4 (a) A Keck telescope at Mauna Kea, Hawaii, is the world's largest optical telescope and has a diameter of 10 m and is set to detect waves of wavelength 600 nm. The distance, in metres, from the aperture to the viewing screen is L.

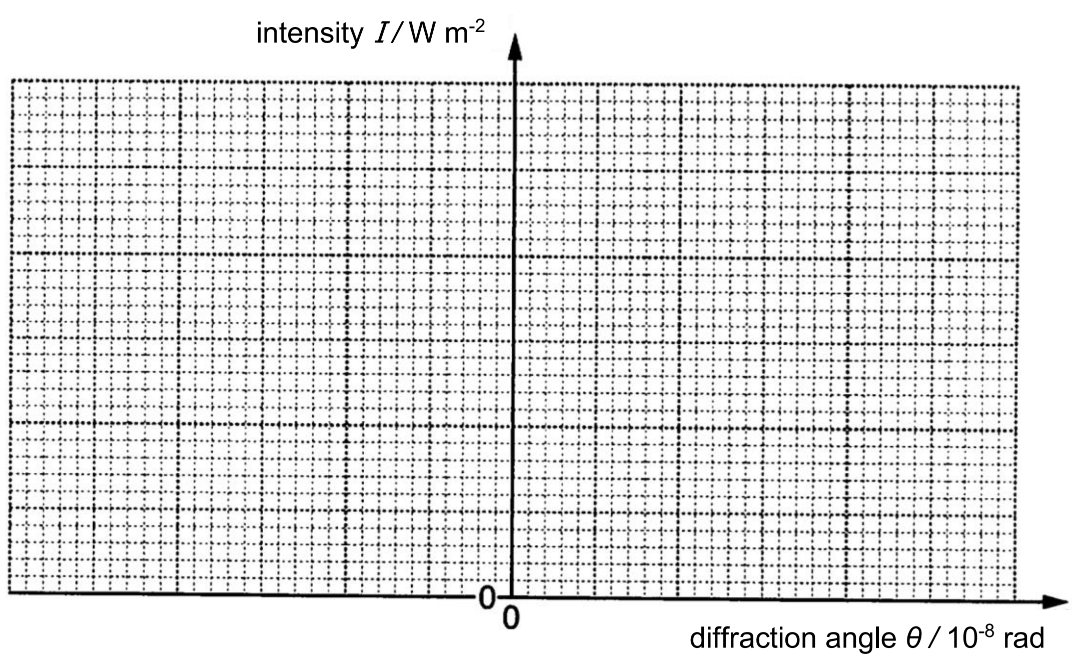
(i) Calculate the diffraction angle θ_{min} at which the first minimum of the diffraction pattern is observed on the viewing screen.

θ_{min} = ... rad [2]

(ii) Determine, in terms of L, the width of the central bright fringe of the diffraction pattern observed on the viewing screen.

width = ... m [2]

(iii) On Fig. 4.1, sketch a graph to show the variation with diffraction angle θ from the central maximum of the intensity I of the light on the viewing screen. Include the angles for the first minima.



[3]

Fig. 4.1

(b) A radio telescope at Arecibo, Puerto Rico, has a diameter of 305 m and is designed to detect radio waves of wavelength 0.75 m.

(i) State two physical quantities that determine the resolving power of the telescope.

quantity 1 : ……………………………………

quantity 2 : …………………………………… [2]

(ii) Explain quantitatively whether the Keck telescope used in the detection of light waves has a higher or lower resolving power compared to the radio telescope used in the detection of radio waves at Arecibo.

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……… [2]