Number			
19(a)	Use of $pV = NkT$ Use of $\frac{1}{2}m\langle c^2\rangle = \frac{3}{2}kT$ $\frac{1}{2}m\langle c^2\rangle = 5.8 \times 10^{-20}$ J <u>Example of calculation</u> $T = \frac{pV}{Nk} = \frac{4.25\times10^{4}\ \text{Pa} \times1.50\times10^{-5}\ \text{m}^3}{1.65\times10^{19} \times1.38\times10^{-23}\ \text{J K}^{-1}} = 2800\ \text{K}$ $\frac{1}{2}m\langle c^2\rangle = \frac{3}{2}\times 1.38 \times 10^{-23}\ \text{J K}^{-1} \times 2800\ \text{K} = 5.80 \times 10^{-20}\ \text{J}$	(1) (1) (1)	**3**
19(b)	Use of $\frac{v}{c} = \frac{\Delta\lambda}{\lambda}$ with wavelength measured on Earth in denominator $v = 13500\ \text{m s}^{-1}$ The student is correct to say that the star is moving towards the Earth, as the measured wavelength is less than that from the lamp spectrum. Comparison of calculated velocity with 1400 m s^{-1} and appropriate conclusion. <u>Example of calculation</u> $v = \frac{\Delta\lambda}{\lambda}c = \frac{(576.933\text{-}576.959)\times10^{-9}\text{m}}{576.959 \times10^{-9}\ \text{m}}\times3.00\times10^{8}\ \text{m s}^{-1} = (\text{-})1.35\times10^{4}\ \text{m s}^{-1}$ So the star's velocity is much larger than 1400 m s^{-1}	(1) (1) (1) (1)	**4**
19(c)	On the main sequence, above the position of the Sun **Or** above and to the left of the position of the Sun	(1)	**1**
	Total for question 18		**8**