1.4.6 Scotopic/photopic ratio

One other measure of light source colour characteristics that has been gaining interest in recent years is the scotopic/photopic ratio (Berman, 1992). This is calculated by taking the relative spectral power distribution, in radiometric units, of the light source and weighting it by the CIE Standard Scotopic and Photopic Observers and expressing the resulting scotopic lumens and photopic lumens as a ratio. The value of scotopic/photopic ratios is that they express the relative effectiveness of different light sources in stimulating the rod and cone photoreceptors in the human visual system. A light source with a higher scotopic/photopic ratio will stimulate the rods more than a light source with a lower scotopic/photopic ratio when both produce the same photopic luminous flux. This information is useful when considering light sources for applications where the operation of both rod and cone photoreceptors is likely. Table 1.4 gives scotopic/photopic ratios for a number of commonly used light sources.

Table 1.4 Scotopic/photopic ratios for a number of widely used electric light sources (from He et al., 1997)

Light source	Photopic efficacy (lm/W)	Scotopic efficacy (lm/W)	Scotopic/photopic ratio
Incandescent	14.7	20.3	1.38
Fluorescent	84.9	115.9	1.36
Mercury vapour	52.3	66.8	1.28
Metal halide	107.4	181.7	1.69
High pressure sodium	126.9	80.5	0.63
Low pressure sodium	180.0	40.8	0.23

1.4.7 Colour order systems

A colour ordering system is a physical, three-dimensional representation of colour space. There are several different colour ordering systems but one of the most widely used is the Munsell system. Figure 1.10 shows the organisation of the Munsell system. The azimuthal hue dimension consists of 100 steps arranged around a circle, with five principal hues (red, yellow, green, blue and purple) and five intermediate hues (yellow-red, green-yellow, blue-green, purple-blue and red-purple). The vertical value scale contains ten steps from black to white. The horizontal chroma scale contains up to 20 steps from gray to highly saturated. The position of any colour in the Munsell system is identified by an alphanumeric reference made up of three terms, hue, value and chroma, e.g. a strong red is given the alphanumeric 7.5R/4/12. Achromatic surfaces, i.e. colours that lie along the vertical value axis and hence have no hue or chroma, are coded as Neutral 1, Neutral 2 etc. depending on their reflectance. To a first approximation, the percentage reflectance of a surface is given by the product of V and (V–1) of the surface, where V is the Munsell value of the surface.