State Examination Commission – Physics Higher Level, 2008

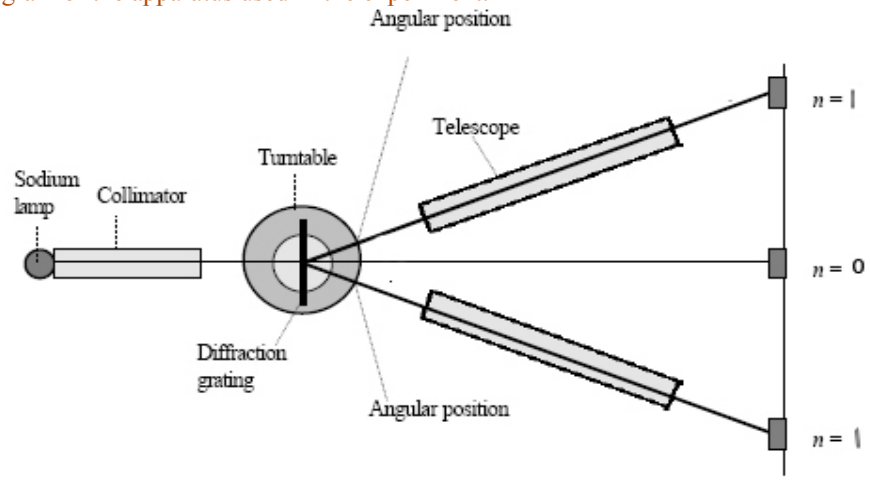
Question 3

In an experiment to measure the wavelength of monochromatic light, a diffraction pattern was produced using a diffraction grating with 500 lines per mm.
The angle between the first order images was measured. This was repeated for the second and the third order images.

Angle between first order images	Angle between second order images	Angle between third order images
34.2°	71.6°	121.6°

The table shows the recorded data.
Draw a labelled diagram of the apparatus used in the experiment. (12)
Explain how the first order images were identified.
Describe how the angle between the first order images was measured. (12)
Use the data to calculate the wavelength of the monochromatic light. (16)

Draw a labelled diagram of the apparatus used in the experiment. (12)



Explain how the first order images were identified.

The first line on either side of the straight -through (n = 0) position is the first order. The telescope was rotated to these positions, and when the vertical cross-hair was in a position of no-parallax with the image of the illuminated slit, the angles were read from the vernier scales.

Describe how the angle between the first order images was measured. (12)

The values for the first order positions, read from the vernier scales, were subtracted from each other to give 34.2^0

Use the data to calculate the wavelength of the monochromatic light. (16)

$d = 1/(5 \times 10^5) = 2 \times 10^{-6}$ m

	Angle between first order images n = 1	Angle between second order images n = 2	Angle between third order images n = 3
	34.2°	71.6°	121.6°
θ_n	17.1^0	35.8^0	60.8^0
$\lambda = (d \sin \theta_n)/n =$	5.88×10^{-7}	5.85×10^{-7}	5.82×10^{-7}
Average $\lambda = 5.85 \times 10^{-7}$ m			