Advanced Computer Graphics

1. Flux Φ is radiant energy per time, i.e. $\Phi = \frac{\mathrm{d}Q}{\mathrm{d}t}$, which can roughly be interpreted as the number of photons per time.

   ◯ true ◯ false

2. Irradiance E at a position $\boldsymbol{x}$ is $E(\boldsymbol{x}) = \frac{\mathrm{d}\Phi(\boldsymbol{x})}{\mathrm{d}A(\boldsymbol{x})}$.

   ◯ true ◯ false

3. Irradiance is a quantity that can be used to characterize the illumination of a surface.

   ◯ true ◯ false

4. Radiosity quantifies the overall flux that leaves a surface position into arbitrary directions.

   ◯ true ◯ false

5. The incident radiance at a surface position $\boldsymbol{x}$ with surface normal $\boldsymbol{n}$ from a direction $\boldsymbol{\omega}$ is $L(\boldsymbol{x}, \boldsymbol{\omega}) = \frac{\mathrm{d}^2\Phi}{\mathrm{d}A \cdot \cos\theta \cdot \mathrm{d}\omega}$, where $\mathrm{d}A$ is a differential surface area around $\boldsymbol{x}$, θ is the angle between $\boldsymbol{n}$ and $\boldsymbol{\omega}$ and $\mathrm{d}\omega$ is a differential solid angle around direction $\boldsymbol{\omega}$. $\mathrm{d}\Phi$ is flux from direction $\boldsymbol{\omega}$.

   ◯ true ◯ false

6. Radiance is a quantity that can be used to characterize flux that travels along a ray.

   ◯ true ◯ false

7. The irradiance at an illuminated surface decreases quadratically with the distance from a light source.

   ◯ true ◯ false

8. Radiance is preserved along a ray over arbitrary distances in a setting without participating media.

   ◯ true ◯ false

9. A color value at a pixel in a sensor-generated image characterizes photons per time per projected sensor area per small solid angle.

   ◯ true ◯ false

10. A sensor element generally receives flux from directions within a large solid angle.

    ◯ true ◯ false

11. The distribution of wavelengths within the perceived radiance is referred to as spectral power distribution or spectrum. Spectra are weighted with absorption spectra of the eye and perceived as colors.

    ◯ true ◯ false

12. The solid angle of a hemisphere is 2π.

    ◯ true ◯ false

13. Surface reflection models characterize the interaction of light at surfaces. They quantify, how much incoming flux from a particular direction is absorbed or reflected into a particular direction.

    ◯ true ◯ false

14. Specular surfaces reflect most flux into some dominant reflection directions.

    ◯ true ◯ false

15. Diffuse surfaces reflect the same amount of flux into all directions.

    ◯ true ◯ false

16. At diffuse surfaces, reflected flux is proportional to the cosine of the angle between flux direction and surface normal.

    ◯ true ◯ false

17. At diffuse surfaces, incident radiance is independent from the direction.

    ◯ true ◯ false

18. The reflectance equation can be written as $L_o(\boldsymbol{p}, \boldsymbol{\omega}_o) = \int_{2\pi} f_r(\boldsymbol{p}, \boldsymbol{\omega}_i, \boldsymbol{\omega}_o) L_i(\boldsymbol{p}, \boldsymbol{\omega}_i) \mathrm{d}\omega_i$

    ◯ true ◯ false

19. The BRDF of a Lambertian surface is $f_{r,d}(\boldsymbol{\omega}_i, \boldsymbol{\omega}_o) = \frac{\rho}{\pi}$, where ρ is the reflectance of the surface.

    ◯ true ◯ false

20. The integral of a function f over the hemisphere $\int_{2\pi} f(\boldsymbol{\omega})\ \mathrm{d}\omega$ can be written in terms of two angles θ and ϕ as $\int_0^{2\pi} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} f(\theta, \phi) \sin\theta\ \mathrm{d}\theta\ \mathrm{d}\phi$

    ◯ true ◯ false

21. At a Lambertian surface, the exitant radiance $L_o(\boldsymbol{p})$ at a point $\boldsymbol{p}$ is related to the radiosity $B(\boldsymbol{p})$ at $\boldsymbol{p}$ with $L_o(\boldsymbol{p}) = \frac{B(\boldsymbol{p})}{\pi}$.

    ◯ true ◯ false

22. $\int \delta(x) \mathrm{d}x = 1$

    ◯ true ◯ false

23. BRDF values are non-negative and not larger than one.

    ◯ true ◯ false

24. A BRDF is energy conserving, if $\forall \boldsymbol{\omega}_i : \int_{2\pi} f_r(\boldsymbol{\omega}_i, \boldsymbol{\omega}_o) \cos\theta_o \mathrm{d}\boldsymbol{\omega}_o \leq 1$.

