Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• set up diffraction grating at right angles to light from laser (1) **Or** set up grating parallel to screen • measure the distance between the diffraction grating and the screen (1) • measure the distance between 1st order images on the screen (1)	An annotated diagram could score these marks MP3 accept between other correct specified orders.	3

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• use of $d\sin\theta = n\lambda$ (1) • Calculation of one of the diffraction angles (for any n) (1) • Attempt to calculate a difference in the angles (1) **Or** statement that the two angles are very similar • So (accurate) measurement would be very difficult (1) **Or** the difference in wavelength could not be determined with this grating	MP4 dependent on MP3 Example of calculation: $\sin\theta_1 = \frac{656.2\times10^{-9}\,\text{m}}{2.2\times10^{-6}\,\text{m}}$ $\therefore \theta_1 = 17.354°$ $\sin\theta_2 = \frac{656.0\times10^{-9}\,\text{m}}{2.2\times10^{-6}\,\text{m}}$ $\therefore \theta_1 = 17.348°$ $\therefore \Delta\theta = 17.354° - 17.348° = 0.006°$	4

Q2

Question Number	Acceptable Answers	Additional Guidance	Mark
(a)	An explanation that makes reference to: • waves/light passing through a narrow gap spread/s out **(1)** • light reaches the wall from each part of the slit with differing phase relationships **(1) OR** light reaches the wall from each part of the slit with differing path lengths **(1)** • when the waves meet superposition takes place and if the waves are in antiphase it results in destructive interference so a dark spot is seen **(1) OR** when the waves meet superposition takes place and if the waves are in phase it results in constructive interference so a bright(er) region is seen **(1)**	Accept relevant reference to Huygen's construction for first mark.	**3**
(b)	An explanation that makes reference to: • green light has a shorter wavelength than red light **(1)** **OR** red light has a longer wavelength that green light **(1)** • so green light diffracts less than red light **or** red light diffracts more than green light **(1)** • so the dark points would be closer to the centre or more dark points would be seen in the same space on the wall or central fringe narrower **(1)**	Accept a diagram clearly to the same scale and showing a narrowed pattern. MP2 and MP3 may be awarded if reference is made to frequency difference rather than wavelength.	**3**
(c)	• use of trigonometrical functions to calculate θ **(1)** • calculate diffraction grating spacing **(1)** • wavelength = 5.1×10^{-7} m **(1)**	Example of calculation: $\theta = \tan^{-1}(0.23\text{ m}/1.5\text{ m}) = 8.7°$ $d = 10^{-3}/300 = 3.3 \times 10^{-6}$ m $\lambda = 3.3 \times 10^{-6}$ m $\times \sin 8.7°$ $= 5.1 \times 10^{-7}$ m	**3**

Q3

Question Number	Acceptable Answers		Additional guidance	Mark
(i)	Any one • Monochromatic **or** small range of wavelength / frequencies • Coherent • Little divergence of wave over a distance • Produces plane wavefronts			1
(ii)	• d = 0.005 mm **or** use of $d = \frac{1}{200\ \text{mm}^{-1}}$ • Use of tan to find θ • Use of $n\lambda = d\sin\theta$ with $n = 3$ • $\lambda = 5.4 \times 10^{-7}$ (m) • Concludes that the laser light is green **Or** conclusion consistent with their value of λ	(1) (1) (1) (1) (1)	Example of Calculation $d = \frac{1}{200\ \text{mm}^{-1}} = 0.005$ mm $\theta = \tan^{-1}\left(\frac{1.02\ \text{m}}{3.0\ \text{m}}\right) = 18.8°$ $\lambda = \frac{(5\times10^{-6}\text{m})\times\sin 18.8°}{3} = 5.37 \times 10^{-7}$m so light is green	5