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1. From the intensity measured at an image pixel, one can uniquely determine: **1 / 1 point**

- ○ Depth
- ○ Surface normal
- ○ Light source brightness
- ◉ None of the above

Correct
The internsity measured at a pixel depends on several factors - illumination, surface properties, camera parameters, etc. Hence, it does not directly reveal any of the source or scene properties.

2. If the distance between a point light source and a scene point is doubled without changing their orientation, the brightness of the scene point is reduced by a factor of: **1 / 1 point**

- ○ 2
- ◉ 4
- ○ 8
- ○ 16

Correct
The irradiance of the surface point varies as $\frac{1}{r^2}$, where r is the distance between the source and the surface.

3. Which of the following statements is NOT true? **0 / 1 point**

- (●) Image brightness falls off as an object moves away from the optical axis at fixed depth
- ( ) Image brightness falls off as an object scene depth increases
- ( ) Halving the f-number of a camera will quadruple the image brightness
- ( ) If there is no surface radiance, there must be zero image brightness

⊗ **Incorrect**

4. The radiance of a scene point increases when: **2 / 2 points**

- ( ) The aperture of the camera is increased
- ( ) The focal length of the lens is increased
- ( ) The exposure of the image sensor is increased
- (●) None of the above

✓ **Correct**
The radiance of a surface is a measure of the light energy reflected by the surface and is independent of all camera parameters.

5. The Bidirectional Reflectance Distribution Function (BRDF) is the ratio of: **1 / 1 point**

- ( ) Source intensity to surface radiance
- ( ) Image intensity to pixel area
- ( ) Image irradiance to source intensity
- (●) Scene radiance to image irradiance

✓ **Correct**
See definition of BRDF.

6. Which of the following BRDF functions violates the Helmholtz Reciprocity Property? (Assume all extraneous variables are constants). **3 / 3 points**

- $\frac{\delta(\theta_i-\theta_r)\delta(\phi_i-\phi_r+\pi)}{\cos\theta_i \sin\theta_i}$
- $\frac{1}{4\sigma \sin\theta_r \sin\theta_i} e^{2\alpha}$
- $\frac{\delta(\phi_i-\phi_r+\pi)}{\cos\theta_i \sin\theta_i}$
- $\frac{\rho}{4}$

Correct

This violates the Helmholtz Reciprocity Property since $\frac{\delta(\phi_i-\phi_r+\pi)}{\cos\theta_i \sin\theta_i} \neq \frac{\delta(\phi_r-\phi_i+\pi)}{\cos\theta_r \sin\theta_r}$.

Note that the first answer choice does not violate the Helmholtz Reciprocity Property since the BRDF is only non-zero when $\delta(\theta_i - \theta_r) \neq 0$.

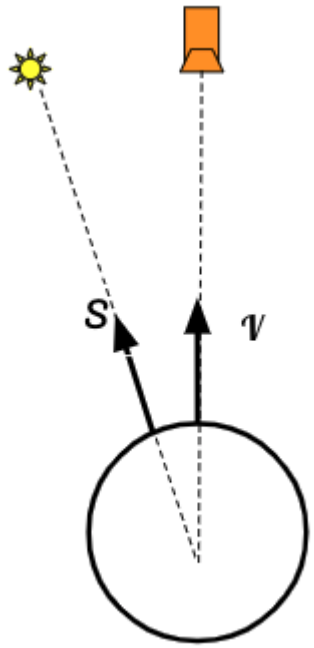
7. A Lambertian surface appears equally bright for all: **1 / 1 point**

- Source directions
- Surface normals
- Camera exposures
- Viewing directions

Correct

The radiance of a Lambertian surface is proportional to $\cos\theta_i$, where θ_i is the angle of incidence.

8. **0 / 2 points**



Consider a specular (mirror) sphere illuminated by a distant point source in the direction s and viewed by a distant camera in the direction v. The surface normal n of the brightest point on the sphere is equal to:

- ○ $n = s$
- ◉ $n = v$
- ○ $n = \frac{s+v}{2}$
- ○ $n = v - s$

⊗ **Incorrect**

9. In the microfacet model for rough surfaces, what causes rough objects to deviate from ideal specular or Lambertian behavior? **1 / 1 point**

- ○ Each point on the surface may have a set of two or more surface normals in any direction
- ◉ The surface normal may deviate from a mean value according to some distribution
- ○ Different facets of the surface may exhibit Lambertian or specular behavior
- ○ Light may be trapped, absorbed, or refracted by the rough surface

Correct

In the micro-facet model, a surface has a mean orientation, however, due to its roughness, each facet's orientation may deviate from this mean.

10. A pink cup is lit under only brown light. In RGB, the body color is (255, 193, 203) and the illumination color is (181, 101, 29). According to the dichromatic model, which of the following colors is most likely to be observed in an image of the scene? **2 / 2 points**

- (181, 101, 203)
- (255, 101, 203)
- (255, 255, 255)
- (218, 147, 116)

Correct

According to the dichromatic model the color of the image is in the plane formed by the body color and the illumination color. This is the only answer that is a linear combination of both.