    ◯ true ◯ false

25. The bihemispherical reflectance characterizes the ratio of all exitant flux to all incident flux at a surface point.

    ◯ true ◯ false

26. The rendering equation can be written as
$L(\boldsymbol{p} \rightarrow \boldsymbol{\omega}_o) = L_e(\boldsymbol{p} \rightarrow \boldsymbol{\omega}_o) + \int_\Omega f_r(\boldsymbol{p}, \boldsymbol{\omega}_i \leftrightarrow \boldsymbol{\omega}_o)\ L(\boldsymbol{p} \leftarrow \boldsymbol{\omega}_i)\ \cos(\boldsymbol{\omega}_i, \boldsymbol{n}_p)\ \mathrm{d}\omega_i$

○ true ○ false

27. The raycasting operator at point $\boldsymbol{p}$ into direction $\boldsymbol{\omega}$ returns the radiance from that direction onto point $\boldsymbol{p}$.

○ true ○ false

28. In the radiosity rendering concept, the image generation is basically a look-up of a pre-computed solution for the entire light transport in a scene.

○ true ○ false

29. The original radiosity rendering concept is restricted to diffuse and specular surfaces. It does not handle mirror and transparent surfaces.

○ true ○ false

30. In a scenario with n non-emissive faces and m emissive faces, the radiosity rendering approach computes n radiosity values.

○ true ○ false

31. The radiosity rendering concept solves a linear system to compute radiance values.

○ true ○ false

32. The form factor is a double integral over the areas of two faces.

○ true ○ false

33. Form factors are non-negative.

○ true ○ false

34. For two faces i and j with areas A_i and A_j, the reciprocity property for form factors states that $A_i F_{ij} = A_j F_{ji}$.

○ true ○ false

35. If the linear system in a radiosity approach is stated as $(\boldsymbol{I} - \boldsymbol{F})\boldsymbol{B} = \boldsymbol{B_e}$, then the solution can be expressed as $\boldsymbol{B} = \boldsymbol{B_e} + \boldsymbol{F}\boldsymbol{B_e} + \boldsymbol{F}\boldsymbol{F}\boldsymbol{B_e} + \boldsymbol{F}\boldsymbol{F}\boldsymbol{F}\boldsymbol{B_e} + \ldots$, if the solution exists and if the series converges.

○ true ○ false

36. The inverse of the matrix $\boldsymbol{I} - \boldsymbol{F}$ can be written as $(\boldsymbol{I} - \boldsymbol{F})^{-1} = \sum_{k=0}^{\infty} \boldsymbol{F}^k \boldsymbol{B_e}$, if the inverse exists and if the series converges.

○ true ○ false

37. If the solution of a radiosity problem is computed as $\boldsymbol{B} = \boldsymbol{B_e} + \boldsymbol{F}\boldsymbol{B_e} + \boldsymbol{F}\boldsymbol{F}\boldsymbol{B_e} + \boldsymbol{F}\boldsymbol{F}\boldsymbol{F}\boldsymbol{B_e} + \ldots$, then $\boldsymbol{B_e}$ represents emitted radiosity, $\boldsymbol{F}\boldsymbol{B_e}$ represents emitted radiosity after one surface bounce and so on.

○ true ○ false

38. In raytracing, our goal is to compute radiances by approximately solving the rendering equation, e.g.
$L(\boldsymbol{p} \to \boldsymbol{\omega}_o) = L_e(\boldsymbol{p} \to \boldsymbol{\omega}_o) + \int_\Omega f_r(\boldsymbol{p}, \boldsymbol{\omega}_i \leftrightarrow \boldsymbol{\omega}_o) L(\boldsymbol{p} \leftarrow \boldsymbol{\omega}_i) \cos(\boldsymbol{\omega}_i, \boldsymbol{n}_p) \mathrm{d}\omega_i$.

○ true ○ false

39. Monte Carlo is a popular scheme to approximate the reflectance integral in the rendering equation as it naturally handles adaptive, non-uniform sample sets for multi-dimensional integrals.

○ true ○ false

40. Monte Carlo is a popular scheme to approximate the reflectance integral in the rendering equation due to its exceptional high accuracy.

○ true ○ false

41. Monte Carlo integration typically introduces noise to the solution.

○ true ○ false

42. A 1D probability density function $p(x)$ that is defined for an interval from a to b is non-negative and the integral $\int_a^b p(x)\mathrm{d}x$ is one.

○ true ○ false

43. A uniform PDF $p(x)$ that is defined for an interval from a to b is one for all x with $a \leq x \leq b$.

○ true ○ false

44. Using the Monte Carlo estimator, a 1D integral can be approximated with
$\int_a^b f(x)\mathrm{d}x \approx \sum_{i=1}^{N} \frac{f(X_i)}{p(X_i)}$

○ true ○ false

45. In raytracing, importance sampling describes the concept of designing a PDF as close as possible to the integrand in the reflectance integral.

○ true ○ false

46. In raytracing, stratified sampling describes the concept to subdivide the integration domain of the reflectance integral into strata.

○ true ○ false

47. The inversion method starts with canonical random samples and transforms the samples with the inverse of the cumulative distribution function of the desired probability density function.

○ true ○ false

48. The rejection method does not require a CDF or the inverse of a CDF.

○ true ○ false

49. The inverse and the rejection method discard some samples.

○ true ○ false

50. The inverse function of $y = f(x) = \sin(x)$ is $x = g(y) = -\cos(y)$.

○ true ○ false

51. The inverse function of $y = f(x) = 2x - x^2$ with $0 \leq x \leq 1$ is $x = g(y) = 1 - \sqrt{1-y}$.

○ true ○ false