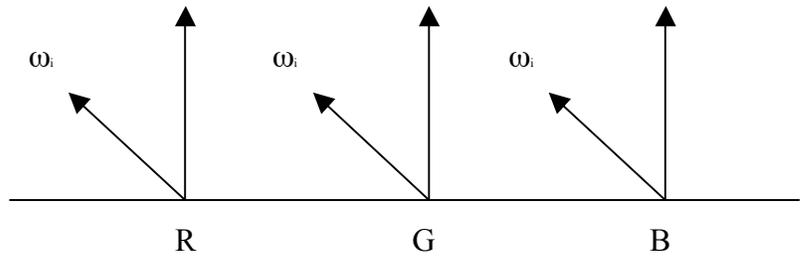
3. Draw a plausible (2D) RGB BSDF for each of the following surfaces. You may want to examine real-world surfaces closely before answering. The first is done for you.
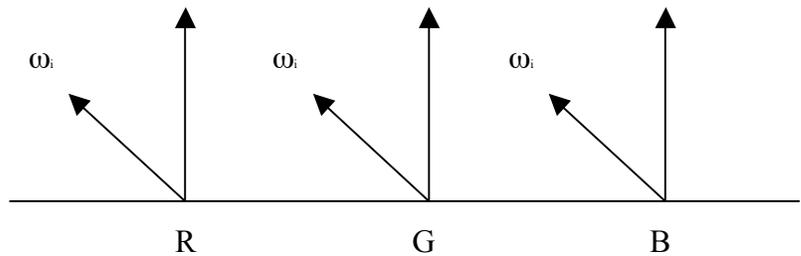

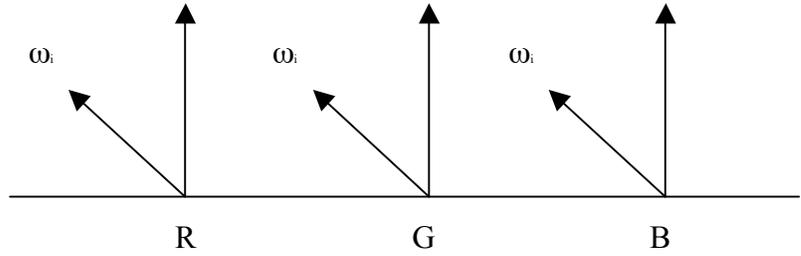"Yellow" Car Finish
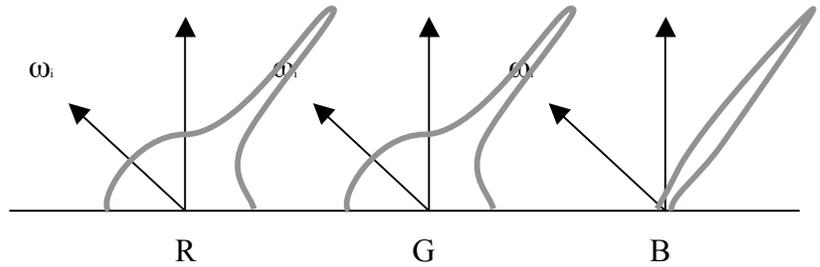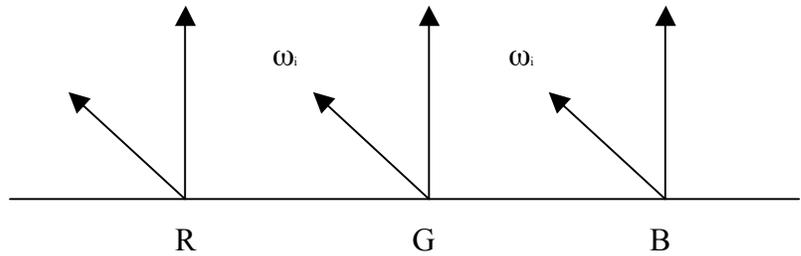

"Red" Sand Dune

"Blue" Glass

Brass

R   G   B

"Blue" Demim

R   G   B
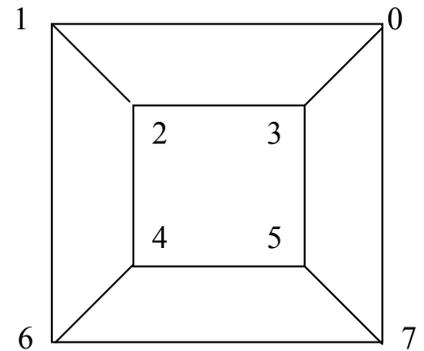
4. a) Write the coordinates for the five faces of a cube with the front removed and edges of length 2. Assume that Y = up, X = right, and Z = out of the page.

Index	X	Y	Z
0			
1			
2			
3			
4			
5			
6			
7			

b) List the coordinates indices for five of the faces in counter-clockwise order for each quadrilateral. Always start with the LOWEST number index.

Top				
Bottom				
Back				
Left				
Right				

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