Question Number	Answer	Mark
16(a)	<table><tr><th>H_α / nm</th><th>Point</th></tr><tr><td>656.2837</td><td>B</td></tr><tr><td>656.2797</td><td>C</td></tr><tr><td>656.2757</td><td>A</td></tr></table> **(1)**	**1**
16(b)	**MAX 2 from:** Light from the edge of the Sun moving toward the Earth is received with a shorter wavelength [Accept "point A" for "edge moving toward the Earth" and "blue shift" for "shorter wavelength"] **(1)** Light from the edge of the Sun moving away from the Earth is received with a longer wavelength [Accept "point B" for "edge moving away from the Earth" and "red shift" for "longer wavelength"] **(1)** There is a variation in the relative velocity between the Earth and different points on the Sun's surface [Can be awarded if A and B incorrectly linked to change in wavelength] **(1)** [Reference to Doppler effect can score max 1]	**2**
16(c)	Use of $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$ with λ = 656.2797 nm **(1)** Use of $v = \frac{2\pi r}{T}$ to calculate T **(1)** Conversion of T into days. **(1)** T = 27.8 days which is approximately 28 days **(1)** **OR** Conversion of T = 28 days into seconds Use of $v = \frac{2\pi r}{T}$ to calculate v [1820 m s^{-1}] **(1)** Use of $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$ with λ = 656.2797 nm **(1)** v = 1830 m s^{-1} which is approximately 1820 m s^{-1} **(1)** **OR** Conversion of T = 28 days into seconds Use of $v = \frac{2\pi r}{T}$ to calculate v [1820 m s^{-1}] **(1)** Use of $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$ with λ = 656.2797 nm to calculate $\Delta\lambda$ **(1)** $\Delta\lambda = 3.98 \times 10^{-3}$ m which is approximately 4.0×10^{-3} m **(1)** Full credit for other approaches e.g. comparison of calculated value of v/c from T = 28 days and calculated value of v/c from $\frac{\Delta\lambda}{\lambda}$ **(1)** <u>Example of calculation</u> $v = c \times \frac{\Delta\lambda}{\lambda} = 3.00 \times 10^8 \text{ m s}^{-1} \times \frac{(656.2837 - 656.2797) \text{ nm}}{656.2797 \text{ nm}} = 1828 \text{ m s}^{-1}$ $T = \frac{2\pi r}{v} = \frac{2\pi \times 7.0 \times 10^8 \text{ m}}{1828 \text{ m s}^{-1}} = 2.41 \times 10^6 \text{ s}$ $T = \frac{2.41 \times 10^6 \text{ s}}{86400 \text{ s day}^{-1}} = 27.8 \text{ days}$	**4**
	Total for question 16	**7**