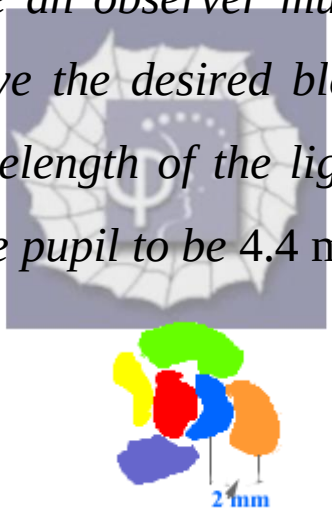
661.

Problem 46.23 (RHK)

The paintings of Georges Seurat consist of closely spaced small dots $(\approx 2$ mm *in diameter*$)$ *of pure pigment, as indicated in the figure. The illusion of colour mixing occurs because the pupils of the observer's eyes diffract light entering them. We have to calculate the minimum distance an observer must stand from such a painting to achieve the desired blending of colour. We may take the wavelength of the light to be* 475 nm *and the diameter of the pupil to be* 4.4 mm.



Solution:

Because of diffraction effects, dots of 2 mm diameter will cease to be resolved by eyes, if viewed from a distance beyond the Rayleigh's criterion limit.

The Rayleigh's criterion is that two objects when viewed by a lens of aperture d using light of wavelength λ will

cease to be resolvable if their angular separation is less than θ_R :

$$\theta_R = \sin^{-1}\left(\frac{1.22\lambda}{d}\right).$$

For the problem the data are

$d = 4.4 \text{ mm},$

and

$\lambda = 475 \text{ nm}.$

Therefore, dots separated by 2 mm will cease to remain resolved when viewed from a distance l given by the following relation:

$l \times \theta_R = 2 \times 10^{-3} \text{ m},$

or

$$l = \frac{2 \times 10^{-3} \text{ m}}{\left(1.22 \times 475 \times 10^{-9} / 4.4 \times 10^{-3}\right)} = 15.18 \text{ m}.$$