

Question 2:

a)

(i) Fraunhofer diffraction: (Far field)

Diffraction at a long distance, i.e. the diffraction pattern is viewed at a long distance from the diffracting object. The wavefront at the aperture will ~~approx~~ approximate a plane wavefront, thus there is no relative phase difference between the individual wavelets acting as the secondary sources. Furthermore the screen is far enough from the aperture, so that rays arriving at point p from the aperture ~~may~~ may be considered to travel parallel to one another. The first condition can be achieved by placing a lens between the source and the aperture, and the second can be achieved by placing a lens between the aperture and the screen so the light is focused.

(ii) Fresnel diffraction: (Near field)

Diffraction where the screen and aperture are close together. The source is close to the aperture, compared to its size. Secondary wavelets arriving consequently at point p will have a complex dependence on the position across the aperture. Furthermore the phase difference on ~~arr~~ arrival at p depends in a non-linear way on the position from where the secondary wave emanated across the aperture.

b) graph

c) ~~$I(\theta) = I(0) \sin^2 \theta$~~
$$2.5 \times 10^{-4} = \frac{2 \times 3 \times 514 \times 10^{-7}}{0.01} = 3.087 \times 10^{-4}$$

d) graph

$$I(\theta) = I(0) \left(\frac{\sin^2 \beta^2}{\beta^2} \right)$$