(6b) (6 points) In path tracing, we discussed two types of importance sampling: sampling over the surface of light sources, or sampling the BRDF in the directions where it is large.

GLaDOS is considering a point on the surface of a material at which there is a very shiny BRDF and light source that subtends a large solid angle. To obtain a more accurate image, would it be better for GLaDOS to importance sample the lights or the BRDF, and why?

Solution: Better to sample the BRDF. In importance sampling we want the pdf to sample proportional to the integrand function. In this case, we have an integral over directions where the integrand is the product of the intensity of the lights and the magnitude of the BRDF. We are told the lights have large support in this domain, and the BRDF being shiny means it has narrow support. The integrand, being the product of these two functions, has a support that is closer in size to the BRDF's smaller support.

(e) (1 point) ___ If we switch the incident and outgoing directions, an anisotropic BRDF will give us different values.

F. Anisotropy means that the BRDF depends on rotating around the normal (absolute azimuth). Since swapping incident and outgoing directions is a different operation, we can't conclude that an anisotropic BRDF will definitively give us different values.

(m) (1 point) ___ Total internal reflection can only happen when light approaches a material with a smaller index of refraction.

T. By Snell's law, total internal reflection occurs only when light goes from a higher-index medium to a lower-index one, in which case a critical angle $\theta_c = \arcsin(n_2/n_1)$ exists such that for $\theta_1 > \theta_c$ no refraction occurs and all light is reflected

(2e) (1 point) ___ With the microfacet BRDF model, the surface will appear more shiny if the microfacet normal distribution function is more concentrated about the surface normal.

T, more concentrated about surface normal, more facets mirror light aligned with normal, which results in a shinier highlight.

(2f) (1 point) ___ An anisotropic BRDF is effectively a three-dimensional function.

F, Isotropic BRDF's are 3D because value depends only on azimuth difference. Anisotropic materials don't have rotational symmetry so they are still 4D like general BRDF's

(4c) (6 points) In path tracing, we discussed two types of importance sampling: sampling over the surface of light sources, or sampling the BRDF in the directions where it is large.

Your friend is considering a point on the surface of a material at which there is a diffuse BRDF and light source that subtends a very small solid angle. To obtain a more accurate image, would it be better for your friend to importance sample the lights or the BRDF, and why?

Solution: Better to importance sample the lights. In importance sampling we want the pdf to sample proportional to the integrand function. In this case, we have an integral over directions where the integrand is the product of the intensity of the lights and the magnitude of the BRDF. We are told the lights have small support in this domain, and the BRDF being diffuse means it has broad support. The integrand, being the product of these two functions, has a support that is closer in size to the light's smaller support.

(1r) T ◯ F ◯ A microfacet BRDF with a concentrated normal distribution function will appear matte.

F, see explanation for 2e)