4 An optical telescope detects light in the visible spectrum. It has an aperture of width 20.0 cm which is 1.50 m from the eyepiece. It is pointed at a binary star system 8.14 x 10^{16} m away, as shown in Fig. 4.1.

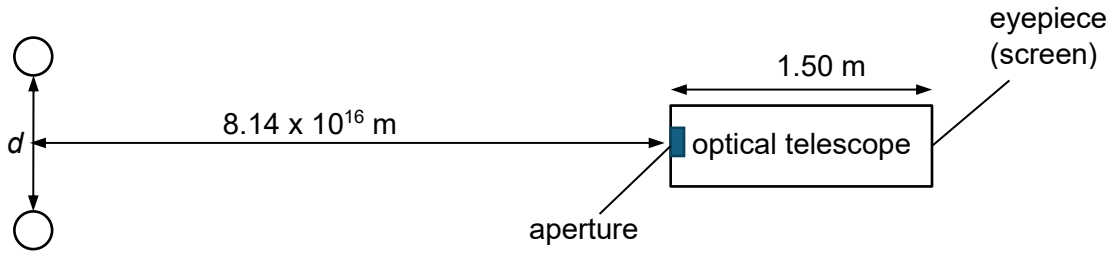

Fig. 4.1 (not drawn to scale)

(a) State Rayleigh's Criterion.

……

……

……

…..... [2]

(b) The two stars are **just** resolvable on this telescope for wavelength of 600 nm.

Calculate the separation *d* of the stars if the plane of the stars' orbits is perpendicular to the earth (i.e. "face-on") as shown in Fig. 4.1.
Show your working clearly.

d = …… m [2]

(c) The light of the entire visible spectrum (400 nm to 700 nm) collected by the telescope is passed through a diffraction grating with 500 lines per mm.

(i) Find the angular width of the second order spectrum.

angular width = …… ° [3]

(ii) State an advantage of using the second order spectrum instead of the first order spectrum to determine the wavelength of a radiation.

……
…….

……
…….. [1]

[Total: 8]