Q1- Light of wavelength 589 nm from a sodium lamp illuminates two narrow slits. The fringe spacing on a screen 150 cm behind the slits is 4.0 mm. What is the spacing between the two slits?

The fringe width β for young's double slit experiment is given by

$$\beta = D^* \lambda/d$$

Where D is the distance between the slits and the screen, d is the slit spacing and λ is the wavelength of the light used.

gives $d = D^* \lambda /\beta$

Substituting the values we have

$$d = (1.50)^*(589^*10^{-9})/(4.0^*10^{-3}) = 2.209^*10^{-4} \text{ m} = 0.221 \text{ mm.}$$

Q2- A double-slit experiment is performed with light of wavelength 600 nm. The bright interference fringes are spaced 1.8 mm apart on the viewing screen. What will the fringe spacing be if the light is changed to a wavelength of 800 nm?

Using the same equation as in previous question as the spacing d and the distance D is not changed we have

$$\frac{\lambda_1}{\beta_1} = \frac{\lambda_2}{\beta_2}$$

or $$\beta_2 = \frac{\lambda_2 \beta_1}{\lambda_1} = \frac{800 * 1.8}{600} = 2.4 \text{ mm.}$$

(As the ratio of wavelengths was there, no need of conversion to units of wavelengths)

Q3- In a single-slit experiment the slit width is 200 times the wavelength of the light used. What is the width of the central maximum on a screen 2.0 m behind the slit?

The angle between the two first order minima on either side of the central maximum is called the angular width of the central maximum. This is given by

$\theta = 2\lambda/d$ where d is the width of the slit.

According to the question the $d = 200 \lambda$ hence

$$\theta = (2\lambda)/(200\lambda) = 0.01 \text{ radians.}$$

As the angle is small we can get the width x of the maximum on the screen equal to the length of the arc and hence

Angle = arc length /radius

Gives x = angle* radius = 0.01*2 = 0.02 m = 2 cm.