Young's Double-slit ***SOLUTIONS***

1. a) They are producing the same part (e.g. crest or trough) of the waves at the same time if in phase, and producing opposite parts if out of phase.

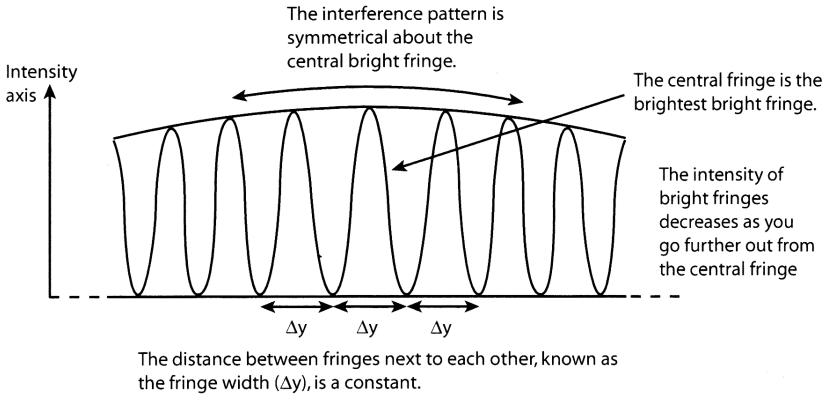
   b) The charges in the filament of an incandescent light vibrate randomly, meaning the waves given off do not have a constant phase relationship (not coherent) and have random frequencies (not monochromatic).

   c) Constructive: two vectors in same direction combine – vector sum is larger
   Destructive: two vectors in opposite directions combine – vector sum is smaller

   d) After passing through the slit, the light spreads out on either side of the slit, forming an approximately semicircular wavefront. The light is faintest furthest to each side of the slit.

2. The light passing through the single slit diffracts, causing it to act like a coherent source. If the double slits are equidistant from the single slit, they will act like coherent, in phase sources (necessary for the interference pattern).

3.



The brighest spots occur when the light has a path difference of mλ therefore constructive. The darkest spots are from a path difference of (m+0.5)λ therefore destructive, and in between are the intermediate path differences.

4. a) $m = 1 \qquad \theta = 5.0° \qquad d = 1.1\times10^{-6}\text{ m}$

$$d\sin\theta = m\lambda$$

$$\therefore \lambda = \frac{d\sin\theta}{m} = 1.1\times10^{-6}\sin 5.0° = 9.6\times10^{-8}\text{ m}$$

   b) $\Delta y = L\tan\theta = 5\tan 5.0° = 0.4\text{ m}$

INCORRECT METHOD (angle too large):

$$\Delta y = \frac{\lambda L}{d} = \frac{9.6\times10^{-8}\times5}{1.1\times10^{-6}} = 0.4\text{ m}$$