$$X = h\,\Sigma\, S(\lambda)\, x(\lambda)\, \lambda$$
$$Y = h\,\Sigma\, S(\lambda)\, y(\lambda)\, \lambda$$
$$Z = h\,\Sigma\, S(\lambda)\, z(\lambda)\, \lambda$$

where: $S(\lambda)$ = spectral radiant flux of the light source (W/nm)
$x(\lambda)$, $y(\lambda)$, $z(\lambda)$ = spectral tristimulus values from the appropriate colour matching function
λ = wavelength interval (nm)
h = arbitrary constant

If only relative values of the X, Y and Z are required, an appropriate value of h is one that makes $Y = 100$. If absolute values of the X, Y, and Z are required it is convenient to take $h = 683$ since then the value of Y is the luminous flux in lumens.

If the colour being calculated is for light reflected from a surface or transmitted through a material, the spectral reflectance or spectral transmittance is included as a multiplier in the above equations. For a reflecting surface, an appropriate value of h is one that makes $Y = 100$ for a perfect white reflecting surface because then the actual value of Y is the percentage reflectance of the surface.

Having obtained the X, Y, and Z values, the next step is to express their individual values as proportions of their sum, i.e.

$$x = X\,/\,(X+Y+Z) \quad y = Y\,/\,(X+Y+Z) \quad z = Z\,/\,(X+Y+Z)$$

The values x, y and z are known as the CIE chromaticity coordinates. As $x + y + z = 1$, only two of the coordinates are required to define the chromaticity of a colour. By convention, the x and y coordinates are used. Given that a colour can be represented by two coordinates, then all colours can be represented on a two dimensional surface. Figure 1.6 shows the CIE 1931 chromaticity diagram. The outer curved boundary of the CIE 1931 chromaticity diagram is called the spectrum locus. All pure colours, i.e. those that consist of a single wavelength, lie on this curve. The straight line joining the ends of the spectrum locus is the purple boundary and is the locus of the most saturated purples obtainable. At the centre of the diagram is a point called the equal energy point, where a colourless surface will be located. Close to the equal energy point is a curve called the Planckian locus. This curve passes through the chromaticity coordinates of objects that operate as a black body, i.e. the spectral power distribution of the light source is determined solely by its temperature.

The CIE 1931 chromaticity diagram can be considered as a map of the relative location of colours. The saturation of a colour increases as the chromaticity coordinates get closer to the spectrum locus and further from the equal energy point. The hue of the colour is determined by the direction in which the chromaticity coordinates move. The CIE 1931 chromaticity diagram is useful for indicating approximately how a colour will appear, a value recognised by the CIE in that it specifies chromaticity coordinate limits for signal lights and surfaces so that they will be recognised as red, green, yellow, and blue (CIE Publication 107:1994).