Question 1 (8 points)

Describe a situation in which a probability distribution function factors into the evaluation of the light transport equation, and explain why this is the case. Also describe how and why the value of the PDF changes depending on the likelihood of the sampled ray. Your answer should be **no more than three sentences**.

The LTE is divided by a PDF when using importance sampling (the PDF used is the PDF of the sampling used, e.g. the PDF of the ray going towards a light source). The PDF is necessary to counteract the fact that we're only sampling within a subset of the hemisphere around the point of interest. The more likely a ray is to be sampled, the higher the denominator of the LTE, since we want to lessen an individual ray's contribution inversely proportionally to how often it will be sampled.

Question 2 (8 points)

Explain why using multiple importance sampling to sample based on both the scene's light sources and its BRDFs is very effective in scenes containing diffuse BRDFs, specular BRDFs, small lights, and large lights. Your answer should be **no more than three sentences**.

Sampling by lights alone produces high variance in samples on large light sources seen by specular surfaces, since very few of the sampled directions (if any) will align with the specular reflection direction and therefore contribute to the color at that point on the object. Likewise, sampling based on a diffuse BRDF that can see a small light source will cause very few of the (entirely random) rays sampled to contribute to the direct lighting since they will be likely to miss the small light source. By using both methods of importance sampling with a balancing heuristic, the scene will converge to the desired image much faster.