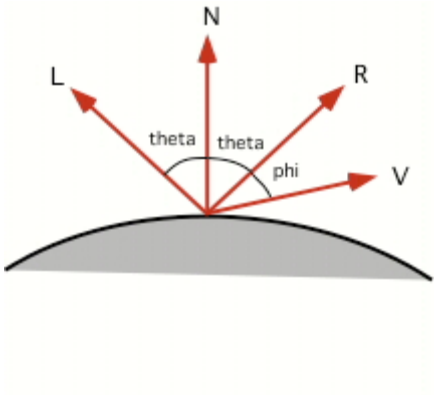
5. The equation below represents a variety of contributions to the illumination for a point on a surface. The equation takes into account the surface properties, the light sources and their direction, as well as the direction of viewing. Explain the nature and significance of the various terms, and draw vector diagrams as needed to help clarify your explanation.

$$I = k_d I_a + k_d I_l (\mathbf{N} \cdot \mathbf{L}) + k_s W(\text{theta}) I_l \cos^n(\text{phi})$$

Answer: The first term appears in eq. 14-1 of the text, accounting for diffuse reflection with reflectivity k_d of ambient light of intensity I_a. (In eq. 14-4 in the book an additional distinction is made, using k_a, an ambient light reflectivity, distinct from k_d. This is for modeling convenience, not a consequence of a different physics for the two types of illumination.) The second term appears in eq. 14-3, and accounts for a point light source of intensity I_l and reflectivity k_d. The term $(\mathbf{N} \cdot \mathbf{L})$ accounts for the geometric factor related to the angle of incidence; the dot product introduces a cosine factor. $\mathbf{N}$ is the normal to the surface and $\mathbf{L}$ is the direction from the surface element to the point source. Both are normalized (unit) vectors. The last term deals with specular reflection. k_s is the specular reflection coefficient, I_l is as before, $W(\text{theta})$ accounts for the reflectivity as a function of the angle of incidence, and $\cos^n(\text{phi})$ is a function of the angle phi between the reflected light and the viewing direction. n is a large number, e.g., 100, accounting for the small cone of angles over which a typical highly specular surface is reflective.

The vector diagram requested that binds all this together is Fig. 14-12 of the text, shown below:



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